Report of Geotechnical Exploration and Evaluation of Slope Stability

Eastern Perimeter Dike
East Stilling Pond
Allen Fossil Plant
Shelby County, Tennessee

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Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

February 4, 2010

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Mr. Barry Snider
Tennessee Valley Authority
1101 Market Street
LP 5E-C
Chattanooga, Tennessee 37402

Re: Report of Geotechnical Exploration and Evaluation of Slope Stability
Eastern Perimeter Dike
East Stilling Pond
Allen Fossil Plant
Shelby County, Tennessee

Dear Mr. Snider:

As requested, Stantec Consulting Services Inc. (Stantec) has completed the geotechnical exploration and evaluation of the stability of the eastern perimeter dike at the Allen Fossil Plant located in Memphis, Shelby County, Tennessee. This report documents the subsurface conditions, results of laboratory testing, findings from historical document reviews, results of our seepage and slope stability analyses, and our conclusions and recommendations. These services were performed under Engineering Service Request ESR 909 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.

Shaikh Z. Rahman, PE
Project Engineer

Patrick V. Kiser, PE
Project Manager/Senior Associate

/lp

Enclosures: 1

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Executive Summary

Stantec Consulting Services Inc. (Stantec) has completed the geotechnical exploration and stability evaluation for the eastern perimeter dike of the East Stilling Pond at the Tennessee Valley Authority's Allen Fossil Plant. The purpose of this study was to evaluate the stability of the dike against current dam safety criteria. To this end, Stantec conducted reviews of historic documentation to gain an understanding of the development of the ash storage facility and construction of the dike; developed and executed a geotechnical exploration to provide information as to the type, strength, and permeability of the dike materials and foundation soils; installed and monitored piezometers to develop an understanding of steady-state state seepage piezometric surface; performed seepage and slope stability analyses for steady-state seepage conditions at both the normal and maximum storage pools to evaluate the long-term stability of the subject stilling pond perimeter dike.

The engineering analyses focused on three cross-sections through the eastern perimeter dike. The cross-sectional geometry and subsurface profiles were established using data from the drilling and lab testing programs and historical documents such as design drawings and memoranda provided by TVA. Stantec estimated material properties such as unit weight, saturated hydraulic conductivity, horizontal to vertical permeability ratio, and drained shear strength parameters for the dike and foundation soils based on the results of field and laboratory testing, published data, and Stantec's experience with like materials in similar settings and applications. The soil parameters selected for use in the seepage and stability analyses are tabulated in the report.

Seepage analyses were performed at the three referenced dike cross-sections in order to estimate the magnitude of seepage gradients for the evaluation of piping potential, and pore water pressures within the embankment and foundation soils used in slope stability analyses. Stantec developed the seepage model based on the previously defined cross-sectional geometry and the estimated hydraulic properties of the principal soil horizons. The analyses were performed using SEEP/W, a finite element program tailored for modeling water seepage conditions in soil and rock. SEEP/W uses cross-section geometry, boundary conditions and soil properties provided by the user to compute the total hydraulic head at nodal points within the modeled cross-section.

The analyses were performed for steady-state seepage through saturated and unsaturated soils. The applied boundary conditions represented the normal and maximum storage pool elevations in the stilling pond – elevations 230 feet and 233 feet, respectively; an estimated normal water elevation of 215 feet in the drainage channel to the Horn Lake Cutoff based on Shelby County GIS data and visual observations; and median pool elevation of 185 feet for McKellar Lake based on river gauge data provided by the US Army Corps of Engineers, Memphis District. The seepage model was iteratively "calibrated" to match the existing field conditions by varying the estimated hydraulic soil properties until the total head at corresponding locations were in reasonable agreement with water levels measured in piezometers installed in the dike. Graphical results from the seepage analyses are provided in Appendix F of the report. The seepage pressures predicted by the model were mapped to provide the pore water pressures needed for the subsequent slope stability analyses.

The results from the seepage analyses were also examined to identify conditions where piping and erosion of soil might develop due to seepage forces. To quantify the potential for piping, Stantec evaluated upward, vertical exit gradients in the area of the dike toe. Factors of safety against piping, computed for the surficial 3 to 5 feet of soil in these areas, ranged from 1.6 to 9.9 for the normal stilling pond pool elevation of 230 feet and from 1.3 to 6.4 for the maximum storage pool elevation of 233 feet. Based on USACE design criteria for dams (EM 110-2-1901), target minimum factor of safety against piping is 3.0. The results from the seepage model indicate that portions of the eastern perimeter dike do not meet current criteria for soil piping due to seepage.

Stantec evaluated the stability of the three referenced cross-sections using conventional, two-dimensional, limit equilibrium methods. The analyses were performed using the SLOPE/W program to enable direct mapping of the pore water pressures generated from the SEEP/W solution of the seepage conditions. Factors of safety for slope stability were computed using Spencer's method of analysis, circular and noncircular slip surfaces, and search routines that helped to identify critical (low safety factor) sliding surfaces.

This analyses performed as part of this study are limited to static, long-term, fully drained conditions within the existing dike. The dike has existed in its current cross-sectional geometry (slopes and crest elevation) for about 30 years. Excess pore water pressures generated in the underlying soil during construction have had sufficient time to dissipate, and steady state seepage conditions have developed within the dike. Hence, for the current static conditions, the soils can be treated as fully drained and the stability can be assessed using effective stress analyses.

The three referenced cross-section were evaluated for potential deep-seated slides that would threaten partial to total loss of the impoundment (global stability), as well as more shallow critical slip surfaces that correspond to the observed minimum factors of safety, but are generally more maintenance type issues. The potential for upstream sliding, into the stilling pond, was also evaluated. The results of the stability analyses indicate factors of safety for global stability range from 1.4 to 1.8 and 1.3 to 1.7 for steady-state seepage conditions at the normal pool and maximum storage pool, respectively. It should be noted that the dike was originally constructed with an "End-of-Construction" factor of safety of 1.42 (as per TVA drawing 10N226). Based on discussions with TVA and to be in accordance with current prevailing practices, a minimum 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". Therefore, the downstream slope does not meet the established criteria for a long term factor of safety of 1.5 for a deep seated failure.

TVA is planning to convert the Allen plant systems to dry handling of fly ash, which will significantly reduce the fly ash combustion product storage role for the ash pond and stilling basin. Stantec anticipates the ash pond and stilling basin configuration will be modified in association with the conversion and reduced storage needs. The assessment of the eastern perimeter dike and the associated recommendations are based on this understanding of the plant setting.

In conclusion, portions of the eastern perimeter dike do not meet the required factors of safety for piping or global slope stability under long-term steady state seepage conditions at normal operating pool elevations for the East Stilling Pond. This does not imply that the dike is in immediate danger of failure, but TVA should undertake efforts to improve the safety of this facility in association with planned dry ash conversion process following the conclusions and recommendations presented herein.

Based on the results of the seepage and slope stability analyses, possible remedial measures for improving the long-term stability of the eastern perimeter dike could include construction of an earth or rock berm or flattening the slope. Selection of the option for reducing the risks for piping and slope failures will depend on availability of materials, land, cost of construction, and environmental considerations. Design of stabilizing berms or other modifications to the dike cross section should include undrained, total stress slope stability analyses to assess stability during construction.

In the interim, Stantec recommends that TVA implement the following planning measures and monitoring program to reduce the risk of failure in the eastern perimeter dike:

- develop and implement an emergency action plan;
- perform weekly inspections of the dike;
- continue the monthly piezometer readings; and
- install additional piezometers in critical areas to monitor the piezometric conditions in the dike and foundation soils.

This report provides detailed discussions of the scope of work performed as part of this study; results of the historic document review, subsurface exploration, and laboratory testing program; assumptions, methodologies and results of the engineering analyses; and Stantec's conclusions and recommendations for future actions.

Report of Geotechnical Exploration and Evaluation of Slope Stability

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1. Introduction

1.1. General

Subsequent to the failure of the dredge cell at the Kingston Fossil Plant in December of 2008, the Tennessee Valley Authority (TVA) contracted with Stantec Consulting Services Inc. (Stantec) to perform stability evaluations for the coal combustion byproduct (CCB) storage facilities at each of its eleven active and one inactive coal fired power plants. Initial efforts consisted of site visits with TVA personnel and review of historical documents to provide recommendations for immediate risk reduction measures and to identify sites/facilities that require further evaluation. The final reports for these efforts, labeled as Phase I of the stability evaluations, were submitted in June of 2009. In general, these reports recommend conducting geotechnical explorations for CCB disposal facilities and perform engineering analyses of existing configurations for comparison against current dam safety criteria.

1.2. Facility Layout and CCB Storage

The Allen Fossil Plant in Memphis, Shelby County, Tennessee consists of a centrally located power plant, an active ash disposal area to the east and an inactive ash disposal area to the west. The east disposal area, originally commissioned in 1967 and expanded in the mid to late 1970's, consists of the East Active Ash Pond, East Dredge Cell, and East Stilling Pond. Figure 1 provides an overview of the east disposal area. The northern perimeter dike for this disposal area was originally constructed by the US Army Corps of Engineers (USACE) and serves as part of the flood protection system along the Mississippi River and its backwaters and tributaries. The east perimeter dike for the stilling pond and divider dike separating it from the ash pond were constructed as part of the expansion in the late 1970's.

The plant currently operates by sluicing fly ash and bottom ash through pipes and then into an open channel that subsequently drains into the East Active Ash Pond. Periodic dredging operations excavate ash from the pond for temporary storage in the East Dredge Cell. Reed Minerals processes the ash for use as off-site structural fill. A spillway near the southeast corner of the ash pond discharges water from the ash pond into the East Stilling Pond. Two 36-inch reinforced concrete pipes situated at the north end of the stilling pond penetrate the north dike to discharge water into McKellar Lake. Additionally, two auxiliary pipes penetrate the eastern perimeter dike and serve as emergency spillways to drain water from the stilling pond into a discharge channel that empties into the Horn Lake Cutoff. The auxiliary spillways are only used when the water level in McKellar Lake is too high to discharge.

It should be noted that TVA has made the decision to switch from wet to dry methods for CCB handling and storage. The east ash disposal area will be closed as part of this conversion process. However, a schedule for the conversion of the Allen Fossil Plant has not been established to date.

Allen Fossil Plant
Eastern Perimeter Dike
East Stilling Pond
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Figure 1. Overview of East Active Ash Pond, East Dredge Cell, and East Stilling Pond

1.3. Scope of Work

This report addresses the geotechnical exploration performed to support Stantec's engineering evaluation of the eastern perimeter dike of the East Stilling Pond. As outlined in ESR 909, the scope of work for this effort included the following tasks:

- Review of available documentation to support the development of a work plan for the geotechnical exploration and engineering evaluations.
- Survey services to develop dike cross-sections – performed by TVA surveyors.
- Development and planning of the geotechnical exploration.
- Execution of a drilling program to develop the subsurface lithology and provide samples for subsequent laboratory testing.
- Installation of piezometers for monitoring water levels in the dikes and foundation soils.
- Execution of a laboratory testing program to develop strength and permeability data to support engineering analyses.
- Instrumentation monitoring program to observe the fluctuations of water levels in the installed piezometers over a period of six months.
- Perform seepage and stability analyses on the existing dike geometry. As previously discussed, the eastern perimeter dike was constructed in the late 1970's and has been in use since that time. As such, the slope stability and seepage analyses model static, long-term steady-state seepage conditions. Seismic stability evaluations were beyond the scope of work for this effort.
- Develop a geotechnical report documenting the scope of work, outlining the results of the exploration, discussing the engineering analyses, and providing recommendations regarding slope stability.

The USACE, Memphis District, requested specific evaluations of the dike geometry and additional engineering analyses for the northern perimeter dike of the east disposal area. As such, the report addressing the geotechnical exploration, subsequent analyses, and recommendations for the northern perimeter dike are provided under a separate cover.

2. General Site Description and Geologic Setting

2.1. Site Location and Description

The Allen Fossil Plant is located in the southwestern corner of Tennessee just west of the city of Memphis. The plant is situated on the south shore of McKellar Lake and the eastern bank of the Mississippi River. The local topography is relatively level, with the constructed dikes rising about 20 to 25 feet above the surrounding terrain. Based on available drawings dating to the time of the construction of the USACE levee (Serial No. 16362, Drawing 1, dated February 12, 1960), the natural ground elevation within the east disposal area varied from about 206 to 218 feet above Mean Sea Level (MSL) prior to excavating native materials for construction of the flood control structure.

The eastern perimeter dike is aligned approximately perpendicular to the northern perimeter dike (USACE levee) in a general north-south direction. Based on design drawings, survey data, and field observations, the dike is approximately 1,600 feet long, 20 feet tall, and exhibits 3H:1V (Horizontal:Vertical) embankment slopes with a 16-foot wide crest. The interior and exterior slopes are vegetated with grass. The drainage channel directing effluent from the ash pond auxiliary spillway to the Horn Lake Cutoff was constructed within a low lying area. As such, water ponds in this area adjacent to the toe of the dike.

2.2. Geologic Setting

Available geologic mapping, Geologic Map of the Tennessee Portion of the Fletcher Lake Quadrangle, Tennessee, Tennessee Department of Conservation, Division of Geology, 1978, indicates the plant and surrounding areas to be underlain by artificial fills and Quaternary age alluvial deposits. The fill is noted to generally consist of alluvium dredged from the flood plain (or loess in select locations) and range in thickness from a few feet beneath residential areas to tens of feet beneath industrial areas in the floodplain of the river. The alluvium consists of irregular lenses of fine sand, silt, and clay in the upper part, and of coarse sands, gravelly sands, and sandy gravels in the lower part. The alluvium varies from about 45 to 90 feet in thickness adjacent to the loess bluffs along the eastern edge of the quadrangle to as much as 175 feet well out in the flood plain. The mapping indicates the alluvium is underlain by the series of highly consolidated clays and dense sands comprising the Claiborne Group.

The East Disposal Area, situated east of the main plant and bounded to the east by Ensley Yard, to the north by McKellar Lake, and to the south by the railroad, is delineated as a tailings pond on the referenced geologic mapping. Specifically, the mapping indicates this area is underlain by the above described alluvial deposits and is surrounded by artificial fills constructed to support development of the plant, railroad, and USACE flood protection system.

3. Review of Available Information

3.1. General

As part of the Phase 1 site assessments, Stantec engineers and geologists reviewed documents provided by TVA with the objective of developing an understanding of the development and history of the plant and CCB storage facilities. The documents reviewed include design drawings, design and construction memoranda, aerial photographs, survey/topographical data, and annual inspection reports. The following documents were reviewed as part of this assessment:

- Drawing No.1, Serial No. 16362, U.S. Army Corps of Engineer, Memphis District: Dike Work, Memphis Harbor Project, Mississippi River, Item No. L-725, Sheet 1

- Drawing No. 10W224: Ash Disposal Area West of Powerhouse Sheet 2

- Drawing No. 10W225: Ash Disposal Area East of Powerhouse Sheet 1

- Drawing No. 10N226: Ash Disposal Area East of Powerhouse Sheet 2
- Drawing No. 10N227: Ash Disposal Area East of Powerhouse Sheet 3
- Drawing No. 10N228: Ash Disposal Area East of Powerhouse Sheet 4
- "Allen Steam Plant – Ash Disposal Areas Dikes Raising –Soil Investigation", TVA Memorandum by Gene Farmer (Chief, Construction Services Branch) to G. L. Buchanan (Chief, Civil Engineering and Design Branch) , May 2, 1975.
- "Allen Steam Plant – Ash Disposal Areas Dikes Raising – Construction Information", TVA Memorandum by G. L. Buchanan to Gene Farmer, July 24, 1975.
- 2009 survey Drawing No.461 K 552(D) R.0
- Allen Fossil Plant Annual Ash Disposal Area Inspection Reports from 1967 to 2009 (Draft), except those for 1990, 1991, and 1992 because they were not available.
- Deed and Bill of Sale made by the City of Memphis, Tennessee and Memphis, Light, Gas, and Water Division to the Tennessee Valley Authority and United States of America, 1984.

3.2. Development of East Ash Disposal Area

The USACE constructed the north perimeter dike as a flood control levee in the early 1960’s using soils excavated from within the area that is now the East Active Ash Pond. As such, the materials used to construct the dike consist of low plasticity silts, silty lean clays, silty sands, and sandy silts. Based on the available drawings, an embankment had already been constructed to support the railroad along what is now the south side of the east ash disposal area.

Starting in the late 1960’s, bottom ash was sluiced into the east ash disposal area via a discharge point in the northwest corner. The disposal area was bounded by higher ground on the east and water was drained from the area via an open channel entering the Horn Lake Cutoff through pipes beneath the railroad embankment. An outside private company reclaimed the bottom ash from the disposal area, processed the material, and sold it off-site. In late 1969, the plant began sluicing fly ash into the east disposal area via a separate pipe system also discharging into the northwest corner of pond. A skimmer system was constructed in 1970 to reduce the possibility for finer ash materials entering the Horn Lake Cutoff. The 1970 inspection report recommended expanding the pond, building a raised dike along the east end of the area, and installing standard spillways and skimmers. Design for the pond expansion was completed in 1975 and construction began in 1976. The east perimeter dike, divider dike, McKellar Lake spillway, and Horn Lake Cutoff auxiliary spillway were completed and in operation at the time of the 1978 annual inspection.

Based on a review of available design plans, the eastern perimeter dike was constructed up to approximate elevation 237 feet with a cross-section incorporating a ten-foot wide core with outer shells. Specifications for the core and shell materials (type and compaction) were provided in the TVA Memorandum. Based on this document, the soils used to construct the core should have consisted of low plasticity silts, lean clays, silty sands or sandy silts with at least 35% fines (particles passing the #200 sieve i.e. silt and clay). To construct the core, these materials should have been compacted to at least 95 percent of the materials maximum standard Proctor dry density within ±3 percent optimum moisture content. Similar to the USACE levee, available drawings and documentation also indicate the dike was constructed over natural ground using borrow soils from the current pond area. Figure 2 depicts the design cross-section for the eastern perimeter dike.

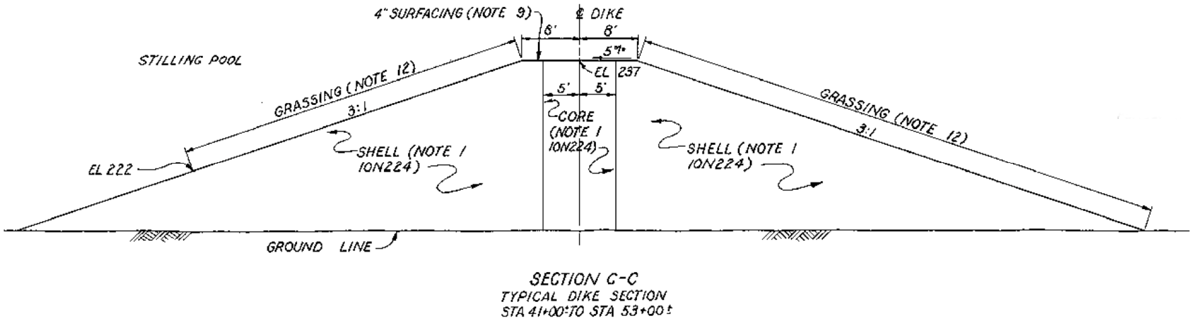


Figure 2. From TVA Drawing 10N226 Design Cross-Section of the Eastern Perimeter Dike

The divider dike was constructed up to approximate elevation 237 feet using bottom ash. The design cross-section indicates the slopes are 2H:1V or flatter.

3.3. Observed Seeps and Sloughs along the Eastern Perimeter Dike

The 1997 annual inspection report noted the presence of red water seeps near the south end of the eastern perimeter dike. The report recommended monitoring of the seeps. The inspection reports for the following years did not note the presence of the seeps, but indicated the toe was submerged and not able to be observed.

Sloughs from wave action and/or erosion have been noted along the interior slope of the eastern perimeter dike in several annual inspection reports since 1999. Scarp heights of one to two feet were observed along the interior slope of the dike during the site visit conducted by Stantec and TVA personnel early in 2009 in support of the Phase 1 assessment efforts.

4. Subsurface Exploration

4.1. General

Stantec prepared a subsurface exploration program based on a review of historic documents, geologic mapping, aerial photography, available topographic mapping, and site observations. A summary of the proposed boring locations was transmitted to TVA for field staking. The boring locations and surface elevations were established in the field by TVA survey personnel.

The subsurface exploration program consisted of drilling and sampling five soil test borings along the crest and near the toe of the eastern perimeter dike and one boring on crest of the southern perimeter dike of the stilling pond. These borings (STN-9 through STN-14) were extended to depths of about 40 to 60 feet below existing ground surface utilizing both truck- and track-mounted drill rigs between July 15, 2009 and July 19, 2009. The borings proposed along the crest were offset by field personnel to be drilled along the shoulder so that the installed piezometers would not be in the middle of the access road along the top of the dike. As such, the borings were advanced through the outer shell of the embankment and did not obtain samples to characterize the core materials. Therefore, Stantec remobilized to the site on October 12, 2009 to advance hand auger borings with the intent of providing samples to characterize the core materials. These borings were extended to depths of about five to six feet below grade. The boring layout in Appendix A depicts the locations of the borings overlain on an aerial photograph. Table 1 provides a summary of the borings advanced as part of the geotechnical exploration. All measurements are expressed in feet.

Table 1. Summary of Borings

Boring No.	Northing*	Easting*	Surface Elevation	Boring Termination Depth	Bottom of Hole Elevation
STN-9	274009.16	763820.47	221.2	40.0	181.2
STN-10	274018.24	763758.37	236.9	60.0	176.9
STN-11	273523.29	763688.16	237.8	60.0	177.8
STN-12	273018.83	763676.83	216.7	40.5	176.2
STN-13	273020.21	763618.05	236.9	60.0	176.9
STN-14	272761.34	763347.91	236.5	60.0	176.5
HA-9	273021.67	763612.37	237.0	6.0	231.0
HA-10	274010.59	763748.55	237.2	5.0	232.2

*Coordinates and Elevations were provided by TVA. The coordinate datum is the Tennessee Lambert Ground and the elevation datum is the NGVD29

In general, continuous standard penetration (SP) tests were performed in each of the borings to provide information as to the consistency or density of the dike and foundation materials and to obtain samples for subsequent laboratory testing. Thin-wall Shelby tube samples were also obtained at select locations within cohesive or moderately cohesive soil materials to provide relatively undisturbed samples for laboratory strength and permeability testing. Disturbed samples were also obtained from the hand-auger borings at one foot intervals of depth utilizing a bucket sampler. A Stantec geologist and/or geotechnical engineer was on site full time with each rig to observe the drilling operations; log the drilling, sampling, and piezometer installation activities; and adjust the drilling and sampling program as warranted by site and subsurface conditions. The geologists/engineers logged the materials obtained from SP testing and Shelby tube sampling, paying particular attention to the textures, colors, moisture contents, plasticities, and consistencies/densities of the materials encountered. Typed boring logs are included in Appendix B.

Both automatic and safety hammers were used to perform SP tests in the borings advanced as part of this exploration. In SP testing, the number of blows required to advance a standard two-inch (outer diameter) split barrel sampler the last 12 inches of the typical total 18 inch penetration by means of a 140 pound hammer with a free fall of 30 inches, is the standard penetration resistance value (N). This value is used to estimate the in situ relative density of cohesionless soils and the consistency of cohesive materials. Standard correlations for Standard Penetration testing have historically been based upon blow counts using a safety hammer (rope/cat-head) system, generally estimated to be about 60 percent efficient. Thus, most correlations report values termed as N_{60} data. The efficiency of the automatic hammers used for this exploration was estimated to be about 80 percent based on previous efficiency testing of Stantec drill rigs equipped with automatic hammers, thus requiring a correction for hammer efficiency. As such, Stantec corrected the blowcounts resulting from SP testing utilizing the automatic hammer. The correction of the SP data is discussed in further detail in Section 5.3.2 of this report.

Piezometers were installed at or near each of the borings to assist in developing an understanding of the steady-state seepage piezometric surface and support the requested seepage and slope stability analyses. The piezometers were constructed from 1-inch diameter Schedule 40 PVC riser pipe and five foot long No. 10 slot well screens. The annular backfill consisted of a sand filter pack to some distance above the screen followed by a minimum two-foot bentonite seal. After allowing the bentonite to hydrate, the remaining annulus was backfilled with cement-bentonite grout tremmied into place. Piezometer construction along the crest of the dike was completed with a concrete surface pad and flush mounted cover. However, the piezometers located along the toe of the Ash Pond Dike incorporated aluminum risers to promote visibility and were protected by concrete-filled steel bollards. Appendix C provides an instrumentation layout depicting the locations of the piezometers overlain on aerial photography. Piezometer installation logs are also provided in Appendix C.

4.2. Subsurface Conditions

Based on the results of the drilling program, subsurface conditions at the site can be generalized as outlined in Table 2 below.

Table 2. Generalized Subsurface Conditions

Approximate Elevation	Materials	Consistency/Density
El. 237 to El. 210	Dike fill – consists of sandy silt, silty sand, silty clay, sandy clay, and lean clay	Stiff to very stiff / medium dense
El. 210 to El. 175 (termination depth)	Alluvium – Irregularly bedded sandy silt, silty sand, silt, lean clay, sand, and fat clay	Very soft to stiff / very loose to medium dense

In general, the embankment core and shell materials are very similar, primarily consisting of sandy silts and silty clays brown to gray-brown in color, moist in terms of natural moisture content, and containing lenses of silty sand and sandy clay scattered throughout. N_{60} from SP tests within the dike fill materials range from 13 to 64 indicating the silty clays and low plasticity silts vary from stiff to hard in terms of consistency and the more sandy materials vary from medium dense to dense. Based on laboratory testing, these materials primarily classify as CL-ML with lesser occurrences of ML, CL, SC, and SC-SM based on the Unified Soil Classification System (USCS).

Based on a review of the subsurface data from the drilling program, the alluvial foundation soils correlate well with the geologic mapping and can be separated into three major horizons – a sandy silt layer from the base of the dike down to approximate elevation 200 feet; a clay layer between approximate elevations 200 and 180 feet; and a low plasticity silt to sandy silt layer below elevation 180 feet.

> The upper horizon of foundation soils consists of sandy silt, brown to gray in color, moist to saturated in terms of natural moisture content, and containing thin sand and silty sand lenses. SP testing yielded N_{60} values ranging from 0 to 15, with the majority of the values being less than 8. As such, the upper horizon of silty soils is

typically soft to medium stiff in terms of consistency and the more sandy materials are generally loose in terms of relative density. Laboratory testing indicates the soils within this horizon primarily classify as ML with lesser occurrences of SM based on the USCS.

The clay materials observed in the borings drilled along the eastern perimeter dike exhibit moderate (lean) to high (fat) plasticity, vary from brown to gray in color, were observed to typically be moist in terms of natural moisture content, and contained lenses of fine sand and/or silt scattered throughout. The majority of the N_{60} values from SP testing vary from 1 to 8 indicating the clay soils vary from very soft to medium stiff in consistency. Soil samples recovered from sampling in the alluvial clay horizon primarily classify as CH or CL with fewer occurrences of ML, CL-ML, and SC based on the USCS.

The lower horizon below the clays primarily consists of sandy silt, gray in color, wet to saturated in terms of natural moisture content, and containing isolated pockets of clayey soils or and gravel lenses typical of alluvial deposits. N_{60} values range from 3 to 21. However, the majority of the values are less than 8 indicating the materials are predominantly soft to medium stiff in terms of materials consistency and the more sandy materials are generally loose in terms of relative density. The higher values are likely a result of encountering gravel in isolated layers. Laboratory testing indicates the soils within this horizon primarily classify as ML with lesser occurrences of CL and SM based on the USCS.

4.3. Laboratory Test Data

4.3.1. General

Stantec performed laboratory testing in accordance with applicable ASTM soil testing standards. In general, the laboratory work consisted of natural moisture content determinations, sieve and hydrometer analyses, Atterberg Limits; specific gravity determinations, consolidated-undrained triaxial compression, and permeability testing. The results of the index, strength, and permeability testing were used to select/derive appropriate parameters for the engineering analyses. The results of these laboratory tests are provided in Appendix D and depicted on the graphical boring logs presented on the cross-sections in Appendix A.

4.3.2. Natural Moisture Content and Laboratory Classification Testing

Natural moisture content determinations (ASTM D 2216) were performed on all soil samples recovered from SP testing and Shelby tube sampling. In general, the results of these determinations correlate well with the visual moisture estimates determined in the field and indicate the soils above the phreatic surface are typically moist and vary from moist to saturated below the water table. The results of the natural moisture content testing are presented on the graphical boring logs in Appendix A and typed boring logs in Appendix B.

Soil classification tests consisting of sieve and hydrometer analyses (ASTM D 422), Atterberg Limits (ASTM D 4318), and specific gravity determinations (ASTM D 854) were performed on combined SP test samples from representative soil horizons and select specimens trimmed from Shelby tube sampling. The results of the classification testing were discussed in detail in Section 4.2 of this report. The descriptions of the soils indicated on the typed boring logs in Appendix B are in general accordance with the USCS and the group symbols are shown on the graphic boring logs depicted on the cross-section in Appendix A.

In general, soils with relatively low plasticity, e.g. silt, silty clay etc., have low moisture content in comparison with lean and fat clays. This is evident in our laboratory test results where sandy silts and silty clays with relatively low plasticity exhibited low moisture contents. The fill soils in the dike exhibited relatively lower moisture content than the foundation soils, indicative of moisture control at the time fill placement. The lean and fat clays typically contain higher percent fines as evident by the gradation analysis test results. The results of the natural moisture content and laboratory classification tests are summarized in Table 3 below.

Table 3. Summary of Natural Moisture Content and Classification Testing

Horizon	Predominant USCS Classification	Water Content Typical Range	Liquid Limit	Plasticity Index	% Passing #200 Sieve
Dike Fill Soils	CL-ML, ML	10% to 24%	20 to 24	3 to 5	40 to 70
Sandy Silt	ML, SM	19% to 42%	NP to 23	NP to 2	40 to 70
Alluvial Clay	CL, CH, ML	24% to 56%	25 to 73	6 to 51	50 to 96
Silt to Sandy Silt	ML	25% to 41%	26 to 30	3 to 8	40 to 97

NP – Non Plastic

4.3.3. Consolidated-Undrained Triaxial Testing

Stantec performed consolidated-undrained (CU) triaxial testing with pore pressure measurements (ASTM D 4767) on selected six-inch specimens extruded from the Shelby tubes to establish effective-stress shear-strength parameters. The engineering staff utilized the results of CU testing to derive total and effective stress shear-strength parameters modeled in slope stability analyses. Table 4 provides a summary of the CU triaxial testing.

Table 4. Consolidated-Undrained Triaxial Compression Test Results

Boring No.	Approx. Sample Elevation (ft)	Textural Classification	Wet Unit Weight (lb/ft^3)	Effective Strength		Liquid Limit	Plasticity Index
				c' tsf	Φ' degree		
STN-1	198 to 200	Fat Clay	105	0.11	26	92	64
STN-1* and STN-2	193 to 195 and 201 to 203	Lean Clay	110 to 115	0.36	21	34 to 47	13 to 26
STN-1	186.5 to 188.5	Lean Clay	110	0.03	32	38	18
STN-3A**	230.5 to 233.5	Sandy Silt	120	0.11	33	28	7
STN-9	184.5 to 191.5	Fat Clay	105	0.08	28	73	47

* STN-1 and STN-2 performed for evaluation for the northern perimeter dike addressed in a separate report.
** STN-3A is an offset boring drilled adjacent to STN-3 to obtain undisturbed samples for subsequent lab testing.

Based on the results of the triaxial testing, the effective internal angle of friction for the alluvial clay soils and silty to sandy lean clays in the embankment varies from about 21 to 33 degrees and the effective cohesion varies from 60 to 720 pounds per square foot. Generally, higher internal angles of friction and lower cohesion values were obtained from test samples with increased percentages of sand and silt in the samples selected for testing while lower internal angles of friction and corresponding higher cohesion values are generally associated with higher percentages of clay. The test results exhibiting internal angles of friction between 21 and 26 degrees are typical of more highly plastic clay soils while those of 28 to 32 degrees are more typical of more silty to sandy clays.

4.3.4. Laboratory Permeability Testing

Falling head permeability tests (ASTM D5084) were performed on select extruded tube specimens and remolded samples of dike fill material. The remolded samples consisted of multiple SP test samples or hand auger samples combined and compacted to a wet density of 115 pcf and moisture content in the range of 16 to 22 percent. Table 5 summarizes the test results.

Table 5. Permeability Test Results

Boring No.	Depth (ft)	In-Situ Water Content (%)	Initial Water Content (%)	Initial Dry unit Weight, pcf	Textural Classification	Average Hydraulic Conductivity, k (cm/s)
STN-1	34.6 – 35.1	36	36	84	Lean Clay	7.04E-08
STN-2	36.6 – 37.1	35	35	85	Lean Clay	5.17E-08
STN-2A	10.0 – 10.5	25	25	96	Fill-Silty Clay	1.35E-07
STN-6	9.0 – 15.0	22	22	94	Fill-Silty Sand	3.66E-05*
STN-7	30.0 – 30.5	16	16	110	Sandy Clay**	9.11E-06**
HA-1	2.0 – 4.0	20	20	95	Fill-Sandy Silt	3.9E-05*
HA-4	2.0 – 5.0	21	21	95	Fill-Sandy Silt	4.26E-05*
HA-5	1.0 – 3.0	21	20	95	Fill-Sandy Silt	8.34E-05*
STA-8A	5.0 – 5.5	18	18	109	Fill-Silty Clay	1.47E-07
STN-9	28.6 – 29.1	46	36	84	Fat Clay	2.00E-08
HA-9	3.0 – 6.0	12	17	98	Fill-Sandy Silt	5.38E-05**

STN-1, -2, -6, -7, -8A, HA-1, and -5 were performed for evaluation of north perimeter dike addressed in a separate report.
* Performed on remolded samples compacted to dry density between 94 and 96 pcf. In-situ dry density and hydraulic conductivity may vary.
**Sample most likely obtained from a sandy clay seam within a fat clay layer.

Laboratory test data provided by TVA from design of the dike indicates the sandy silt and silty sand core materials exhibit hydraulic conductivity values ranging from 7.4E-06 to 8.40E-07 centimeters per second for dry unit weights from 107 to 113 pounds per cubic foot (from TVA memorandum by G.L. Buchanan). In comparison with TVA test results, relatively higher hydraulic conductivity values were obtained in the permeability tests of the remolded samples. These samples were remolded at about 94 to 95 pcf. Based on the TVA memorandum by G.L. Buchanan, the core materials (on-site sandy silt and silty sand of type I, II, III and V) with over 30 percent fines have a maximum dry density in the range of 107 to 113 pcf. Therefore, the tested samples were remolded to only about 85 to 90 percent of the materials reported maximum dry Proctor density and likely resulted in the higher permeability values. The proctor test data was not available at the time of performing these permeability tests.

4.4. Slug Test Data

Slug tests were performed at each piezometer location to evaluate in-situ hydraulic conductivity of the soil. This test involves adding or removing a measured quantity of water (slug) to a static column of water in a well (piezometer) and measuring the resulting changes in water level at a predetermined interval. The changes in water level are recorded until the equilibrium is restored, i.e. water level in the well returns to its original static condition.

For materials with lower permeability, more accurate results are generally obtained by using an in-well transducer to collect periodic water level versus time measurements. The transducer is placed in the well below the pre-test water level a sufficient depth to permit testing. An instrument (data-logger) records water depth above the transducer before, during, and after the "slug" is introduced. The "slug" is introduced suddenly (raising the water level) and a series of water level versus time measurements were made as the water level moves toward an equilibrium situation.

During the initial field exploration, Stantec installed 5-foot long, 1-inch (0.0417 feet) diameter, schedule 40 PVC piezometer screens at each PZ location. To conduct the slug tests, a Stantec field engineer lowered a transducer into the piezometer, added water to the riser pipe, and used a data logger to automatically collect measurements at pre-programmed time intervals. The recorded data from the data-logger was analyzed by AQTESOLVE software from HydroSOLVE, Inc. (www.actesolve.com). The Bouwer-Rice solution method was used in the analysis for an unconfined aquifer. An Anisotropy Ratio ($K_{vertical}/K_{horizontal}$) of 1 was assumed for each PZ location. Results of the slug test are summarized in Table 6 and individual slug test result sheets are provided in Appendix E.

Table 6. Slug Test Results

PZ No.	Depth of PZ Tip (ft)	Saturated Aquifer Thickness (ft)	Static Water Column Height (ft)	Total Well Penetration Depth (ft)	Initial Displacement (ft)	Soil Classification at the PZ Tip	Average Hydraulic Conductivity k (cm/s)
PZ-1	40.2	26.0	22.3	22.3	6.0	Lean Clay	1.40E-04
PZ-2	19.7	16.7	3.5	5.0	0.6	Fill - Silty Clay	1.12E-06
PZ-3	20.1	5.4	5.4	17.1	1.5	Fill - Silty Sand	4.05E-05
PZ-4	19.2	4.0	3.4	5.0	0.1	Fill - Lean Clay	3.30E-04
PZ-5	38.2	24.6	20.6	20.6	2.4	Silty Sand	3.62E-04
PZ-6	17.9	0.4	0.4	5.0	0.4	Fill - Silty Sand	5.30E-03*
PZ-7	15.6	0.1	0.0	5.0	0.4	Fill - Silty Sand	5.38E-02*
PZ-8	19.1	11.6	0.4	4.0	0.4	Fill - Silty Sand	2.53E-04*
PZ-9	41.0	19.2	19.2	19.2	2.9	Fat Clay	3.63E-06
PZ-10	13.1	11.7	12.8	5.0	0.4	Fill - Silty Sand	1.08E-06
PZ-11	14.4	14.3	0.4	5.0	0.3	Fill - Silty Sand	3.08E-04*
PZ-12	43.1	18.6	17.8	17.8	2.5	Silty Sand	4.97E-05
PZ-13	17.7	18.0	6.6	6.6	1.6	Fill - Silty Sand	3.72E-06
PZ-14	19.5	11.8	11.8	11.8	1.5	Fill - Lean Clay	1.38E-04

PZ-1, 2, 3, 4, 5, 6, 7, and 8 were installed to assist in the evaluation of the north perimeter dike addressed in a separate report.
*Performed in a dry or near-dry piezometer. Actual in-situ hydraulic conductivity may vary.

The results of the slug tests outlined above indicate the permeability of the dike and foundation soils are highly variable. Even within the constructed dikes, the hydraulic conductivity values vary by two orders of magnitude. The boring logs reinforce the variability of the dike materials indicating that although the bulk of the dike is constructed of sandy silt and silty sand, there are lean clay layers, silty clay zones, and sand lenses throughout. The effect of this variability on seepage analysis results are further discussed in Section 5.2.4.1 of this report.

4.5. Instrumentation Monitoring Program

Piezometers were installed at/near the sample borings to monitor water levels in the dike and foundation soils. Long-term piezometer readings provide an estimate of the piezometric surface fluctuation at this site. Since their installation, eleven (11) sets of readings have been recorded. Table 7 summarizes the data and individual piezometer readings are included in Appendix C. All measurements in Table 7 are expressed in feet.

Table 7. Piezometer Data

PZ No.	Surface Elevation	Top of Casing Elevation	Depth of PZ Tip	PZ Tip Elevation	Range of Measured Depths (from 7/20/09 to 1/12/10)		Ranged of Observed Water Elevations (from 7/20/09 to 1/12/10)	
					Min.	Max.	Min.	Max.
PZ-1	215.5	218.2	40.2	178.0	14.0	29.7	188.5	204.3
PZ-2	238.8	238.7	19.7	219.0	16.0	18.1	220.6	222.7
PZ-3	234.5	237.4	20.1	217.4	11.0	14.7	222.8	226.5
PZ-4	237.6	237.3	19.2	218.1	15.5	19.1	218.2*	221.8
PZ-5	218.0	220.7	38.2	182.5	14.4	26.6	194.1	206.3
PZ-6	238.5	238.4	17.9	220.5	17.8	18.0	220.4**	220.6*
PZ-7	235.5	235.4	15.5	219.9	13.5	16.0	219.4*	219.9*
PZ-8	237.8	237.7	19.1	218.6	19.0	19.1	218.5**	218.7*
PZ-9	221.2	224.2	41.0	183.2	8.4	19.4	204.8	215.9
PZ-10	237.4	237.1	13.1	224.1	10.1	12.4	224.7	227.0
PZ-11	237.9	237.8	14.3	223.5	14.2	14.3	223.5**	223.6**
PZ-12	217.2	220.1	43.1	177.0	21.9	30.8	189.3	198.2
PZ-13	237.2	237.0	17.7	219.3	10.5	15.2	221.4	226.5
PZ-14	236.6	236.4	19.5	216.9	6.7	9.3	227.2	229.7
McKellar Lake							170.05[†]	213.85[†]
Mississippi River							178.95[‡]	218.50[‡]

*Water level measured was most likely trapped water at the bottom of the piezometer.
**Water elevation is apparently below the piezometer tip elevation.
†Source: USACE, Ensley Engineer Yard Gauge MS129 located in Lake McKellar from 8/24/08 to 12/31/09.
‡Source: USACE, Mississippi River Gauge MS126 – Memphis from 8/24/08 to 12/31/09.

The difference between the maximum and minimum water levels observed in a single piezometer vary from about 0.1 feet in PZ-6, PZ-8 and PZ-11 to just under 16 feet in PZ-1. In general, the differences in water elevations observed in piezometers within the dike are on the order of 2 to 3 feet in magnitude and reflect small fluctuations in the ash and stilling pond pool levels. However, it should be noted that the observed water levels in piezometers PZ-6, PZ-7, PZ-8, and PZ-11, set within the dike, appear to be representative of water trapped in the tip of the screen. The piezometers near the toe of the dike were installed relatively deep with the screened intervals set within or below the clay foundation soils. The differences in the maximum and minimum water levels observed in these instruments vary from about 12 to 15 feet in magnitude and reflect the fluctuations in McKellar Lake.

5. Engineering Analyses

5.1. General

Stantec performed both seepage and slope stability analyses at three cross-sections along the eastern perimeter dike as part of this study – Section C–C' situated just south of borings STN-9 and STN-10; Section D–D' located between borings STN-11 and STN-13; and Section E – E' at borings STN-12 and STN-13. The locations of the analyzed cross-sections are shown on the boring layout provided in Appendix A.

Prior to performing the analyses, Stantec developed the dike geometry at each cross-sections using survey data provided by TVA, design drawings, and site observations. Relatively wider profiles in the upstream and downstream sides of the dike were required to improve the accuracy of the seepage model. Stantec utilized data from the Shelby County GIS (prepared in 2006) to develop the ground surface geometry for area east of the dike. Therefore, these cross-sections should be considered accurate only to the degree by the means and method used to define them. Stantec developed the subsurface profile at each cross-section using the results of the drilling and lab testing programs discussed herein. The modeled permeability and strength parameters were derived based on the results of the drilling and lab testing programs, slug test data, historical information from TVA memoranda, and Stantec's past experience with similar soils and CCB materials. The selection process for material properties modeled in the analyses is discussed in detail in Sections 5.2.1 and 5.3.2 of this report. The cross-sections provided in Appendix A depict the dike geometry, subsurface horizons, and material parameters modeled in the engineering analyses.

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

Stantec performed seepage and slope stability analyses for steady-state seepage at the normal and maximum storage pool elevations of 230 feet and 233 feet above MSL, respectively. The analyses were performed utilizing the GeoStudio 7.14 software package developed by GEO-SLOPE International, Ltd. of Calgary, Alberta, Canada (www.geo-slope.com). This package includes SEEP/W and SLOPE/W modules for seepage and slope stability analysis, respectively.

5.2. Seepage Analysis

5.2.1. SEEP/W Model

Seepage analyses were performed at the three referenced dike cross-sections in order to estimate the magnitude of seepage gradients for the evaluation of piping potential, and pore water pressures within the embankment and foundation soils for the evaluation of slope stability under steady state seepage conditions. The analyses were performed using SEEP/W, a finite element program tailored for modeling water seepage conditions in soil and rock.

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 program divides a two-dimensional problem space, e.g. a dike cross-section, into a number of quadrilateral and triangular elements of specified ‘mesh size’ connected by nodes, then uses a finite-element numerical methodology to calculate seepage properties (such as pore water pressure, total head, etc.) at individual nodes to solve the entire cross-section. The software also includes material models that allow tracking both saturated and unsaturated flows, including the transition in seepage characteristics for soils that become saturated or unsaturated during the problem simulation.

The analyses were performed for steady-state seepage through saturated and unsaturated soils. In the steady-state seepage analysis, it is assumed that the water levels on both upstream and downstream sides of the dike remain constant. Using this model, SEEP/W locates the piezometric surface for unconfined seepage through the dike cross-sections. The cross-sections modeled with SEEP/W were subsequently analyzed for slope stability (Section 5.3).

5.2.2. Seepage Properties

Stantec derived material properties for the seepage analyses based on available laboratory test data and field slug tests. If no data was available, the material properties were estimated based on typical values for similar soils. The material properties modeled in the seepage analyses are summarized in Table 8.

Table 8. Material Properties for SEEP/W Analysis

Soil Horizon	Saturated Hydraulic Conductivity k_v (cm/s)	Anisotropy Ratio k_h / k_v	Specific Gravity G_s	Void Ratio e	Volumetric Water Content		Basis
					Saturated (%)	Residual (%)	
Hydraulically Placed Ash	3.0E-5	50	2.31	0.85	46	0.04	Parsons E&C
Divider Dike - Compacted Bottom Ash	3.0E-5	25	2.31	0.85	46	0.04	Parsons E&C
Dike Fill Core	9.0E-7	4	2.65	0.66	39	0.01	TVA Memoranda
Dike Fill Shell	1.0E-6	4	2.65	0.68	40	0.01	Laboratory Data (STN-2A,8A) Slug Test Data TVA Memoranda
Native Lean and Fat Clay	6.0E-8	20	2.68	0.90	47	0.02	Laboratory Data (STN-1,2,7, & 9)
Native Sandy Silt and Silty Sand	1.0E-6	50	2.69	0.65	49	0.01	Slug Test Data, TVA Memorandum and NAVFAC

Note: Horizontal permeability of materials, k_h and ratio of k_v/k_h were used in the SEEP/W analysis.

Engineering judgment is very important in selecting appropriate hydraulic properties for soil materials. Hydraulic conductivity can vary over several orders of magnitude for various soil horizons, often with substantial anisotropy (seepage in horizontal versus vertical directions).

Laboratory test samples often do not represent important variations within a large soil deposit. For the eastern perimeter dike, an iterative process of parametric calibration was used to arrive at final estimates of the seepage properties. Results from trial seepage analyses were compared to field data (measured piezometric levels and the depth of groundwater in the borings). The material properties shown in Table 8 represent a solution matrix that closely matches the field data on all cross-sections. The results of the seepage analysis are discussed in Section 5.2.4.

Saturated vertical hydraulic conductivity values (k_v) were selected using available field data and laboratory test data, TVA memoranda, and published data. Typical values were selected for materials where laboratory test data were not available, as indicated in Table 8. The value of k_v selected for the alluvial sandy silt to silty sand foundation deposit is one example where engineering judgment was critical to the selection of appropriate material properties. Laboratory permeability tests were conducted on undisturbed Shelby tube samples of predominantly cohesive soils within this deposit; however, the global conductivity of this layer will be closer to that of the more predominant silty to sandy materials.

The ratio of horizontal hydraulic conductivity (k_h) to vertical hydraulic conductivity (k_v) was estimated based on Stantec's understanding of the placement/deposition of these materials. An isotropic material would have $k_h/k_v = 1$, while deposits of horizontally layered soils, such as alluvial deposits, might have values as high as $k_h/k_v = 100$. Relatively high ratios were assumed for the hydraulically placed ash ($k_h/k_v = 50$), compacted ash ($k_h/k_v = 25$) and native sandy silt ($k_h/k_v = 50$), reflective of periodic deposition of materials with different gradations. Such deposits typically exhibit much greater permeability in the horizontal direction than in the vertical direction. A relatively modest value ($k_h/k_v = 4$) was assumed for the dike fill materials, which was reportedly compacted in horizontal lifts.

The SEEP/W program is structured to consider seepage through both saturated and unsaturated soils. To represent the change in hydraulic conductivity due to de-saturation of each soil, SEEP/W implements a model based on two functions – a hydraulic conductivity function and a volumetric water content function. Three parameters are needed to define these two functions: the saturated hydraulic conductivity, saturated water content, and residual water content (water content of air dried soil). Of these three parameters, only the residual water contents were estimated for each soil. The estimated residual water content values in Table 8 are based on Rawls et al. (1982) and Stantec's experience with similar materials at other TVA sites.

5.2.3. Boundary Conditions

The seepage analyses performed assume steady-state seepage with static water levels upstream and downstream of the dike. The upstream boundary condition values used in these analyses are based on normal storage pool elevation and maximum storage pool elevation. The normal pool elevation was obtained from TVA Allen Fossil Plant personnel. The maximum storage pool elevation was established from the Deed and Bill of Sale documents for the property where it is stipulated that the ash fill in the pond shall not exceed elevation 233 feet above MSL.

The ash pond is a major contributor on the upstream side of the dike. The upstream profile was extended beyond the divider dike in order to account for the ash pond contribution. Since Stantec did not have any information about the total head at the pond subsurface, Stantec did not apply any boundary condition on the upstream vertical profile. However, the upstream profile was extended 900 feet from the dike crest to reduce the effect at the dike cross-section. Due to the large distance of the upstream profile, Stantec estimates the absence of a vertical boundary condition will have a negligible impact on seepage conditions at the dike. The results of the seep analysis shows the model matches closely with the field piezometer data, indicative of the validity of these assumptions.

On the downstream side, the normal water level in the drainage channel to the Horn Lake Cut-off is estimated to be at elevation 215 based on the Shelby County GIS map and visual observation. According to the Mississippi River gauge at the Ensley Engineer Yard (data provided by USACE), dating from August 24, 2008 to December 31, 2009, the water elevation in McKellar Lake fluctuated between 170.1 and 213.9 feet above MSL. A median value of elevation 185 feet was used as the normal lake elevation.

The “Potential Seepage Face” boundary condition applied on the downstream slope and toe assumes no flux will be added or removed at these nodes (flux = 0). At the end of first iteration, SEEP/W checks the nodes along the Potential Seepage Face for positive pressure indicative of water ponding which is not possible along the slope face. Physically, it means water wants to leave through these nodes but the boundary condition prohibits the model from doing so. In subsequent iterations, SEEP/W assigns total head at these nodes equal to elevation head. The boundary conditions modeled for steady-state seepage analysis are summarized in Table 9.

Table 9. Summary of Boundary Conditions Modeled in the Seepage Analyses

Upstream Boundary Condition	Value and Location	Downstream Boundary Condition	Value and Location
Stilling Pond Water Elevation for Normal Storage Pool Elevation	Total Head – 230 ft. Applied along the upslope at El. 230 ft. downwards, and along the surface of the hydraulic ash	Potential Seepage Face	Total Flux – 0 cfs. Applied along the down slope and toe where no seepage is expected
Ash Pond Water Elevation for Normal Storage Pool Elevation	Total Head – 230 ft. Applied along the upslope at El. 230 ft. downwards, along the surface of the hydraulic ash	Horn Lake Water Elevation	Total Head – 215 ft. Applied on the downstream boundary from El. 215 ft. downwards.
Stilling Pond and Ash Pond Water Elevation for Maximum Storage Pool Elevation	Total Head – 233 ft. Applied along the upslope at El. 233 ft. downwards, along the surface of the hydraulic ash	Lake McKellar Water Elevation	Total Head – 185 ft. Applied on the downstream boundary from El. 185 ft. downwards

5.2.4. Seepage Analysis Results

Steady-state seepage analysis was performed for three cross-sections of the dike. The material properties and boundary conditions were varied in these analysis until a reasonable match was obtained between the model and field data. Specifically, the saturated hydraulic conductivity of the sandy silt to silty sand was varied, as was the k_h/k_v ratio for all materials. After several iterations, the final soil parameters were within expected ranges, based on soil type and laboratory data, and calibrated to give model predictions consistent with field measurements.

Plots from the SEEP/W analyses of the three cross-sections are presented in Appendix F. These plots show the finite element mesh, material horizons, and boundary conditions used in each analysis. The results are shown in contour plots of total head, pore water pressure, and seepage gradients. The seepage gradients were assessed for maximum exit gradients and the potential for soil piping (Section 5.2.4.3). For the slope stability analyses (Section 5.3), the pore water pressures along the trial slip surfaces were determined by interpolation between the nodal pore pressures predicted with the SEEP/W model.

The piezometric surface (line of zero pore water pressure) is shown on the plots in Appendix F. In SEEP/W, the location of the piezometric surface is found by interpolation between positive pore water pressures in the saturated soil and negative pore pressures or suction in the unsaturated soil zone above. In the SEEP/W formulation, seepage flows are tracked in both the saturated and unsaturated zones. Hence, the top flow line in the SEEP/W results will be above the piezometric line. In more traditional seepage analyses, where unsaturated flows are ignored, the top flow line and the piezometric surface coincide. Hence, while the more complete unsaturated flow formulation in SEEP/W gives a reasonable prediction about the location and shape of the piezometric surface, the results are often different than would be obtained with a solution that considers only saturated flow. Furthermore, the pore water pressures in the stability analysis are determined from the full finite element solution, and not just from the depth below the piezometric surface.

5.2.4.1. Comparison with Field Data

Results from the SEEP/W model were compared to the piezometers readings installed in both the northern and eastern perimeter dikes. Data from 10 piezometers at five modeled cross-sections were used in this evaluation (three cross-sections on the eastern perimeter dike and two on the north perimeter dike). Nodes were placed in the modeled cross-section at the location and elevation of the installed piezometer. The total head predicted at the node was compared to the corresponding piezometer reading.

As previously discussed, eleven sets of piezometer data were collected in the past seven months. Figure 3 shows a comparison between the maximum and minimum piezometer readings over the past seven months and the SEEP/W predicted total head at these piezometer locations.

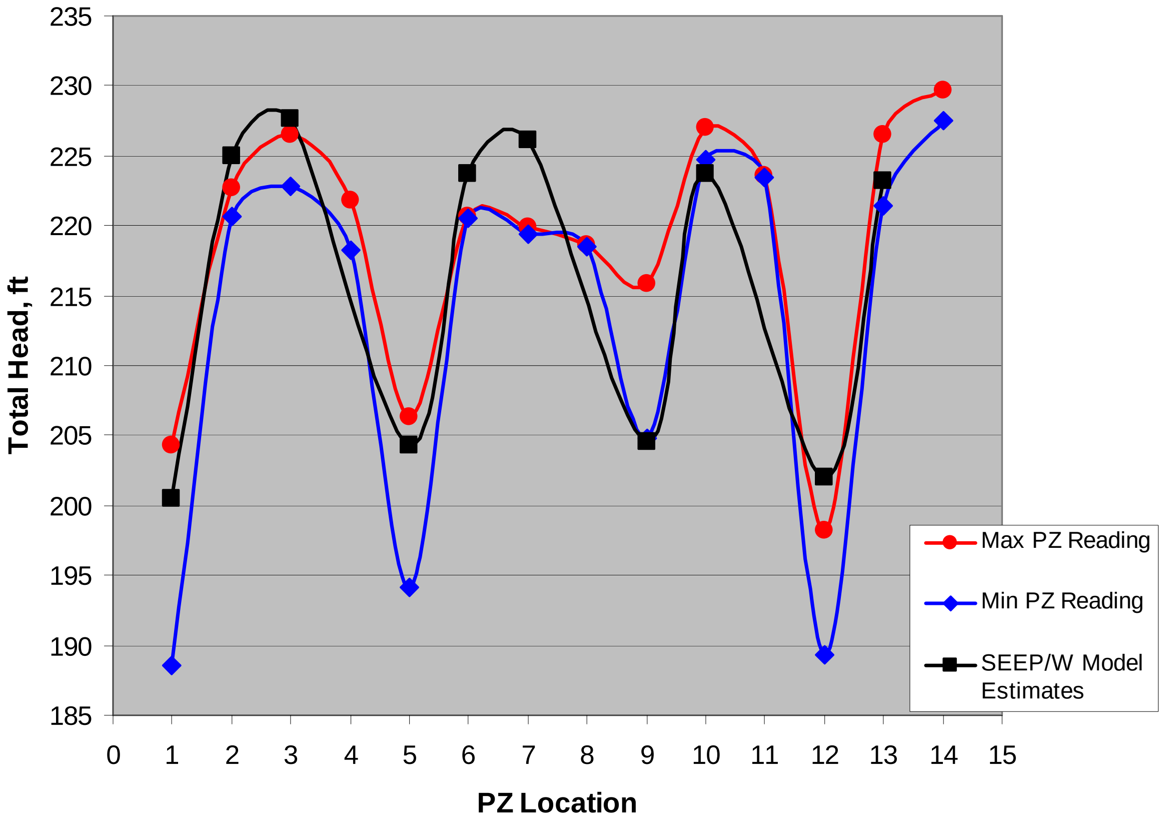


Figure 3. **Comparison between the field piezometer readings and total head predicted by the SEEP/W model**

The difference between field measurements of total head and the model predictions varies from 0.2 foot at PZ-9 to 12.8 feet at PZ-12. The degree of deviation between the model prediction and the actual piezometer reading is a factor of seasonal fluctuations of groundwater table and river levels, precipitation, material properties, sluice discharge volume, and the accuracy of the field data. The model assumed a steady-state condition upstream and downstream using the previously discussed boundary conditions and material properties. It should be noted that the relatively large fluctuation in McKellar Lake and the variability of material properties within the dike most likely accounts for much of the difference between the field measurements and model predictions.

The results from the seepage model were also compared with groundwater observed in the borings at the time of drilling operations. Figure 4 shows the comparison between SEEP/W predicted piezometric surface elevation and groundwater readings (at the time of drilling) at seven (7) boring locations at these cross-sections. It should be noted that the observed water levels are below the predicted piezometric surface. This may result from having insufficient time for the borehole water levels to reach equilibrium, as well as intercepting subsurface strata with varying piezometric levels.

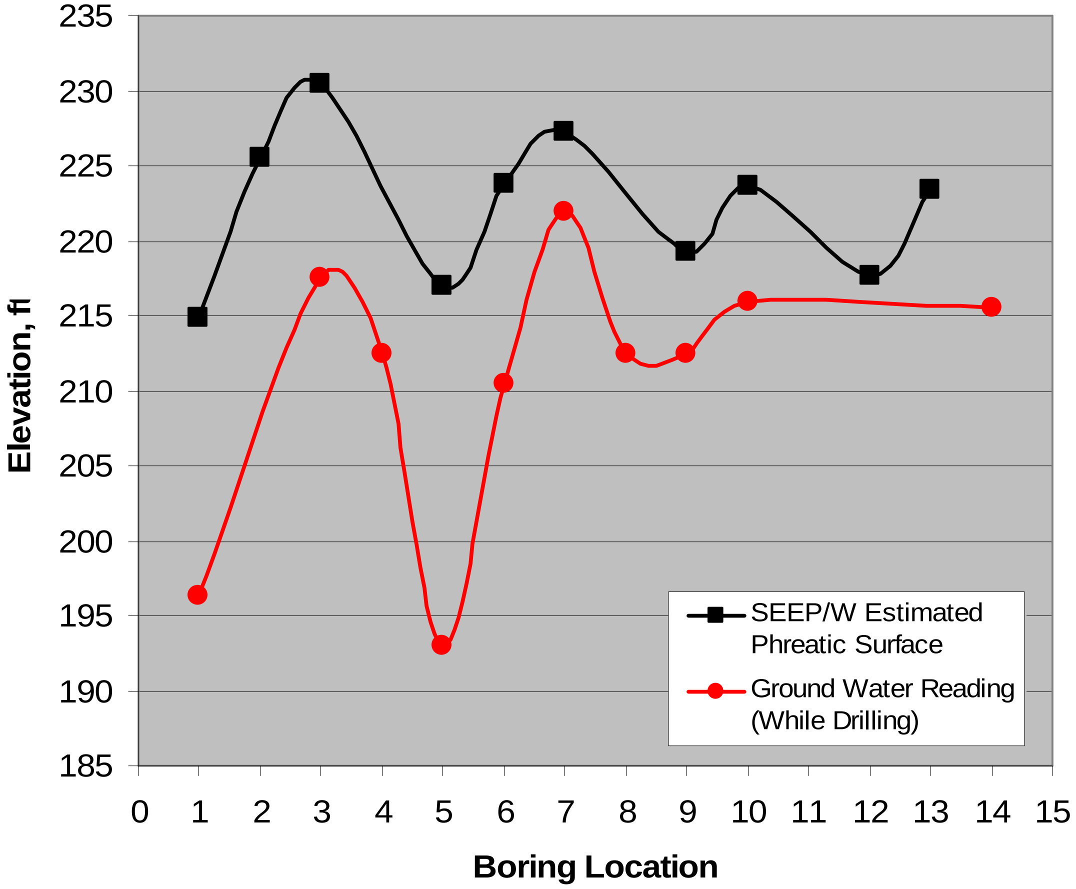


Figure 4. **Comparison between the borehole water levels and the phreatic surface predicted by the SEEP/W Model**

5.2.4.2. Critical Exit Gradients

Seepage forces, resulting from hydrodynamic drag on the soil particles, can destabilize earth structures. Vertical 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 at points where seepage exits onto the ground surface, can be evaluated to understand the potential severity of this problem. The factor of safety with respect to soil piping (FS_{piping}) is defined as:

$$FS_{piping} = \frac{i_{crit}}{i} \qquad \textbf{Eqn. 1}$$

Where:

i = the vertical gradient of a flow vector
i_{crit} = is the critical gradient, a material property of the soil

The critical gradient (i_{crit}) is related to the submerged unit weight of the soil and can be computed as:

$$i_{crit} = \frac{\gamma_{sub}}{\gamma_w} = \frac{G_s - 1}{1 + e} \qquad \textbf{Eqn. 2}$$

Where:

γ_{sub} = the submerged unit weight of the soil, γ_w is the unit weight of water,
G_s = the specific gravity of the soil particles
e = the void ratio.

For nearly all soils, the critical gradient is between about 0.6 and 1.4, with a typical value near 1.0.

Where FS_{piping} = 1, the effective stress is zero and the near-surface soils are subject to piping or heaving. Note that Eqn. 1 is valid only for vertical seepage that exits to the ground surface. If the phreatic surface is buried, then the FSpiping will be greater than 1.0 even when $i=i_{crit}$.

5.2.4.3. Seepage Gradients

Contour plots of the hydraulic gradients computed from the SEEP/W solutions are shown for each modeled cross-section in Appendix F. Large gradients and significant seepage can be seen at various locations within the cross-sections, but the concern is for areas where these gradients can initiate 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. Away from the ground surface, the potential movement of material due to seepage forces is arrested by the adjacent soil. Hence, the evaluation of seepage gradients within the dike is focused on areas near the ground surface on the downstream side of the dike.

In order to locate areas of maximum seepage pressure, contour plots of vertical gradient (i) were generated using a SEEP/W utility function. When turned on, this function can plot contours of maximum vertical gradient within a cross-section. Areas with higher vertical gradient will be shown in gradually darker colors (green to red) in SEEP/W generated models. Results of these models with vertical gradients are attached in Appendix F. All two cross-sections of the eastern perimeter dike exhibited maximum vertical gradient at the downstream slope toe where the piezometric surface is at/near the ground surface. Within a region of maximum vertical gradient, the element with highest vertical gradient, usually a surface element at the toe of the slope, was determined using another SEEP/W utility function. The vertical gradient is calculated from difference in total head (Δh) between two nodes of the element divided by the distance between these nodes (ℓ). The critical gradient (i_{crit}) is determined from the material properties using Equation 2. The factor of safety against piping is then calculated using Equation 1. The factors of safety against piping were computed based on the exit gradients from the SEEP/W model and critical gradients determined from the soil properties are summarized in Table 10.

Table 10. Summary of Computed Exit Gradients and 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}	Pool Elevation
C – C’	0.090	Downstream Slope Toe	Foundation Lean Clay	0.89	9.88	Normal Pool
	0.136	Downstream Slope Toe	Foundation Lean Clay	0.89	6.54	Maximum Storage Pool
D – D’	0.299	Downstream Slope Toe	Fill - Sandy Silt Shell	0.98	3.27	Normal Pool
	0.374	Downstream Slope Toe	Fill - Sandy Silt Shell	0.98	2.62	Maximum Storage Pool
E – E’	0.623	Downstream Slope Toe	Fill-Clay, Sandy Silt Shell	0.98	1.57	Normal Pool
	0.783	Downstream Slope Toe	Fill - Sandy Silt Shell	0.98	1.25	Maximum Storage Pool

The lowest computed factor of safety was found at cross-section E–E’ where water in the drainage channel to the Horn Lake Cutoff ponds near the toe of the slope. Historic annual inpection reports have noted red water seeps in this area. The United States Army Corps of Engineers (USACE) design criteria in EM 1110-2-1901 indicates factors of safety against piping should be at least 3.0. As per our understanding, TVA guidelines match this criterion. Hence, cross-section E–E’ does not meet the design criteria for piping.

5.3. Slope Stability Analyses

The stability of the eastern perimeter dike was evaluated using limit equilibrium methods as implemented in the SLOPE/W module. With SLOPE/W, the distribution of pore water pressures within the earth mass was mapped directly from the corresponding SEEP/W analysis. The unit weight and shear strength properties used in the stability analyses are discussed in Section 5.3.2 of this report.

5.3.1. Limit Equilibrium Methods in SLOPE/W

Limit equilibrium methods for slope stability analyses 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 split into vertical slices and stresses are evaluated along the sides and base of each slice. The factor of safety against a slope failure (FS_{slope}) is defined as:

$$FS_{slope} = \frac{\text{shear strength of soil}}{\text{shear stress required for equilibrium}} \qquad \textbf{Eqn. 3}$$

where the strengths and stresses are computed along a defined failure surface, on the base of the vertical slices. The shearing resistance at locations along the potential slip surface are computed, with appropriate strength parameters (cohesion and friction angle), as a function of the total or effective normal stress.

Spencer's solution procedure (1967), which both moment and force equilibrium, was used in this study. Spencer's procedure computes FS_{slope} for an assumed failure surface; a search must be made to find the critical slip surface corresponding to the lowest FS_{slope}. Both circular and noncircular potential failure surfaces can be evaluated. The optimization scheme available within SLOPE/W was used to consider noncircular, curved slip surfaces. The results of the slope stability analyses discussed in Section 5.3.3 and depicted graphically on the cross-sections in Appendix A, represent factors of safety computed from the optimized, circular slip surface routine.

5.3.2. Strength Parameter Selection

The eastern perimeter dike was constructed in the late 1970's and has exhibited its current cross-sectional geometry (slopes and crest elevation) for about 30 years. Hence, excess pore pressures generated in the underlying soil during construction have had sufficient time to dissipate and steady state seepage conditions have developed within the dike. Additionally, the current analyses will focus only on static conditions (no earthquake or other dynamic loads). For these conditions, only soil unit weights and drained strength parameters (c' and Φ') are needed. If stabilizing berms, flattened slopes, or other geometric modifications are constructed, then undrained, total stress stability analyses will need to be performed.

Drained shear strength (S_d) of the soil can be determined from effective stress strength parameters using the following equations:

$$S_d = c' + \sigma' \tan \phi' \qquad \textbf{Eqn. 4}$$

$$\sigma' = \sigma - u \qquad \textbf{Eqn. 5}$$

Where:

c' = the effective cohesion
ϕ' = the effective angle of internal friction
σ' = the effective stress
σ = the total stress and
u = the pore water pressure

Uncemented (granular) soils exhibit no strength at σ'=0, corresponding to c' = 0. In the case of unsaturated fine grained sands, suction results in apparent cohesion, but this component of strength is lost upon saturation. Over a large pressure range, most granular soils have a curved strength envelope. Fitting a straight line through segments of a curved failure envelope can result in c' > 0, but the values are applicable only over the specified range of effective stress.

For normally consolidated, saturated clays, the Mohr-Coulomb failure envelope exhibits c' = 0. At effective stresses below the pre-consolidation pressure, overconsolidated clays have a curved failure envelope that can be represented with a straight line having c' > 0. However, overconsolidated clays in the field are often fissured and the in situ c' is significantly smaller than values determined from testing of small samples in the laboratory. To avoid progressive failures in overconsolidated, stiff fissured clays, remolded soil samples are recommended for testing; this generally results in "fully softened" strengths with c’ = 0. Thus, in the absence of particle cementation/bonding, long term (drained) shearing resistance related to c’ > 0 is considered unreliable. In routine geotechnical design practice, values of c’ = 0 are usually assumed for both normally and overconsolidated saturated clays, and for uncemented granular soils. Detailed testing and characterization of a particular soil, coupled with careful application of the fitted strength envelopes, are necessary where values of c’ are used in a stability evaluation. For these analyses, c’ = 0 were used for all soils.

When surficial soils have c’ = 0, shallow sliding parallel to the ground surface will be the critical failure mechanism (lowest factor of safety) found in a slope stability analysis. However, apparent cohesion in unsaturated soils and/or weak cementation is often sufficient to prevent shallow sliding. This mode of failure, which might require periodic maintenance, is considered to be less critical in a stability analysis. For deep seated failures, the assumption of c’ = 0 is routinely used for all soils.

The soil parameters used for the dike and existing foundation materials were derived using both current and historical laboratory test data (consolidated undrained triaxial tests, direct shear tests, standard penetration test data, and classification test data) and Stantec’s experience with these materials in similar applications.

Strength parameters for hydraulic and compacted ash are based on test results from AECOM and Law Engineering, Inc., performed for the TVA Fossil Plant at Kingston, Tennessee. The parameters for the dike fill soils (sandy silt to silty sand) are based on lab testing performed as part of this study as well as TVA test results (consolidated-undrained triaxial test, consolidated-drained triaxial tests, and direct shear tests) performed on near surface on-site soils prior to the construction of the eastern perimeter dike. Our borings and classification test data on dike soils confirm materials types reported in the TVA memorandum.

Stantec performed five consolidated undrained triaxial tests on dike soils and the native clays (both lean and fat). The results are summarized in Table 5 of this report. To select the representative strengths for each horizon, the methodology outlined in the US Army Corps of Engineers Engineer Manual EM 1110-2-1902 was used as a guide. Failure stresses measured in the laboratory tests were expressed in terms of "p’-q" values, $[p' = 0.5(\sigma_1' + \sigma_3'), q = 0.5(\sigma_1' - \sigma_3')]$, then envelopes were conservatively fit through the data. In general, the selected strength parameters represent a failure envelope where about two-thirds of the test data falls above the envelope. Strength parameter selection charts using “p’-q” plots are included in Appendix G.

Sandy silt to silty sand was encountered at varying thicknesses within the foundation alluvium. These soils typically exhibited very soft to medium stiff consistency (N_{60} values in the range of 0 to 6 blows per foot) with high moisture contents. The strength and unit weight parameters for these soil horizons were determined from published correlations between SP test blow counts (N_{60}), relative density, and effective friction angle Φ’. However, as discussed in Section 4.1 of this report, much of the SP testing was performed utilizing an automatic hammer and were corrected prior to applying them in correlations with other soil index properties. The correction for hammer efficiency is a direct ratio of relative efficiencies as follows:

$$N_{60} = N_{80}\left(\frac{80}{60}\right) \qquad \textbf{Eqn. 6}$$

Stantec also corrected standardized N_{60} values resulting from SP testing within these materials for the effect of overburden pressure prior to using the data in conjunction with correlations for non-cohesive soil parameters. The N_{60} values were standardized to vertical effective overburden stresses of 2,000 pounds per-square foot. This calculation requires an effective unit weight for each soil horizon multiplied by the depth of the soil horizon. The relationship between the correction factor, C_N, and the effective overburden stress, σ', was based on a relationship proposed by Liao and Whitman as referenced in Seed and Harder [1990]:

$$C_N = \frac{1}{\sqrt{\sigma'}} \qquad \textbf{Eqn. 7}$$

Where:

C_N = correction factor for overburden stress
σ' = vertical effective overburden stress (tsf)

Consequently, the standardized corrected N-value, $(N')_{60}$ is equal to:

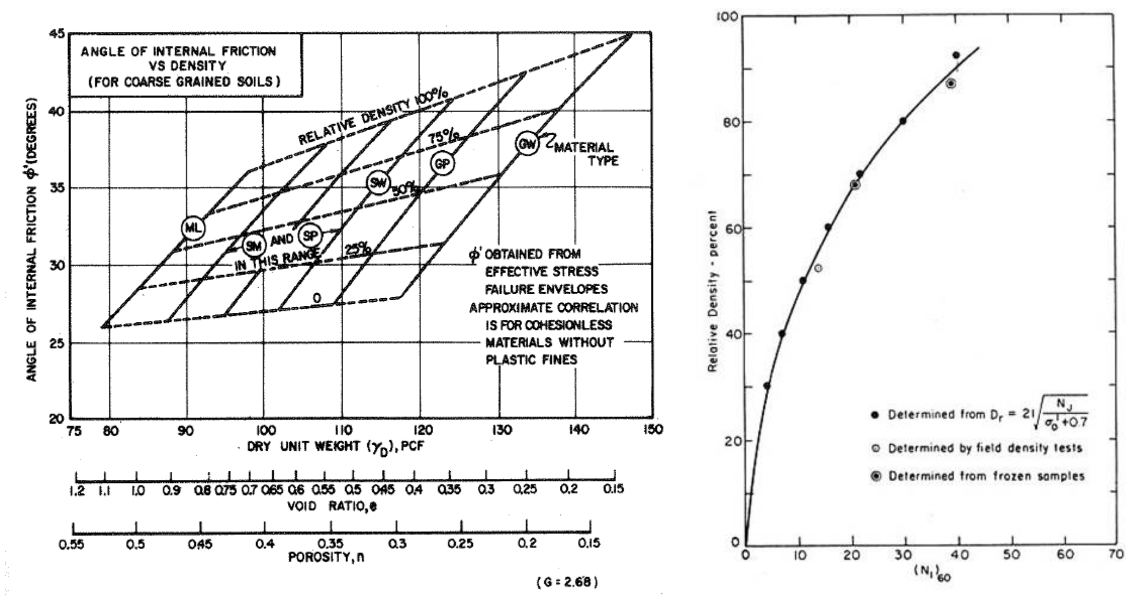
$$(N')_{60} = C_N N_{60} \qquad \textbf{Eqn. 8}$$

Where:

C_N = correction factor for overburden stress
$(N')_{60}$ = standardized N-value

The N-values presented on the graphical boring logs in Appendix A and typed boring logs in Appendix B are the raw data and do not reflect corrections for hammer efficiency or overburden stress.

The N'_{60} values were used to obtain relative densities based on relationships developed by Tokimatsu and Seed (1988) as shown in Figure 4 below. NAVFAC (1982) presents a relationship using relative density and specific soil types to correlate angle of internal friction, unit weight, and void ratio as shown in Figure 4 below. Soil classifications for the correlations are based on laboratory testing results and visual classifications performed by the on-site geotechnical engineer or geologist during the drilling process. Once the relationships for the angle of internal friction, unit weight, and void ratio were established, the in-situ unit weight was calculated based upon the natural moisture content.



From NAVFAC (1982) From Tokimatsu and Seed (1988)

Figure 5. Charts used to Correlate N_{60} to ϕ'

Typical N_{60} values for the sandy silt to silty sand horizon are in the range of weight of the sampling rods to 18 blows per foot (bpf). As such, the unit weight of this soil horizon was estimated to vary between 105 to 120 pcf with a drained friction angle of 27° to 31°. Representative values of a unit weight of 115 pcf and an effective friction angle value of 28° were selected for these strata.

The soil parameters for the dike and generalized foundation soil horizons modeled in the slope stability analyses are summarized in Table 11 and shown on the cross-sections in Appendix A.

Table 11. Selected Strength parameters for Stability Analysis

Soil Horizon	Saturated Unit Weight (pcf)	Effective Stress Strength Parameters	
		C' (psf)	ϕ' (degrees)
Dike Fill – Core	125	0	31
Dike Fill – Shell	124	0	31
Hydraulically Placed Ash	105	0	25
Divider Dike – Compacted Ash	110	0	30
Alluvial Clay	115	0	26
Sandy Silt to Silty Sand Alluvium	115	0	28

5.3.3. Slope Stability Results

Using the strength parameters listed in Table 11, in conjunction with the results of the seepage analyses, the existing dike slopes were analyzed at the three referenced cross-sections of the eastern perimeter dike. The slope stability analyses were performed using SLOPE/W 2007 to evaluate the upstream and downstream faces of the dike as applicable.

The failure surfaces were generated using the “Grid and Radius” method where a wide variation of trial slip surfaces can be generated with a defined grid of possible circle centers and a defined range of radii.

Where the surface of the slope is composed of cohesionless (c’ = 0) materials, an infinite slope failure (shallow sliding parallel to the surface) will be critical. While solutions were obtained for this case, as reported below, there is less concern for this potential failure mechanism. Suction pressures in unsaturated surface soils will often create enough apparent cohesion to prevent this type of failure. If shallow sliding does occur, the resulting deformations are unlikely to threaten the integrity of the dike and can be repaired. To force the search routine to evaluate deeper failure mechanisms, the surfaces were generated using a minimum depth of 10 feet for the slip surface.

The cross-sections in Appendix A depict the modeled shear-strength parameters, predicted failure surfaces, and associated factors of safety. The results of the analyses are included in Appendix F and summarized in Table 12 below.

Table 12. Summary of Computed Factors of Safety for Slope Stability

Cross-Section	Exterior Slope Global Failure	Exterior Slope Maintenance Failure	Interior Slope Failure	Pool Elevation
C – C’	1.84	1.98	2.02	Normal Pool
	1.70	1.83	2.17	Max. Storage Pool
D – D’	1.35	1.33	1.67	Normal Pool
	1.24	1.15	1.76	Max. Storage Pool
E – E’	1.44	1.20	1.51	Normal Pool
	1.29	1.03	1.62	Max. Storage Pool

The term global failure is used in the table above to refer to deep seated failures that would threaten partial or total loss of the stilling pond pool. The term maintenance failures refer to relatively shallow slides that while not detrimental to the overall stability of the dike, could progress into failures that could threaten the pool if not repaired. The inferior slope failures are generally maintenance type failures.

The Tennessee Department of Environment and Conservation (TDEC) "Rules and Regulations Applied to the Safe Dams Act of 1973" provides guidance and standards with regards to existing dams. The standards do not specifically address target factors of safety for slope stability, instead merely indicate that the dam shall be "stable". Based on discussions with TVA and to be in accordance with current prevailing practices, a minimum 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 our stability analyses show that the downstream slope does not meet the established criteria for a long term factor of safety of 1.5 for a deep seated failure. The lowest factor of safety was calculated at the downstream slope (east) where water ponds in the drainage channel to the Horn Lake Cutoff near the toe of the slope. It should be noted that the slope at these locations also does not meet the established factor of safety standard against piping as discussed in the Section 5.2.4.3. Remedial measures will be required to improve the factors of safety for both piping and stability.

6. Conclusions

The conclusions and recommendations that follow are based upon Stantec's understanding of the facility as outlined herein. This understanding of the facility was developed from reviews of historical information provided by TVA, discussions with TVA personnel throughout the course of this work, and results of the geotechnical exploration and engineering analyses.

The results of the seepage analyses were examined to identify conditions where piping (erosion) might develop on the downstream slope of the dike due to seepage forces. The results indicate factors of safety against piping for a normal pool elevation of 230 feet range from 1.57 to 9.88 (see Table 10). The lowest computed factor of safety was found at cross-section E–E' where the toe of the slope is at/near water ponding in the drainage channel to the Horn Lake Cutoff. Corresponding factors of safety against piping for a maximum storage pool elevation of 233 feet vary from 1.26 to 6.36 with low factors of safety at both cross-sections D–D' and E–E'. The analyses indicate cross-sections D–D' and E–E' do not meet the USACE (EM 1110-2-1901) design criteria that stipulate the minimum factor of safety against piping should be 3.0 or greater.

The seepage model also indicates the piezometric surface is at/near the toe of the exterior slope at cross-section E–E' under steady state seepage conditions at the normal pool elevation. Similar conditions exist at cross-sections D–D' and E–E' for the maximum storage elevation. These results indicate a high potential for seepage above the toe of the exterior slope for operating pool levels in the stilling pond. Additionally, the annual inspection report for 1997 indicated the presence of red water seeps in this area, supporting the results of the analyses. However, subsequent inspections indicated the toe of the slope was submerged and could not be observed for seeps.

The results of slope stability analyses for the exterior dike slope at the normal pool and maximum storage pool elevations indicate the factors of safety for relatively deep seated failures vary from 1.35 to 1.84 and 1.29 to 1.70, respectively (see Table 12). Corresponding factors of safety for shallow, maintenance type failures vary from 1.20 to 1.98. Again, the lowest factors of safety were calculated at for cross-section E–E' where water ponds at the toe of the slope in the drainage channel to Horn Lake Cutoff. The factors of safety for long-term stability at this cross-section do not meet the recommended value 1.50. It should be noted that drawing 10N226 indicates the dike was built for an "End of Construction" factor of safety of 1.42.

Based on current design criteria, the seepage and slope stability analyses indicate portions of the eastern perimeter dike do not meet the required factors of safety for piping or stability under long-term steady state seepage conditions at normal operating conditions for the East Stilling Pond. As such, remedial measures are needed to increase the factors of safety against both piping and deep seated slope failures.

The root cause analysis of the December 22, 2008 dredge cell pond failure at TVA's Kingston Fossil Plant identified the four following destabilizing factors contributing to the breach of the containment dike and subsequent failure. Stantec's scope of work included a review the historic documentation, results of the drilling and laboratory testing program, and current dike configuration with respect to these contributing factors to asses the potential for these conditions to exist at the eastern perimeter dike.

- Weak Silt/Ash Foundation – Prior to construction of the eastern perimeter dike, the plant discharged ash into the east disposal area via a discharge point in the northwest corner. The disposal area was bounded by higher ground on the east and water was drained from the area via an open channel entering the Horn Lake Cutoff through pipes beneath the roadway embankment. The alignment of the eastern perimeter dike was constructed on the high ground that bounded the area to the east and the discharge channel to the Horn Lake Cutoff crossed beneath what is now the southern terminus of the eastern perimeter dike. However, the slack-water environment present at the Kingston plant that allowed the very fine ash particles to settle out of suspension beneath the perimeter dike was not present at this site. Additionally, the subsurface exploration and laboratory testing program did not indicate the presence of such materials at the dike/native material interface.

- Hydraulically Placed, Loose, Wet Ash – Based on information from the geotechnical exploration performed for design of the eastern perimeter dike (TVA memoranda prepared by G.L. Buchanan and Gene Farmer), about 8 to 12 feet of hydraulically placed ash was encountered in the borings drilled between stations 22+00 and 44+00 prior to dike construction. The drawing referenced in the memorandum (604K582) was not available for review as part of the current study. The G.L. Buchanan memorandum instructed undercutting the fill in its entirety beneath a 10-foot wide core of the dike. However, documentation regarding hydraulic ash removal could not be verified and no instruction was found about undercutting the hydraulic fill beneath the rest of the dike foundation area. Ash was not encountered beneath the dike in any of the borings drilled as part of this exploration.

- Increased Loads Due to Embankment/Fill Height – This factor is not applicable for the eastern perimeter dike because the contained facility is a stilling pond and does not include the stacking of fill material.

- Embankment Geometry Setback – This factor is not applicable because the eastern perimeter dike is a single tier.

Although Stantec's review of historic documentation indicates the potential for a weak silt/ash foundation and possibility of hydraulically placed ash beneath the perimeter dikes, these conditions were not observed during the geotechnical exploration. Additionally, the geometric factors (fill height and embankment setback) are not applicable for the eastern perimeter dike.

7. Recommendations

TVA is planning to convert the Allen plant systems to dry handling of fly ash, which will significantly reduce the fly ash combustion storage role for the ash pond and stilling basin. Stantec anticipates the ash pond and stilling basin configuration will be modified in association with the conversion and reduced storage needs. The assessment of the eastern perimeter dike and associated recommendations are based on this understanding of the plant setting.

The current configuration of the pond dikes does not exhibit acceptable factors of safety for piping or long-term stability. While this does not imply that the dike is in immediate danger of failure, TVA should undertake specific efforts to improve the safety of this facility. The following specific actions are recommended:

7.1. To improve long-term stability of the eastern perimeter dike, TVA should initiate a mitigation design and construction program as soon as possible. Considering the seepage and slope stability analysis results, the remedial measures should address both piping and slope stability. Possible measures could include construction of an earth or rock berm or flattening of the slope. Selection of the option for reducing the risks for piping and slope failure will depend on the availability of materials, land, cost of construction, and maybe most importantly, environmental considerations.

7.2. Based on a review of design plans for the development of the East Stilling Pond and enclosure of the ash pond, the area currently ponding water near the toe of the exterior slope correlates with a low spot within an enclosed drainage basin prior to construction. As such, discharge water from the stilling pond, surface drainage, and possibly seepage from the stilling pond likely contribute to the water ponding adjacent to the toe of the dike. This area is marshy, appears to stay wet most if not all of the year, and might be classified as a wetland. TVA should initiate an environmental survey of the area to establish if the area is a wetland in order to facilitate future permitting and design efforts.

7.3. The berm/flattened slope should also be designed to provide protection against seepage and piping failures, and increase the factor of safety against piping to meet the design guideline value of 3.0. The gradation of the berm should be selected to filter suspended particles and reduce the potential for the migration of fine-grained materials (i.e., silt and clay).

7.4. Consistent with USACE design criteria, the dimensions/configuration of the berm or flattened slope should be selected to obtain factors of safety greater than 1.5 for sliding under long-term, drained conditions. For the period immediately after such construction, undrained stability analyses will be needed to demonstrate a factor of safety of at least 1.3 for short-term conditions.

7.5. The existing scarps on the interior slope of the eastern perimeter dike should be repaired and the slope armored with riprap to protect against future erosion and surface sloughs initiated by wave action and surface drainage.

7.6. Between now and the completion of the mitigation program, TVA should implement planning measures and a monitoring program to reduce the risk of failure in the eastern perimeter dike. This should include development of an emergency action plan, weekly inspections, continuation of the monthly piezometer readings, and installation of additional piezometers in critical areas along the dike to monitor piezometric conditions in the dike and foundation soils. This instrumentation monitoring program should be continued until permanent improvements to the dike have been completed.

7.7. Lowering the water levels in the ash pond and stilling basin would lessen the potential for failure due to seepage and piping through the dike, and would also improve slope stability. Operating the ponds at lower water levels should be considered as an option in the overall mitigation plan for the eastern perimeter dike.

8. Limitations of Study

The scope of this evaluation was limited to consider only the potential risks to the eastern perimeter dike from excessive seepage and slope instability. This assessment did not consider potential failure modes related to spillway capacity and overtopping, seepage along penetrations through the embankment (including the buried spillway pipes), vegetation on the dike face, performance of the internal divider dike, or other possible mechanisms.

The stability of the dike during a potential earthquake was not analyzed. It should be noted, the seismic risk at this site (likelihood of experiencing a large magnitude earthquake) is relatively high because of its proximity to the New Madrid Seismic Zone.

Stability analyses were not performed for rapid drawdown conditions:

- On the upstream side, a rapid drawdown condition would correspond to a failure of the ash pond, perhaps due to a breach in the dike or failure of the spillway. While the upstream dike slope may be vulnerable to sliding due to rapid drawdown, this mechanism would result from, and not cause, a pond failure. However, any plan for lowering the pool in the ash pond and stilling basin should include an evaluation of rapid drawdown conditions on the stability of the upstream slopes of the dike.

- On the downstream side, the USACE flood control levee protects the eastern perimeter dike from flood events associated with the Mississippi River and McKellar Lake. Therefore, rapid drawdown analyses were not performed as part of this study.

9. Closure

9.1. 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.

9.2. 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.

9.3. It should be noted that construction records indicating the methods used to construct the eastern perimeter dike, as-built dike configurations, etc. were not available for review. As a result, consideration should be given to some of the generalizations made in this report with regards to dike construction and geometry prior to using this data in future evaluations.

10. References

The following is a list of documents referenced in this report and/or used to evaluate the stability of the eastern perimeter dike:

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

Geotechnical Investigations, Department of the Army, US Army Corps of Engineers, Engineering Manual EM 1110-1-1804, January 1, 2001.

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Liao, S.C. and Whitman, R.V. Overburden Correction Factors for SPT in Sand, JGED, ASCE, Vol. 112, No. 3, pp. 373-377, 1985 as referenced in Seed and Harder, "SPT Based Analysis of Cyclic Pore Pressure Generation and Undrained Residual Strength", Volume 2 Memorial Symposium Proceedings, pp. 361-362, May 1990.

A Method of Analysis of Embankments assuming Parallel Interslice Forces, Geotechnique, Vol 17 (1), pp. 11-26, Spencer, E., 1967.

Seepage Analysis Summary Report: Dredge Cell III – Calibration, Seepage Failure, Future Dredge Cell to 900 Foot Elevation and Seepage and Slope Stability Analysis for 842 Permit Elevation, TVA Report prepared for the Kingston Fossil Plant by Greg McNulty, Ph.D., PE, PG, Parsons E & C, May 2005.

Root Cause Anaylsis of TVA Kingston Dredge Cell Pond Failure from December 22, 2008, AECOM, June 12, 2009.

Appendix A

Boring Layout & Dike Cross-Sections

Appendix B

Typed Boring Logs

SUBSURFACE LOG

Project No. 172679032

Project Name Allen Fossil Plant (TVA)

Location Memphis, Tennessee

Project Type Geotechnical Exploration

Supervisor Patrick Kiser Driller J. Wethington

Logged By Craig Millhollin

Location N 274009.16, E 763820.47 (NAD27)

Boring No. **STN-9** Total Depth 40.0 ft

Surface Elevation 221.2 ft. (NGVD29)

Date Started 7/15/09 Completed 7/16/09

Depth to Water 8.5 ft Date/Time 7/15/09

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
221.2'	0.0'	Top of Hole							
		FILL - SANDY SILT, brown, moist, very stiff		SPT-1	0.0 - 1.5	1.0	6-8-9	13	Boring advanced using 3 1/4" Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.3	9-10-10	16	
				SPT-3	3.0 - 4.5	1.3	17-18-21	15	
216.7'	4.5'								
		SANDY SILT, brown to gray, moist to very moist, very soft to stiff		SPT-4	4.5 - 6.0	1.5	8-5-4	26	
				SPT-5	6.0 - 7.5	1.5	3-3-3	30	
				SPT-6	7.5 - 9.0	1.5	2-1-1	30	Wet at 8.5'
				SPT-7	9.0 - 10.5	1.3	1-1-1	27	LL-23, PI-2 71% passing #200
				SPT-8	10.5 - 12.0	0.8	WOR-WOR-WOR	31	
				SPT-9	12.0 - 13.5	1.5	3-4-5	32	
207.2'	14.0'								
		LEAN CLAY, brown, moist to very moist, very soft to medium stiff, with silt		SPT-10	13.5 - 15.0	1.3	2-1-1	37	
				ST-1	15.0 - 17.0	2.0		30	LL-31, PI-11 92% passing #200
				SPT-11	17.0 - 18.5	1.5	2-2-2	33	
202.2'	19.0'								
		FAT CLAY, gray, moist to very moist, medium stiff, some silt, with sand and gravel @ 36'		SPT-12	18.5 - 20.0	1.5	2-3-4	34	
				SPT-13	20.0 - 21.5	1.5	2-2-3	38	
				ST-2	21.5 - 23.5	0.8		36	
				SPT-14	23.5 - 25.0	1.0	3-2-3	45	
				SPT-15	25.0 - 26.5	1.0	3-2-3	46	LL-58, PI-38 96% passing #200
				SPT-16	26.5 - 28.0	0.9	3-4-5	46	
				ST-3	28.0 - 30.0	2.0		46	
				SPT-17	30.0 - 31.5	1.5	3-3-3	52	Wood fragments at 31'
				SPT-18	31.5 - 33.0	1.5	3-3-3	49	
				SPT-19	33.0 - 34.5	1.5	3-2-2	--	

SUBSURFACE LOG

Project No. 172679032
Location N 274009.16, E 763820.47 (NAD27)
Project Name Allen Fossil Plant (TVA)
Boring No. **STN-9** Total Depth 40.0 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
183.2'	38.0'	FAT CLAY, gray, moist to very moist, medium stiff, some silt, with sand and gravel @ 36' *(Continued)*		SPT-20	34.5 - 36.0	0.9	2-2-3	56	
				ST-4	36.0 - 38.0	2.0		63	LL-73, PI-47 38% passing #200
181.2'	40.0'	SILTY CLAY, gray, very moist, medium stiff		ST-5	38.0 - 40.0	2.0		30	LL-29, PI-6 97% passing #200

No Refusal /
Bottom of Hole

Piezometer installed upon completion of drilling. See piezometer installation record for specific details.

Stantec

SUBSURFACE LOG

Project No. 172679032
Location N 274018.24, E 763758.37 (NAD27)
Project Name Allen Fossil Plant (TVA)
Boring No. **STN-10** Total Depth 60.0 ft
Location Memphis, Tennessee
Surface Elevation 236.9 ft. (NGVD29)
Project Type Geotechnical Exploration
Date Started 7/17/09 Completed 7/17/09
Supervisor Patrick Kiser Driller G. Thompson
Depth to Water 21.0 ft Date/Time 7/17/09
Logged By Briggs Evans
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
236.9'	0.0'	Top of Hole							
		FILL - SAND, brown to gray, moist, medium dense, fine grained, some clay		SPT-1	0.0 - 1.5	1.3	5-6-9	14	Boring advanced using 3 1/4" Hollow Stem Augers Wood fragments at 2.0' Thin clay lenses from 3.3' to 5'
233.9'	3.0'			SPT-2	1.5 - 3.0	1.4	6-12-12	13	
		FILL - SANDY SILT, grayish brown, moist, very stiff		SPT-3	3.0 - 4.5	1.5	7-7-8	17	
				SPT-4	4.5 - 6.0	1.5	5-7-9	14	
				SPT-5	6.0 - 7.5	1.5	6-10-15	15	
				SPT-6	7.5 - 9.0	1.5	5-8-11	13	
				SPT-7	9.0 - 10.5	1.5	4-6-10	14	LL-22, PI-4 58% passing #200
				SPT-8	10.5 - 12.0	1.5	4-12-14	21	
223.4'	13.5'			SPT-9	12.0 - 13.5	1.5	13-21-19	14	
		FILL - SILTY SAND, gray to tan brown, moist to very moist, medium dense to loose, fine grained		SPT-10	13.5 - 15.0	1.5	4-6-8	17	
				SPT-11	15.0 - 16.5	1.0	2-5-8	22	Pea gravel at 15.5'
				SPT-12	16.5 - 18.0	1.5	8-7-13	15	
				SPT-13	18.0 - 19.5	1.5	3-11-20	15	48% passing #200
				SPT-14	19.5 - 21.0	1.5	5-12-13	18	
213.9'	23.0'			SPT-15	21.0 - 22.5	1.5	5-11-11	17	
		SANDY SILT, grayish brown, very moist to saturated, very soft to medium stiff		SPT-16	22.5 - 24.0	0.0	WOR-2-2	--	
				SPT-17	24.0 - 25.5	1.5	WOR-WOR-1	33	Saturated at 25' LL-25, PI-3 78% passing #200
				SPT-18	25.5 - 27.0	1.5	WOR-WOR-WOR	35	
				SPT-19	27.0 - 28.5	1.5	WOH-WOH-WOH	35	
				SPT-20	28.5 - 30.0	1.5	WOR-WOR-WOR	34	
				SPT-21	30.0 - 31.5	1.3	1-3-3	30	
				SPT-22	31.5 - 33.0	1.5	5-5-6	37	
				SPT-23	33.0 - 34.5	1.5	WOH-1-1	42	

SUBSURFACE LOG

Project No.	172679032	Location	N 274018.24, E 763758.37 (NAD27)
Project Name	Allen Fossil Plant (TVA)	Boring No.	**STN-10**
		Total Depth	60.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
				SPT-24	34.5 - 36.0	1.5	WOH-WOH-WOH	33	LL-32, PI-9 95% passing #200
199.4'	37.5'			SPT-25	36.0 - 37.5	1.5	WOH-WOH-2	35	
		FAT CLAY, tan to gray, moist, very soft to medium stiff, some fine grained sand		SPT-26	37.5 - 39.0	1.3	WOH-2-3	37	
				SPT-27	39.0 - 40.5	1.5	WOH-2-2	35	
				SPT-28	40.5 - 42.0	1.5	2-2-3	40	
				SPT-29	42.0 - 43.5	1.5	2-3-3	43	
				SPT-30	43.5 - 45.0	1.5	WOR-2-2	47	LL-72, PI-51 82% passing #200
				SPT-31	45.0 - 46.5	1.5	WOR-1-1	46	
				SPT-32	46.5 - 48.0	1.5	3-4-3	41	
				SPT-33	48.0 - 49.5	1.5	WOR-WOH-1	43	
				SPT-34	49.5 - 51.0	1.5	WOH-1-2	50	
		with seams of sandy silt below 51'		SPT-35	51.0 - 52.5	1.5	3-4-3	38	LL-26, PI-2 80% passing #200
				SPT-36	52.5 - 54.0	1.5	WOH-2-1	33	
				SPT-37	54.0 - 55.5	1.0	WOH-WOH-1	40	
				SPT-38	55.5 - 57.0	1.0	WOR-2-1	37	
				SPT-39	57.0 - 58.5	1.5	WOH-2-1	41	
176.9'	60.0'			SPT-40	58.5 - 60.0	1.5	WOH-2-4	40	

No Refusal /
Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

Boring backfilled with bentonite grout.

Piezometer installed in offset boring. See piezometer installation record for specific details.

SUBSURFACE LOG

Project No. 172679032
Project Name Allen Fossil Plant (TVA)
Location Memphis, Tennessee
Project Type Geotechnical Exploration
Supervisor Patrick Kiser Driller G. Thompson
Logged By Briggs Evans
Location N 273523.29, E 763688.16 (NAD27)
Boring No. **STN-11** Total Depth 60.0 ft
Surface Elevation 237.8 ft. (NGVD29)
Date Started 7/18/09 Completed 7/18/09
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
237.8'	0.0'	Top of Hole							
		FILL - SILTY SAND, tan, moist, medium dense, fine grained		SPT-1	0.0 - 1.5	1.0	2-4-6	14	Boring advanced using 3 1/4" Hollow Stem Augers
234.8'	3.0'			SPT-2	1.5 - 3.0	1.3	8-8-9	13	
		FILL - SILTY SAND, gray, moist, medium dense to dense, fine grained		SPT-3	3.0 - 4.5	1.5	4-6-10	18	
				SPT-4	4.5 - 6.0	1.5	5-11-12	12	
				SPT-5	6.0 - 7.5	1.5	14-25-23	10	
				SPT-6	7.5 - 9.0	1.5	4-13-18	11	
				SPT-7	9.0 - 10.5	1.5	8-10-12	11	LL-20, PI-4 42% passing #200
				SPT-8	10.5 - 12.0	1.5	7-13-18	11	
				SPT-9	12.0 - 13.5	1.5	5-13-12	11	
				SPT-10	13.5 - 15.0	1.5	3-9-9	12	
				SPT-11	15.0 - 16.5	1.5	5-12-17	13	
				SPT-12	16.5 - 18.0	1.5	17-21-20	14	
				SPT-13	18.0 - 19.5	1.5	7-11-10	15	
				SPT-14	19.5 - 21.0	1.5	8-10-14	14	
				SPT-15	21.0 - 22.5	1.5	13-15-16	11	40% passing #200
				SPT-16	22.5 - 24.0	1.5	6-6-9	14	
				SPT-17	24.0 - 25.5	1.5	6-10-11	13	
				SPT-18	25.5 - 27.0	1.5	6-12-11	14	
208.8'	29.0'			SPT-19	27.0 - 28.5	1.5	11-12-11	22	Saturated at 27'
		SILTY CLAY, dark gray, moist, soft to medium stiff, trace fine grained sand		SPT-20	28.5 - 30.0	1.5	WOH-2-2	29	
				SPT-21	30.0 - 31.5	1.3	1-5-6	24	LL-29, PI-7 89% passing #200
204.8'	33.0'			SPT-22	31.5 - 33.0	1.5	3-3-5	31	
				SPT-23	33.0 - 34.5	1.5	WOR-2-2	33	

SUBSURFACE LOG

Project No. 172679032
Location N 273523.29, E 763688.16 (NAD27)
Project Name Allen Fossil Plant (TVA)
Boring No. **STN-11** Total Depth 60.0 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, gray to tan brown, moist to very moist, soft to stiff, some fine grined sand *(Continued)*		SPT-24	34.5 - 36.0	1.5	WOH-3-3	36	
				SPT-25	36.0 - 37.5	1.5	3-5-7	35	
				SPT-26	37.5 - 39.0	1.3	1-2-3	36	LL-70, PI-46 88% passing #200
				SPT-27	39.0 - 40.5	1.5	1-1-3	43	
				SPT-28	40.5 - 42.0	1.5	WOR-1-2	40	
				SPT-29	42.0 - 43.5	1.5	3-4-4	43	
				SPT-30	43.5 - 45.0	1.5	WOR-2-2	45	
				SPT-31	45.0 - 46.5	1.5	1-2-4	40	
				SPT-32	46.5 - 48.0	1.5	3-5-6	38	
				SPT-33	48.0 - 49.5	1.0	WOR-WOH-1	37	
				SPT-34	49.5 - 51.0	1.5	WOR-2-3	46	
				SPT-35	51.0 - 52.5	1.5	3-4-4	38	
183.3'	54.5'			SPT-36	52.5 - 54.0	1.5	WOH-2-1	36	
		SILTY CLAY, dark gray, saturated, soft to stiff, trace fine grained sand		SPT-37	54.0 - 55.5	1.5	WOR-2-2	38	
				SPT-38	55.5 - 57.0	1.5	2-1-3	34	Clay layer from 56.4' to 56.8' LL-30, PI-8
				SPT-39	57.0 - 58.5	1.0	WOH-3-6	46	89% passing #200 Clay layer from 57.2' to 57.7'
177.8'	60.0'			SPT-40	58.5 - 60.0	1.5	WOH-2-4	36	

No Refusal /
Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

Boring backfilled with bentonite grout.

Piezometer installed in offset boring. See piezometer installation record for specific details.

SUBSURFACE LOG

Project No. 172679032
Location N 273018.83, E 763676.83 (NAD27)
Project Name Allen Fossil Plant (TVA)
Boring No. **STN-12** Total Depth 40.5 ft
Location Memphis, Tennessee
Surface Elevation 216.7 ft. (NGVD29)
Project Type Geotechnical Exploration
Date Started 7/18/09 Completed 7/19/09
Supervisor Patrick Kiser Driller G. Thompson
Depth to Water N/A Date/Time N/A
Logged By Briggs Evans
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
216.7'	0.0'	Top of Hole							
		FILL - SANDY SILT, grayish brown, moist, stiff to very stiff		SPT-1	0.0 - 1.5	1.5	3-5-6	25	Boring advanced using 3 1/4" Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.3	7-8-9	11	
				SPT-3	3.0 - 4.5	1.5	7-11-11	14	65% passing #200
				SPT-4	4.5 - 6.0	1.0	7-8-7	19	
209.2'	7.5'			SPT-5	6.0 - 7.5	1.0	6-4-6	19	
		SANDY SILT, gray, moist to saturated, soft to stiff		SPT-6	7.5 - 9.0	1.0	3-2-3	32	
				SPT-7	9.0 - 10.5	1.0	1-2-2	33	53% passing #200
				SPT-8	10.5 - 12.0	1.0	1-2-2	37	Wet at 12.2'
				SPT-9	12.0 - 13.5	1.0	2-5-3	34	
201.7'	15.0'			SPT-10	13.5 - 15.0	1.2	1-2-1	33	
		FAT CLAY, gray, moist to saturated, soft to medium stiff		SPT-11	15.0 - 16.5	1.5	1-2-2	35	
				SPT-12	16.5 - 18.0	1.5	2-3-3	41	
				SPT-13	18.0 - 19.5	1.5	WOH-1-2	46	
				SPT-14	19.5 - 21.0	1.5	2-2-2	43	
				SPT-15	21.0 - 22.5	1.5	1-2-2	41	
192.7'	24.0'			SPT-16	22.5 - 24.0	1.5	WOH-2-2	41	
		SANDY SILT, gray, moist to saturated, soft to stiff		SPT-17	24.0 - 25.5	1.5	1-1-2	33	
				SPT-18	25.5 - 27.0	1.5	WOH-1-2	30	LL-27, PI-4 84% passing #200
188.7'	28.0'			SPT-19	27.0 - 28.5	1.2	1-1-2	38	
		FAT CLAY, gray, wet, soft, trace fine grained sand, trace silt		SPT-20	28.5 - 30.0	1.5	WOH-1-1	49	
				SPT-21	30.0 - 31.5	1.3	WOH-2-2	45	
				SPT-22	31.5 - 33.0	1.5	2-2-2	42	
				SPT-23	33.0 - 34.5	1.5	WOH-1-2	41	

SUBSURFACE LOG

Project No. 172679032

Location N 273018.83, E 763676.83 (NAD27)

Project Name Allen Fossil Plant (TVA)

Boring No. **STN-12** Total Depth 40.5 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
180.7'	36.0'			SPT-24	34.5 - 36.0	1.5	WOH-1-2	41	
		SANDY SILT, gray, wet to saturated, soft to medium stiff		SPT-25	36.0 - 37.5	1.5	2-2-2	37	
				SPT-26	37.5 - 39.0	1.5	WOR-2-1	32	LL-30, PI-7 88%passing #200
176.2'	40.5'			SPT-27	39.0 - 40.5	1.5	1-1-4	41	

No Refusal /
Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

Piezometer installed upon completion of drilling. See piezometer installation record for specific details.

SUBSURFACE LOG

Project No. 172679032
Project Name Allen Fossil Plant (TVA)
Location Memphis, Tennessee
Project Type Geotechnical Exploration
Supervisor Patrick Kiser Driller G. Thompson
Logged By Briggs Evans

Location N 273020.21, E 763618.05 (NAD27)
Boring No. **STN-13** Total Depth 60.0 ft
Surface Elevation 236.9 ft. (NGVD29)
Date Started 7/18/09 Completed 7/18/09
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
236.9'	0.0'	Top of Hole							
		FILL - SANDY SILT, grayish brown to brown, moist, stiff to very stiff		SPT-1	0.0 - 1.5	1.3	2-6-6	13	Boring advanced using 3 1/4" Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.3	7-10-10	13	
				SPT-3	3.0 - 4.5	1.5	3-4-7	16	
				SPT-4	4.5 - 6.0	1.5	3-5-5	16	
				SPT-5	6.0 - 7.5	1.5	5-8-10	17	
				SPT-6	7.5 - 9.0	1.5	3-8-9	15	LL-23, PI-4 69% passing #200
				SPT-7	9.0 - 10.5	1.5	3-10-14	14	
				SPT-8	10.5 - 12.0	1.5	3-12-7	16	
				SPT-9	12.0 - 13.5	1.5	8-10-14	17	
				SPT-10	13.5 - 15.0	1.5	4-6-7	20	
				SPT-11	15.0 - 16.5	1.5	4-8-8	18	Wood fragments at 16.0'
				SPT-12	16.5 - 18.0	1.5	8-10-14	--	
				SPT-13	18.0 - 19.5	1.5	4-7-10	18	LL-21, PI-3 57% passing #200
				SPT-14	19.5 - 21.0	1.5	8-8-11	17	
				SPT-15	21.0 - 22.5	1.5	13-15-15	16	
				SPT-16	22.5 - 24.0	1.5	5-8-9	17	
				SPT-17	24.0 - 25.5	1.5	4-7-9	17	
				SPT-18	25.5 - 27.0	1.5	5-9-10	19	
				SPT-19	27.0 - 28.5	1.5	10-11-10	18	
207.9'	29.0'								
		SANDY SILT, grayish brown, very moist to saturated, soft to stiff		SPT-20	28.5 - 30.0	1.5	3-3-3	33	
				SPT-21	30.0 - 31.5	1.5	3-2-4	34	Organics at 30.0'
				SPT-22	31.5 - 33.0	1.5	2-4-4	37	Saturated from 32.0' to 32.5'
				SPT-23	33.0 - 34.5	1.0	WOH-2-3	32	

Project No. 172679032
Location N 273020.21, E 763618.05 (NAD27)
Project Name Allen Fossil Plant (TVA)
Boring No. **STN-13**
Total Depth 60.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		SANDY SILT, grayish brown, very moist to saturated, soft to stiff *(Continued)*		SPT-24	34.5 - 36.0	1.5	1-3-3	32	LL-30, PI-6 91% passing #200
				SPT-25	36.0 - 37.5	1.5	5-5-6	36	
				SPT-26	37.5 - 39.0	1.5	WOH-2-2	39	
				SPT-27	39.0 - 40.5	1.5	WOH-2-3	41	
				SPT-28	40.5 - 42.0	1.5	WOH-3-3	39	
				SPT-29	42.0 - 43.5	1.5	3-4-4	38	
				SPT-30	43.5 - 45.0	1.5	WOH-WOH-1	36	
				SPT-31	45.0 - 46.5	1.5	WOH-WOH-WOH	32	LL-26, PI-3 74% passing #200
				SPT-32	46.5 - 48.0	1.5	WOR-WOR-WOH	31	
186.9'	50.0'			SPT-33	48.0 - 49.5	1.5	WOR-WOR-WOR	34	
		FAT CLAY, gray, moist, soft to medium stiff, some silt		SPT-34	49.5 - 51.0	1.5	WOR-WOH-2	44	
				SPT-35	51.0 - 52.5	1.5	2-2-3	42	
				SPT-36	52.5 - 54.0	1.5	2-2-2	40	
180.9'	56.0'			SPT-37	54.0 - 55.5	1.5	WOH-WOH-2	39	
		CLAYEY SILT, gray, moist to wet, soft to medium stiff		SPT-38	55.5 - 57.0	1.5	WOH-WOH-2	39	
				SPT-39	57.0 - 58.5	1.5	WOR-7-4	34	
177.4'	59.5'			SPT-40	58.5 - 60.0	1.5	3-7-9	25	
176.9'	60.0'	SAND, light gray, saturated, medium dense, fine grained							

No Refusal /
Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

Boring backfilled with bentonite grout.

Piezometer installed in offset boring. See piezometer installation record for specific details.

SUBSURFACE LOG

Project No. 172679032

Location N 272761.34, E 763347.91 (NAD27)

Project Name Allen Fossil Plant (TVA)

Boring No. **STN-14** Total Depth 60.0 ft

Location Memphis, Tennessee

Surface Elevation 236.5 ft. (NGVD29)

Project Type Geotechnical Exploration

Date Started 7/18/09 Completed 7/19/09

Supervisor Patrick Kiser Driller J. Wethington

Depth to Water 21.0 ft Date/Time 7/18/09

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
236.5'	0.0'	Top of Hole							
		FILL - SANDY SILT, brown with gray, moist, very stiff, some sand		SPT-1	0.0 - 1.5	0.9	6-9-13	14	Boring advanced using 3 1/4" Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.0	16-13-18	15	
				SPT-3	3.0 - 4.5	1.5	8-8-13	16	
				SPT-4	4.5 - 6.0	1.2	7-7-12	15	
				SPT-5	6.0 - 7.5	1.1	13-16-15	16	
				SPT-6	7.5 - 9.0	0.7	6-7-14	15	
				SPT-7	9.0 - 10.5	1.5	6-7-11	19	LL-24, PI-5 62% passing #200
				SPT-8	10.5 - 12.0	1.5	12-12-12	15	
				SPT-9	12.0 - 13.5	1.3	12-13-15	16	
222.5'	14.0'								
		FILL - LEAN CLAY, silty, gray, moist to wet, stiff to very stiff		SPT-10	13.5 - 15.0	1.2	13-12-12	22	
				SPT-11	15.0 - 16.5	1.3	2-3-4	31	
				SPT-12	16.5 - 18.0	1.4	7-11-11	25	
				SPT-13	18.0 - 19.5	0.8	6-9-11	29	
				SPT-14	19.5 - 21.0	1.5	6-6-7	28	
				SPT-15	21.0 - 22.5	1.2	5-5-6	33	LL-43, PI-26 85% passing #200
				SPT-16	22.5 - 24.0	1.3	7-7-8	35	
				SPT-17	24.0 - 25.5	1.4	5-5-5	36	Brown layering at 25.0'
				SPT-18	25.5 - 27.0	1.2	3-4-7	33	
208.5'	28.0'			SPT-19	27.0 - 28.5	1.5	7-7-8	25	
		SANDY SILT, gray, moist to saturated, stiff, some clay		SPT-20	28.5 - 30.0	1.2	4-5-6	27	
				SPT-21	30.0 - 31.5	1.2	1-1-3	37	
				SPT-22	31.5 - 33.0	1.2	3-3-2	31	
				SPT-23	33.0 - 34.5	1.5	3-3-1	35	

SUBSURFACE LOG

Project No. 172679032

Location N 272761.34, E 763347.91 (NAD27)

Project Name Allen Fossil Plant (TVA)

Boring No. **STN-14**

Total Depth 60.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		SANDY SILT, gray, moist to saturated, stiff, some clay *(Continued)*		SPT-24	34.5 - 36.0	1.0	2-1-3	39	
199.5'	37.0'			SPT-25	36.0 - 37.5	1.5	2-2-4	29	
		FAT CLAY, gray, moist to very moist, medium stiff to stiff		SPT-26	37.5 - 39.0	1.4	2-3-4	40	
				SPT-27	39.0 - 40.5	1.5	3-4-5	36	
				SPT-28	40.5 - 42.0	1.2	5-7-7	44	
				SPT-29	42.0 - 43.5	1.5	5-5-7	37	
				SPT-30	43.5 - 45.0	1.5	3-4-5	43	
189.7'	46.8'			SPT-31	45.0 - 46.5	1.5	4-4-4	32	
		SILTY SAND, gray, moist to saturated, medium dense to dense, fine grained		SPT-32	46.5 - 48.0	0.8	5-18-39	35	
				SPT-33	48.0 - 49.5	1.2	12-12-20	24	41% passing #200
				SPT-34	49.5 - 51.0	1.0	12-13-16	22	
				SPT-35	51.0 - 52.5	1.4	3-6-7	40	clay seam from 51' - 53'
				SPT-36	52.5 - 54.0	0.7	9-15-23	26	
				SPT-37	54.0 - 55.5	0.8	11-20-12	20	
				SPT-38	55.5 - 57.0	0.9	5-9-13	22	
				SPT-39	57.0 - 58.5	1.2	WOR-WOR-WOR	51	clay seam from 57' - 59'
176.5'	60.0'			SPT-40	58.5 - 60.0	1.5	5-6-9	37	

No Refusal /
Bottom of Hole

WOR = Weight of Rods

Boring backfilled with bentonite grout.

Piezometer installed in offset boring. See piezometer installation record for specific details.

SUBSURFACE LOG

Page: 1 of 1

Project No. 172679032
Location N 273021.67, E 763612.37 (NAD27)
Project Name ALLEN FOSSIL PLANT (TVA)
Boring No. **HA-9** Total Depth 6.0 ft
Location Memphis, Tennessee
Surface Elevation 237.0 ft. (NGVD29)
Project Type Geotechnical Exploration
Date Started 10/12/09 Completed 10/12/09
Supervisor Patrick Kiser Driller Briggs Evans
Depth to Water N/A Date/Time N/A
Logged By Shaikh Rahman
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
237.0'	0.0'	Top of Hole							
		FILL - SANDY SILT, grayish brown to brown, moist			0.0 - 1.0			--	Boring advanced with a hand auger.
					1.0 - 2.0			--	
					2.0 - 3.0			16	62% passing #200
					3.0 - 4.0			--	
		with lean clay below 4'			4.0 - 5.0			12	LL - 29, PI - 10 71% passing #200
					5.0 - 6.0			--	
231.0'	6.0'								
		No Refusal / Bottom of Hole							

SUBSURFACE LOG

Page: 1 of 1

Project No.	172679032	Location	N 274010.59, E 763748.55 (NAD27)		
Project Name	ALLEN FOSSIL PLANT (TVA)	Boring No.	**HA-10**	Total Depth	5.0 ft
Location	Memphis, Tennessee	Surface Elevation	237.2 ft. (NGVD29)		
Project Type	Geotechnical Exploration	Date Started	10/12/09	Completed	10/12/09
Supervisor	Patrick Kiser Driller Briggs Evans	Depth to Water	N/A	Date/Time	N/A
Logged By	Shaikh Rahman	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
237.2'	0.0'	Top of Hole							
236.9'	0.3'	CRUSHED STONE							Boring advanced with a hand auger
		FILL - SILTY SAND, fine to coarse grained, grayish brown			0.0 - 1.0			--	
					1.0 - 2.0			--	
234.2'	3.0'				2.0 - 3.0			20	44% passing #200
		FILL - SANDY SILT, gray, moist to very moist			3.0 - 4.0			--	
232.2'	5.0'	with silty clay below 4.5'			4.0 - 5.0			29	LL - 26, PI - 7 74% passing #200
		No Refusal / Bottom of Hole							

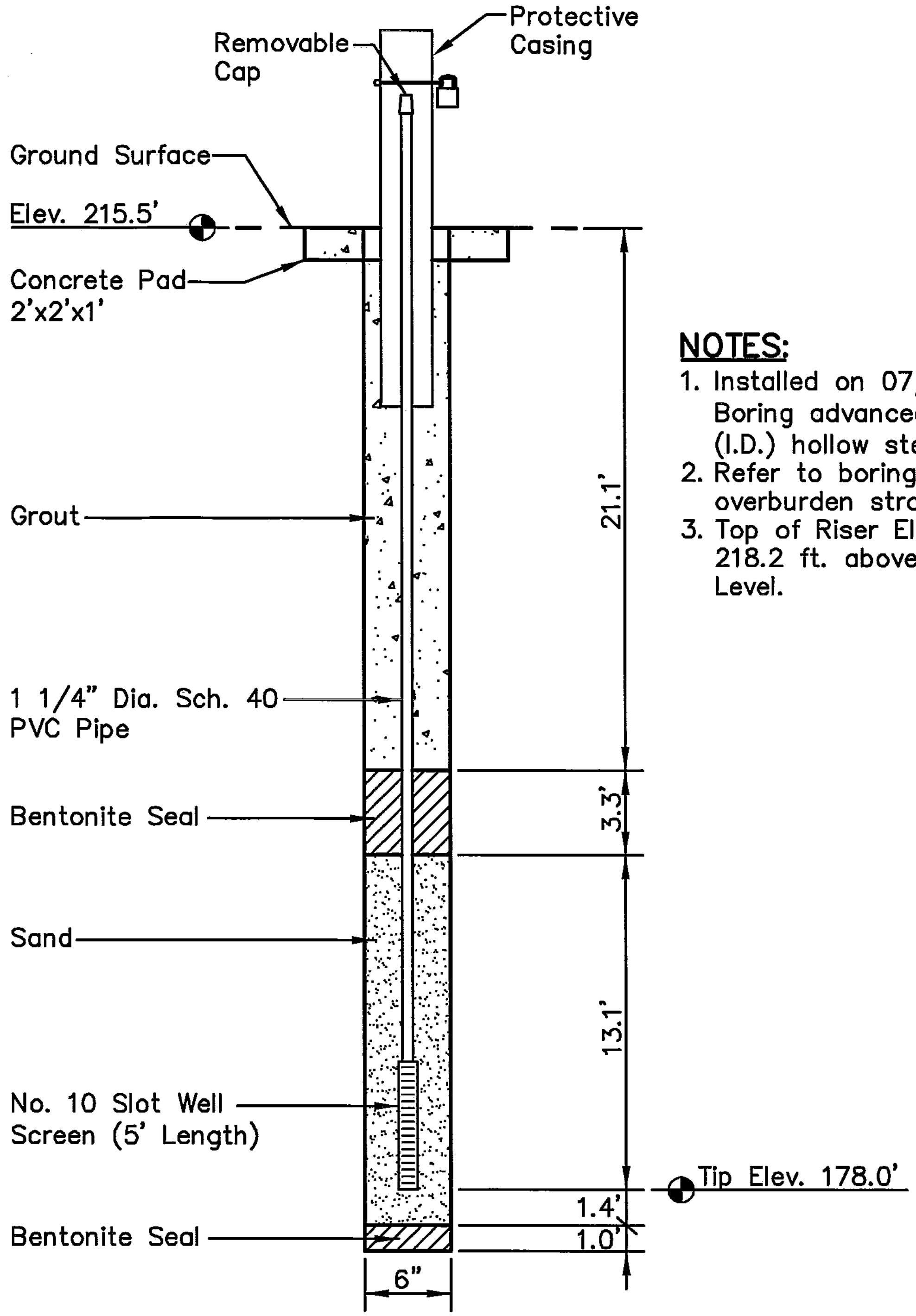
Appendix C

Instrumentation Monitoring Program

- Instrumentation Layout
- Piezometer Installation Details
- Piezometer Data

Instrumentation Layout

Piezometer Installation Details



NOTES:

1. Installed on 07/15/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 218.2 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ1.DWG

LOCATION:

Northing: 274580.31
Easting: 762195.58
Ground Elevation: 215.5 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD 29

PIEZOMETER STN-1
EAST FLY ASH POND
ALLEN FOSSIL PLANT

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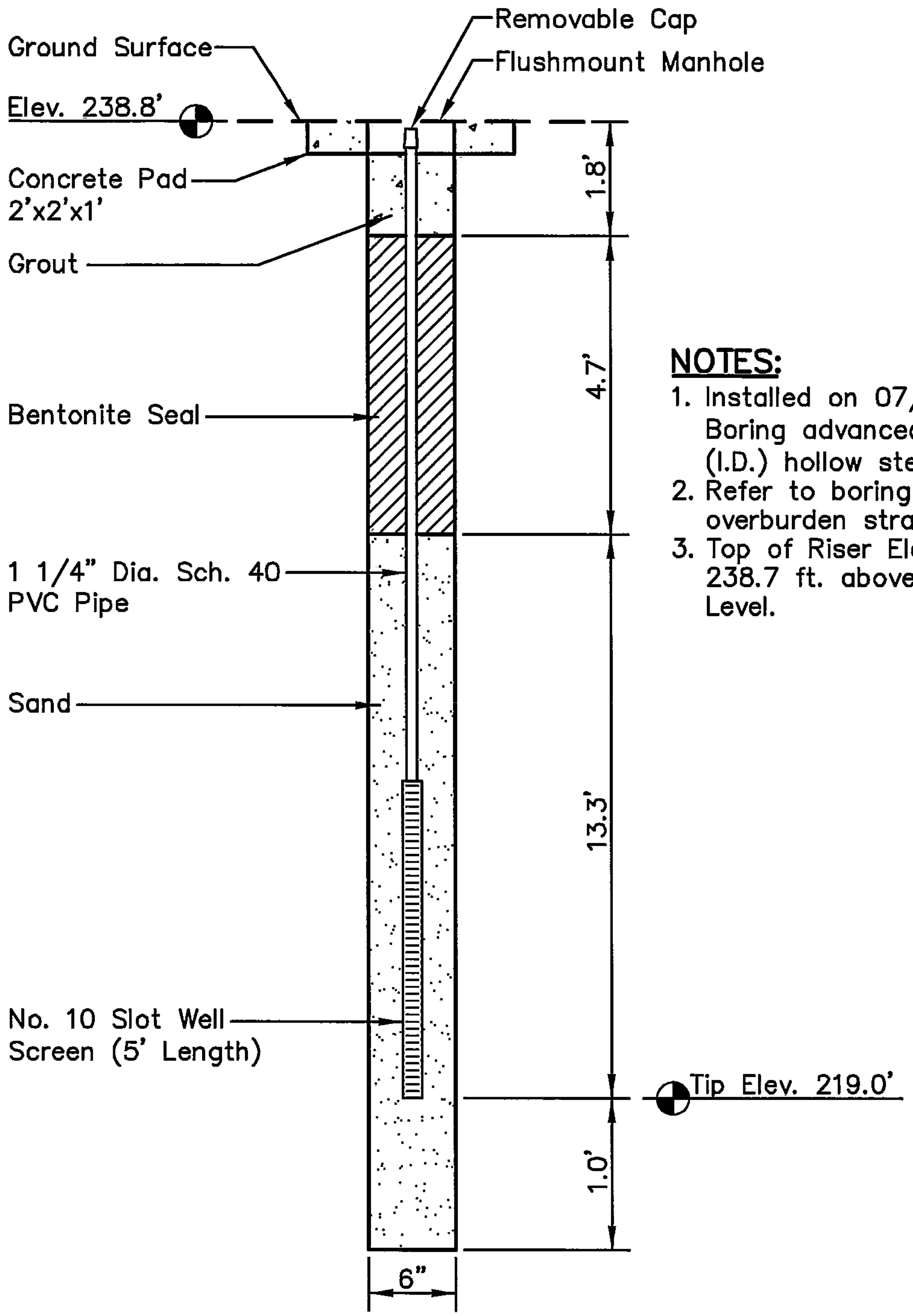

NOTES:

1. Installed on 07/15/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 238.7 ft. above Mean Sea Level.

LOCATION:

Northing: 274441.99
Easting: 762201.92
Ground Elevation: 238.8 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD 29

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ2.DWG

PIEZOMETER STN-2
EAST FLY ASH POND
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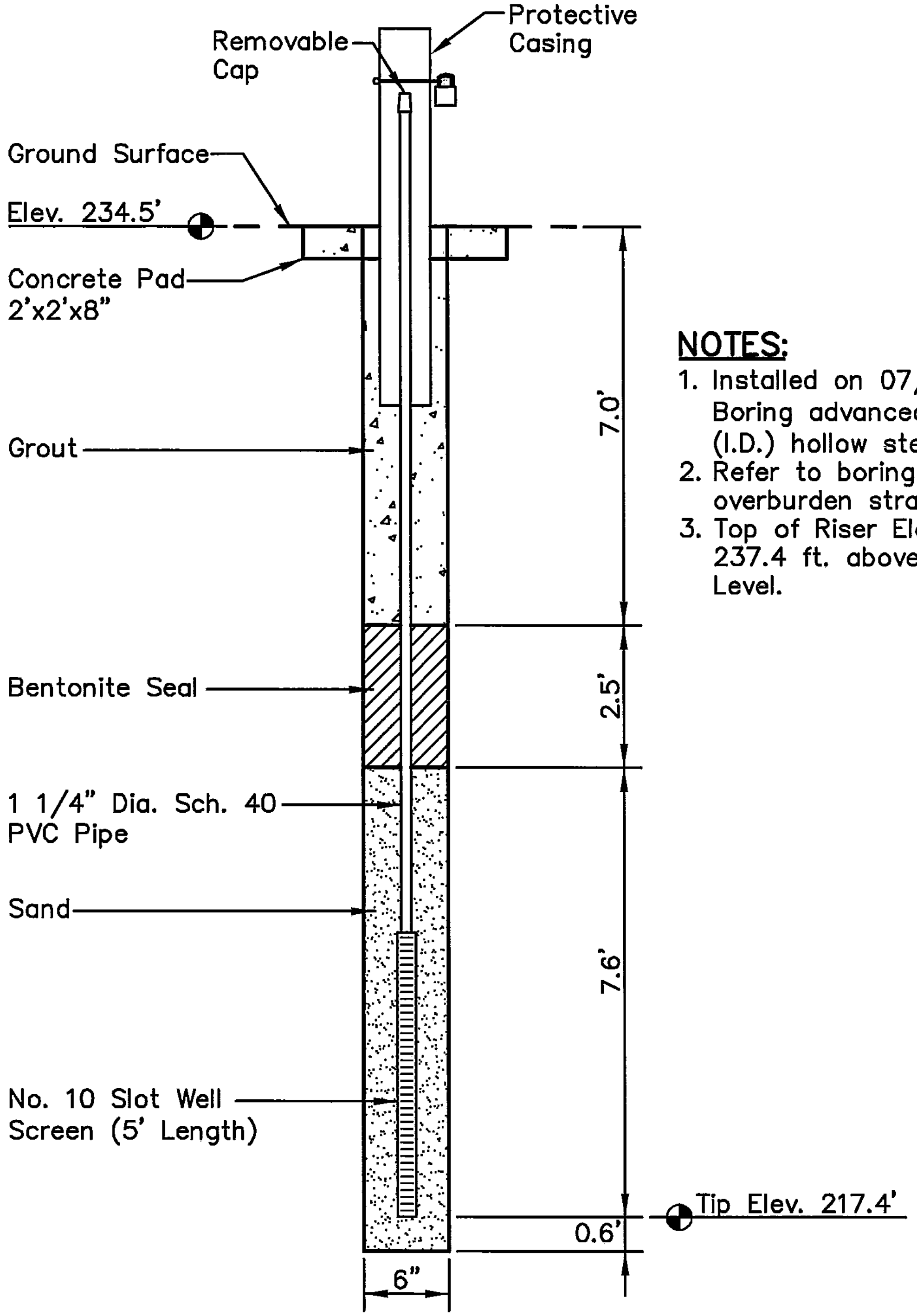

NOTES:

1. Installed on 07/17/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 237.4 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B–ALF–PZ3.DWG

LOCATION:

Northing: 274411.16
Easting: 762192.94
Ground Elevation: 234.5 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD 29

PIEZOMETER STN-3
EAST FLY ASH POND
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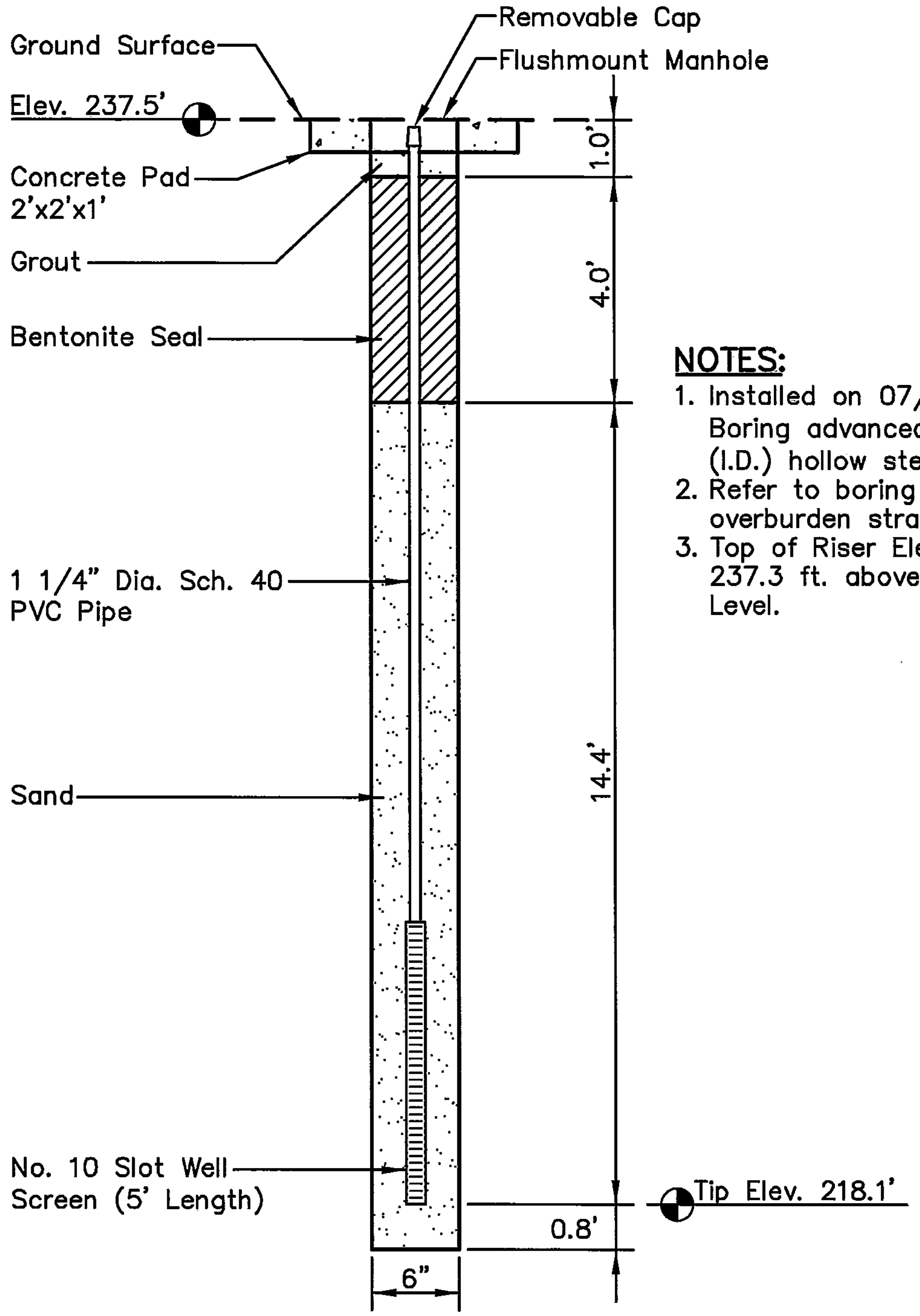

NOTES:

1. Installed on 07/16/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 237.3 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ4.DWG

LOCATION:

Northing: 274367.46
Easting: 762679.46
Ground Elevation: 237.5 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD 29

PIEZOMETER STN-4
EAST FLY ASH POND
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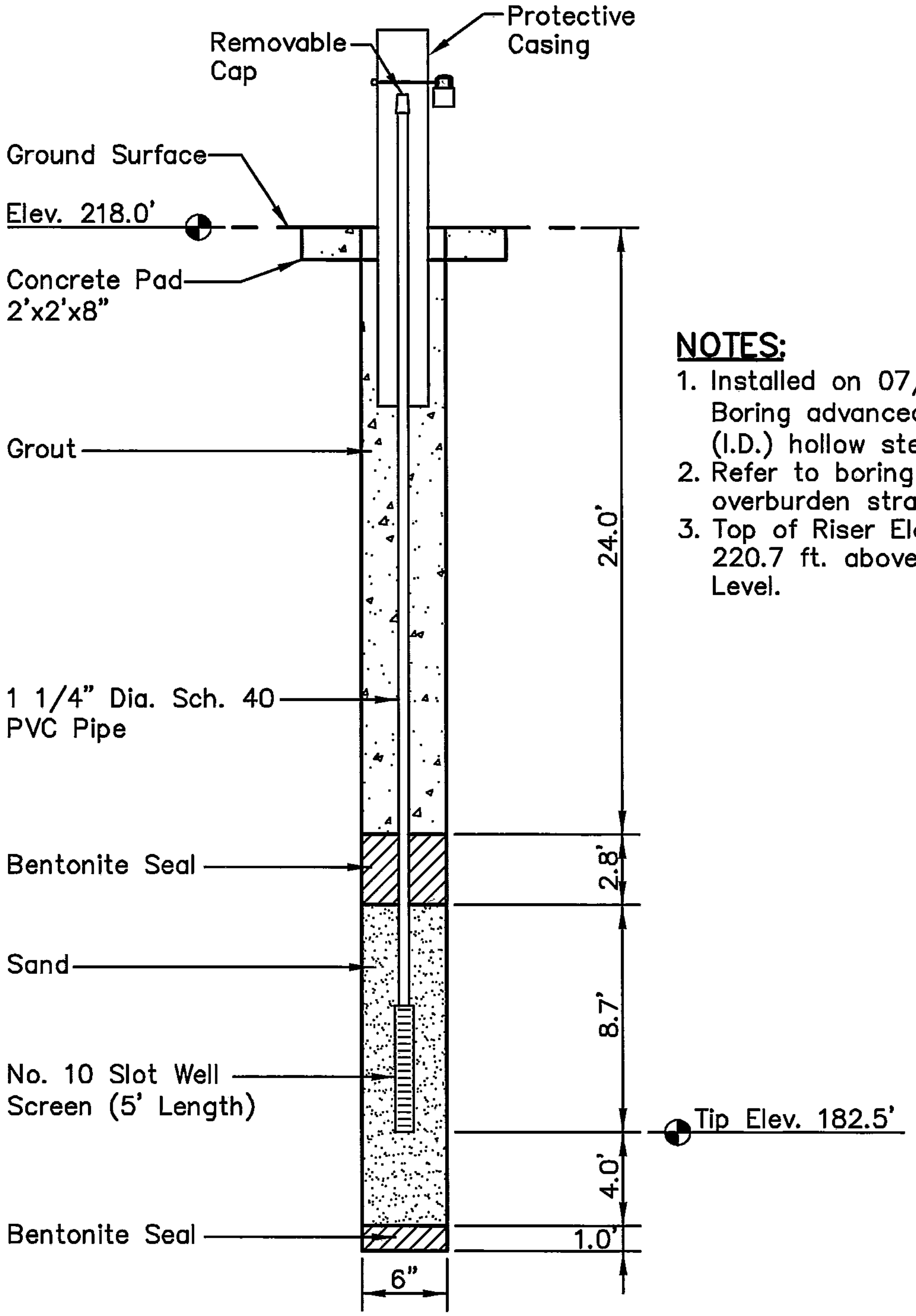

NOTES:

1. Installed on 07/14/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 220.7 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ5.DWG

LOCATION:

Northing: 274364.82
Easting: 763202.51
Ground Elevation: 218.0 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD 29

PIEZOMETER STN-5
EAST FLY ASH POND
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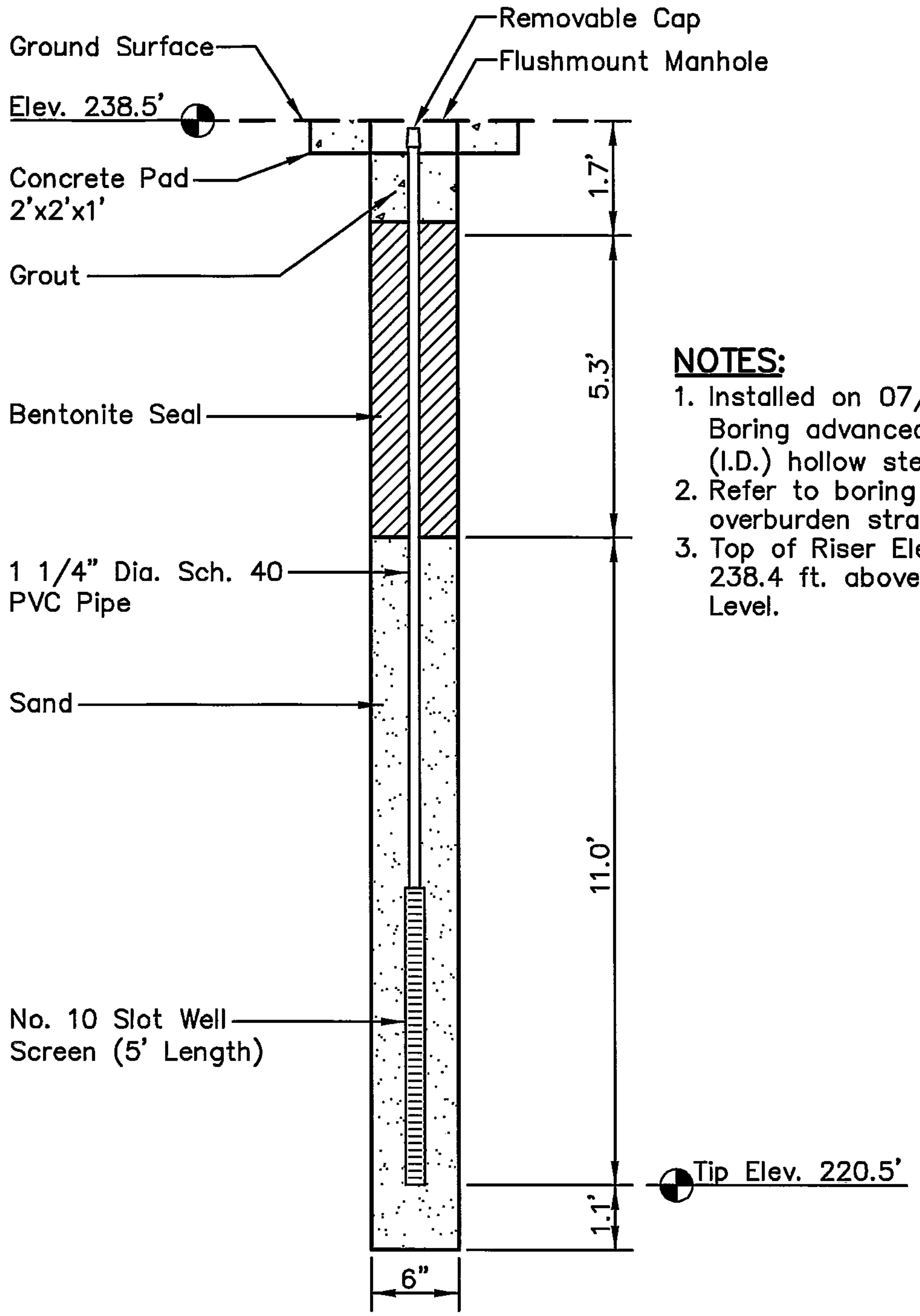

NOTES:

1. Installed on 07/14/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 238.4 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ6.DWG

LOCATION:

Northing: 274263.61
Easting: 763180.87
Ground Elevation: 238.5 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
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Vertical Datum: NGVD 29

PIEZOMETER STN-6
EAST FLY ASH POND
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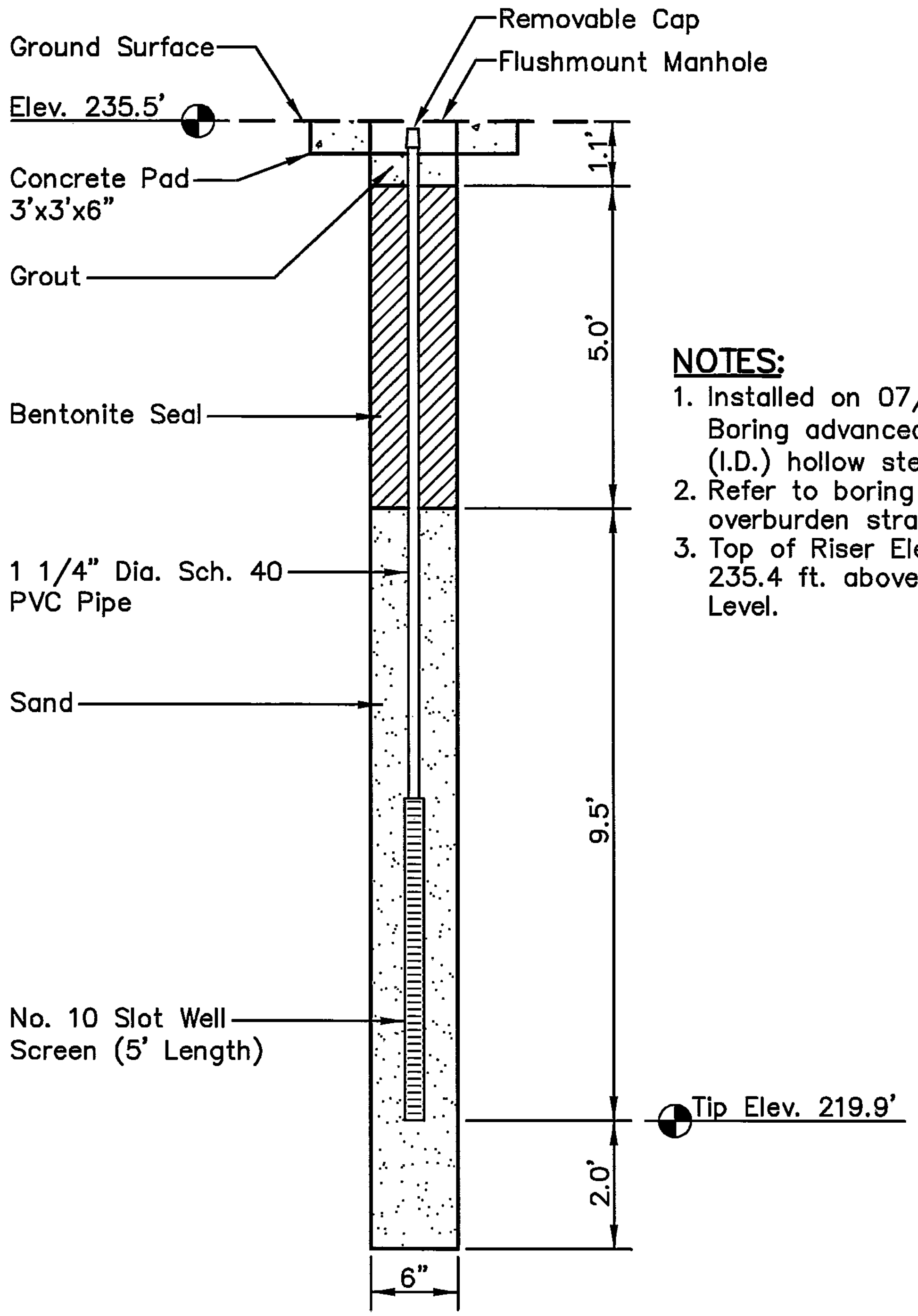

NOTES:

1. Installed on 07/18/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 235.4 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ7.DWG

LOCATION:

Northing: 274235.39
Easting: 763163.82
Ground Elevation: 235.5 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
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Vertical Datum: NGVD 29

PIEZOMETER STN-7
EAST FLY ASH POND
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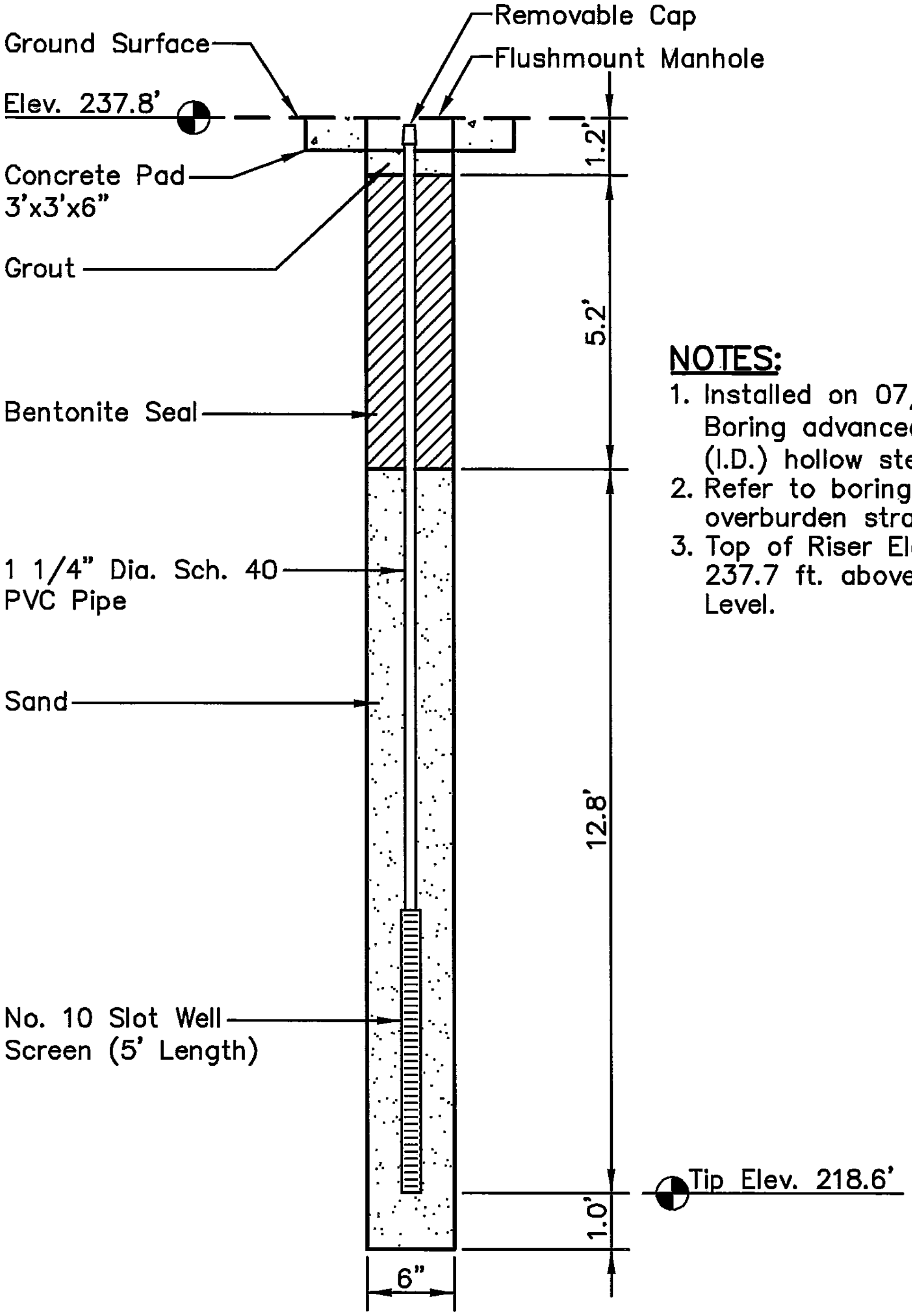

NOTES:

1. Installed on 07/17/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 237.7 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B–ALF–PZ8.DWG

LOCATION:

Northing: 274166.09
Easting: 763641.32
Ground Elevation: 237.8 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
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Vertical Datum: NGVD 29

PIEZOMETER STN-8
EAST FLY ASH POND
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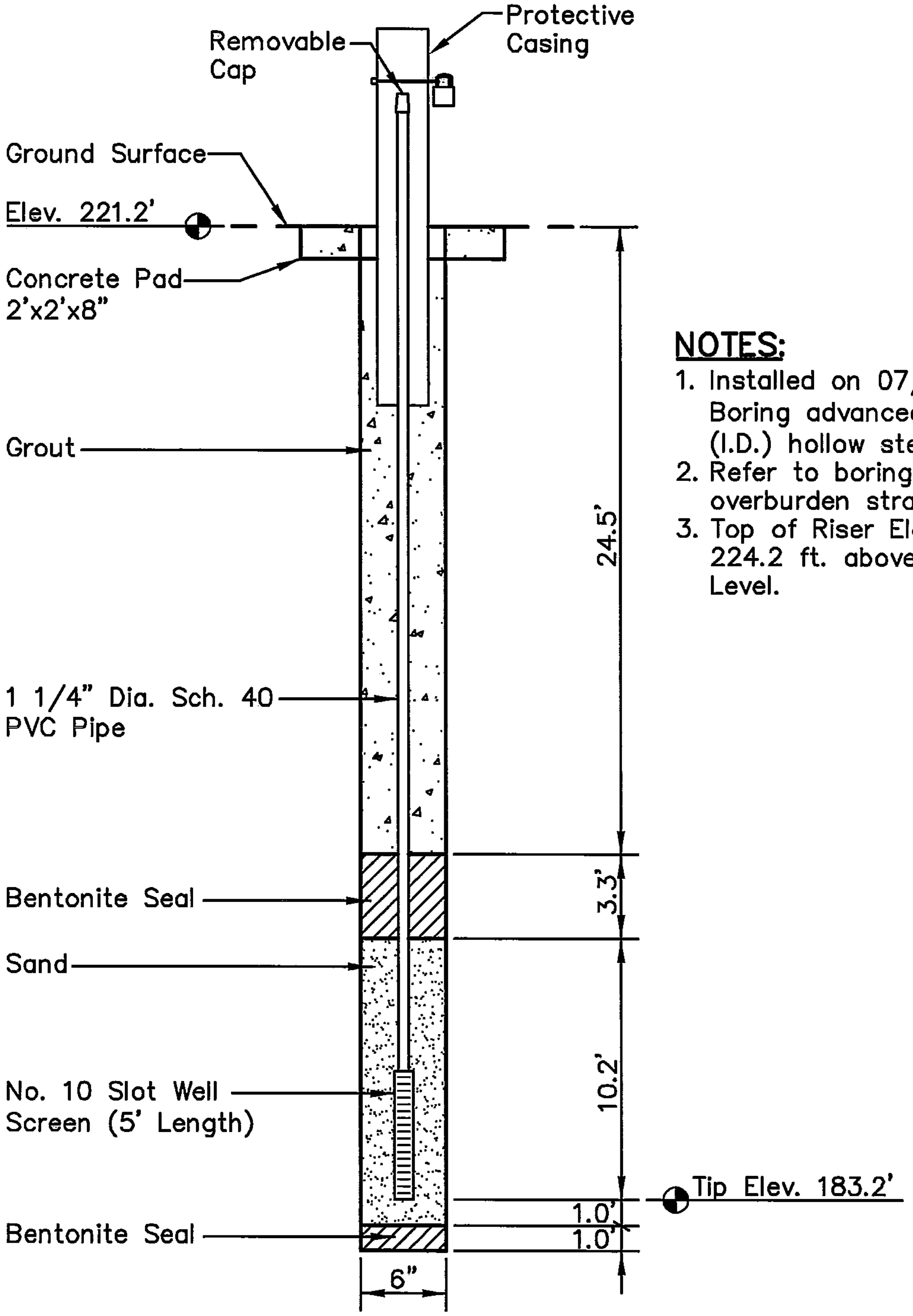

NOTES:

1. Installed on 07/16/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 224.2 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ9.DWG

LOCATION:

Northing: 274009.16
Easting: 763820.47
Ground Elevation: 221.2 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD 29

PIEZOMETER STN-9
EAST FLY ASH POND
ALLEN FOSSIL PLANT

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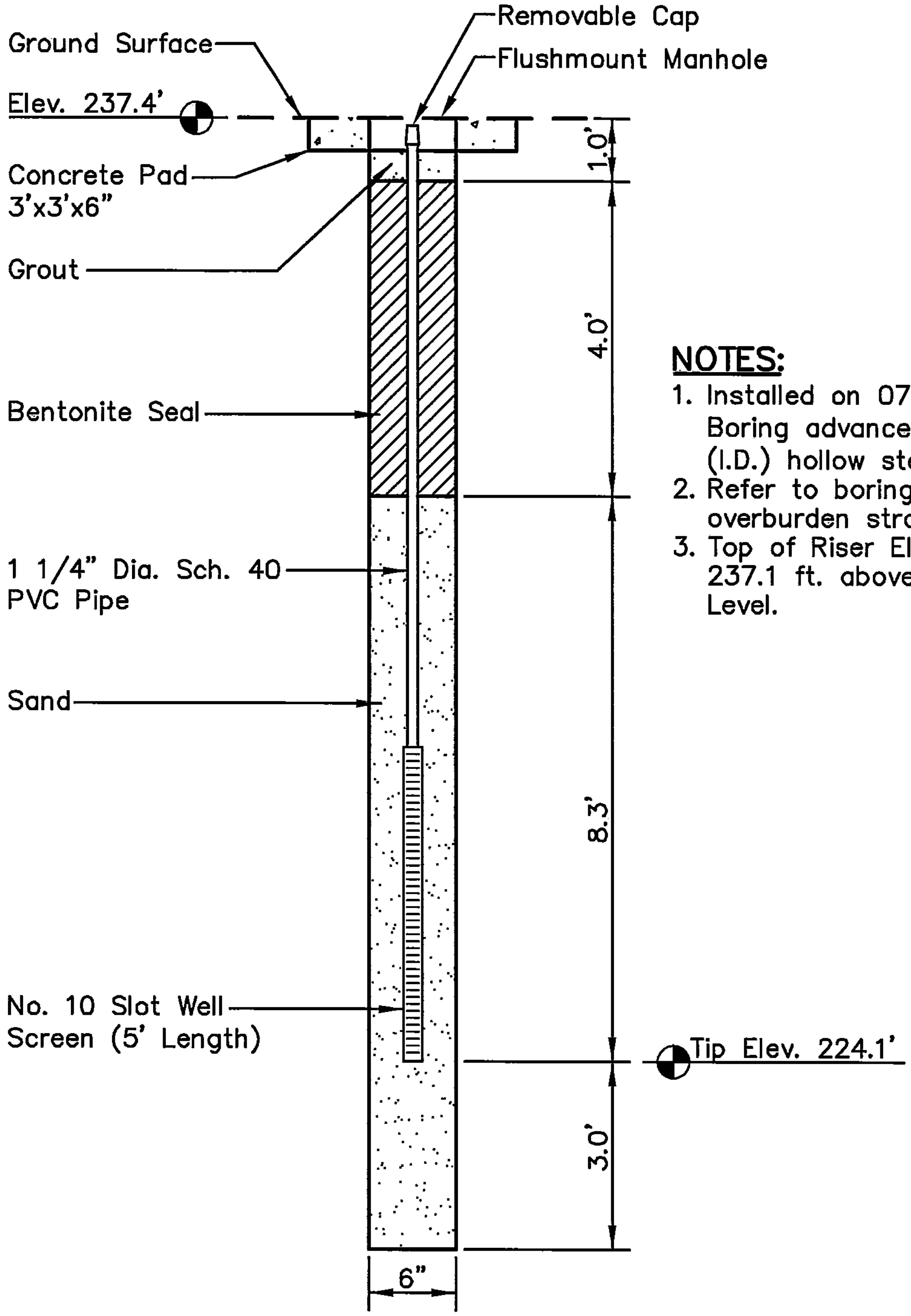

NOTES:

1. Installed on 07/18/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 237.1 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V: \1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ10.DWG

LOCATION:

Northing: 274009.41
Easting: 763758.03
Ground Elevation: 237.4 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD 29

PIEZOMETER STN-10
EAST FLY ASH POND
ALLEN FOSSIL PLANT

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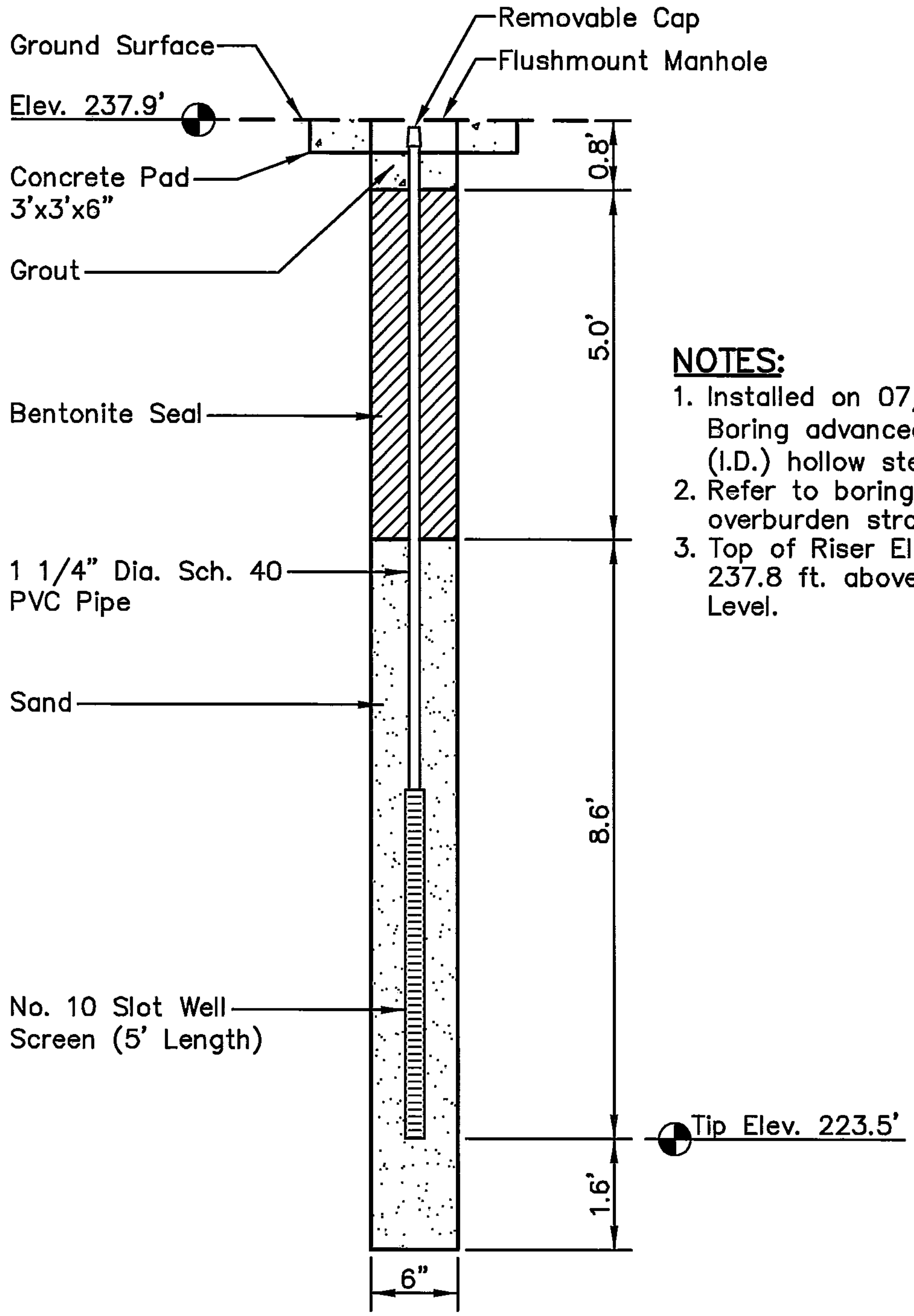

NOTES:

1. Installed on 07/18/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 237.8 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ11.DWG

LOCATION:

Northing: 273517.12
Easting: 763687.47
Ground Elevation: 237.9 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD 29

PIEZOMETER STN-11
EAST FLY ASH POND
ALLEN FOSSIL PLANT

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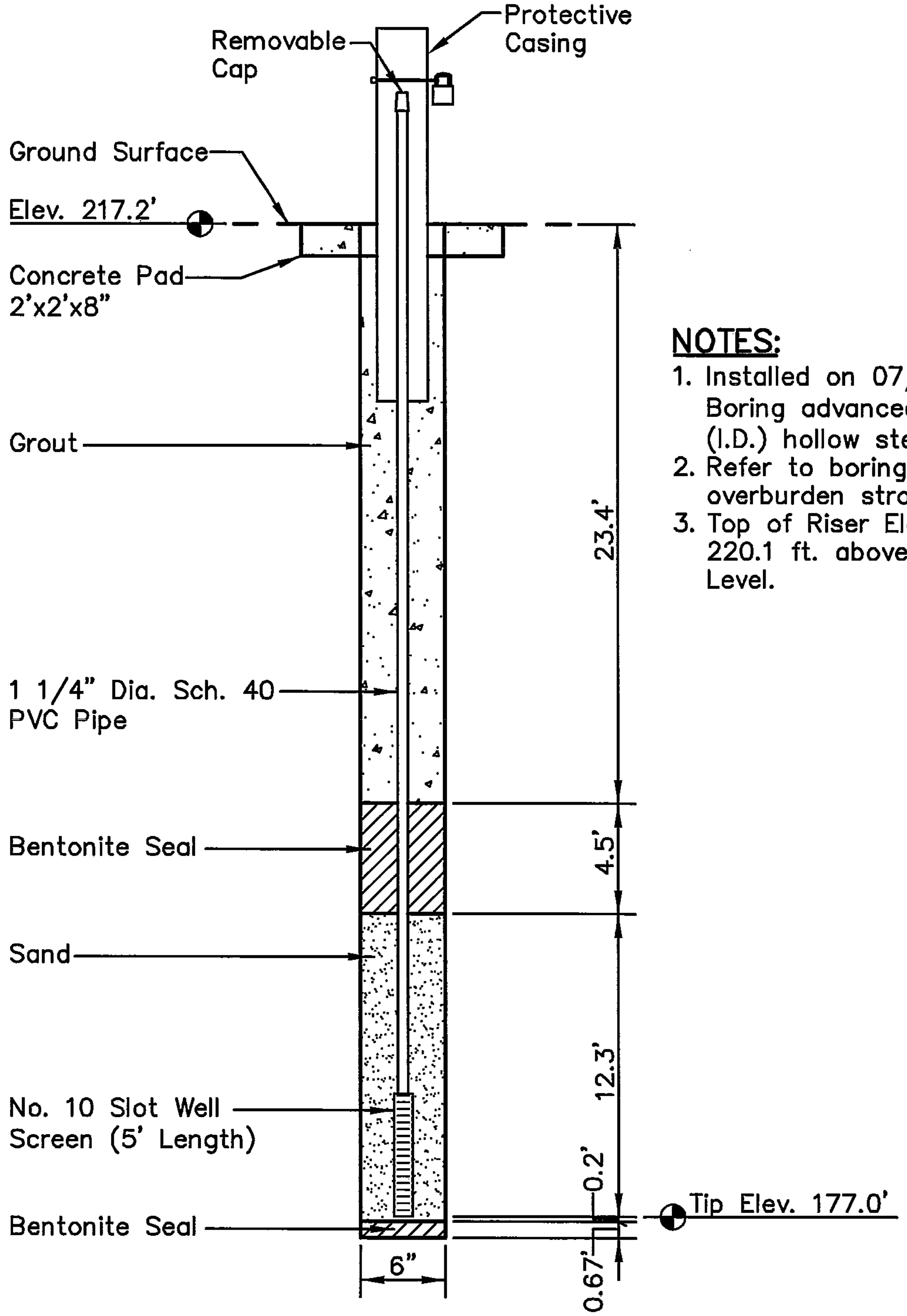


NOTES:

1. Installed on 07/19/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 220.1 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ12.DWG

LOCATION:

Northing: 273018.83
Easting: 763676.83
Ground Elevation: 217.2 feet

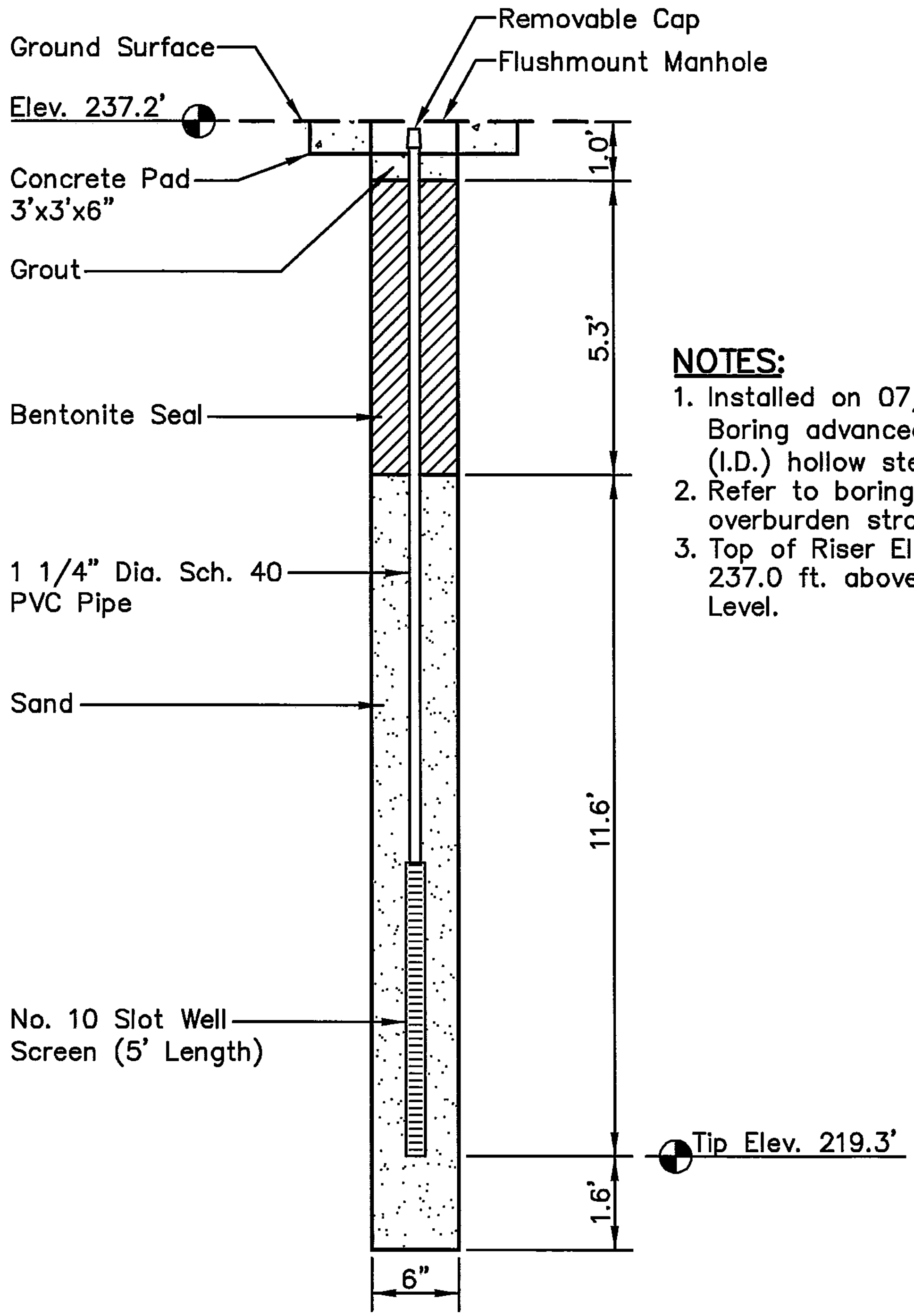
Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD 29

PIEZOMETER STN-12
EAST FLY ASH POND
ALLEN FOSSIL PLANT

Stantec

Stantec Consulting Services Inc.
100 Westwood Pl., Ste. 420
Nashville, Tennessee
37027-5044
615-885-1144
www.stantec.com

DRAWN BY	PS	DATE	AUG., 2009	REVISED		SHEET
CHECKED BY	PW	PROJ. NO.	172679016	1. 11/04/09	3.	1 OF 1
CHECKED BY	BE	SCALE	NTS	2.	4.	



NOTES:

1. Installed on 07/18/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 237.0 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ13.DWG

LOCATION:

Northing: 273020.94
Easting: 763619.04
Ground Elevation: 237.2 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD 29

PIEZOMETER STN-13
EAST FLY ASH POND
ALLEN FOSSIL PLANT

Stantec

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100 Westwood Pl., Ste. 420
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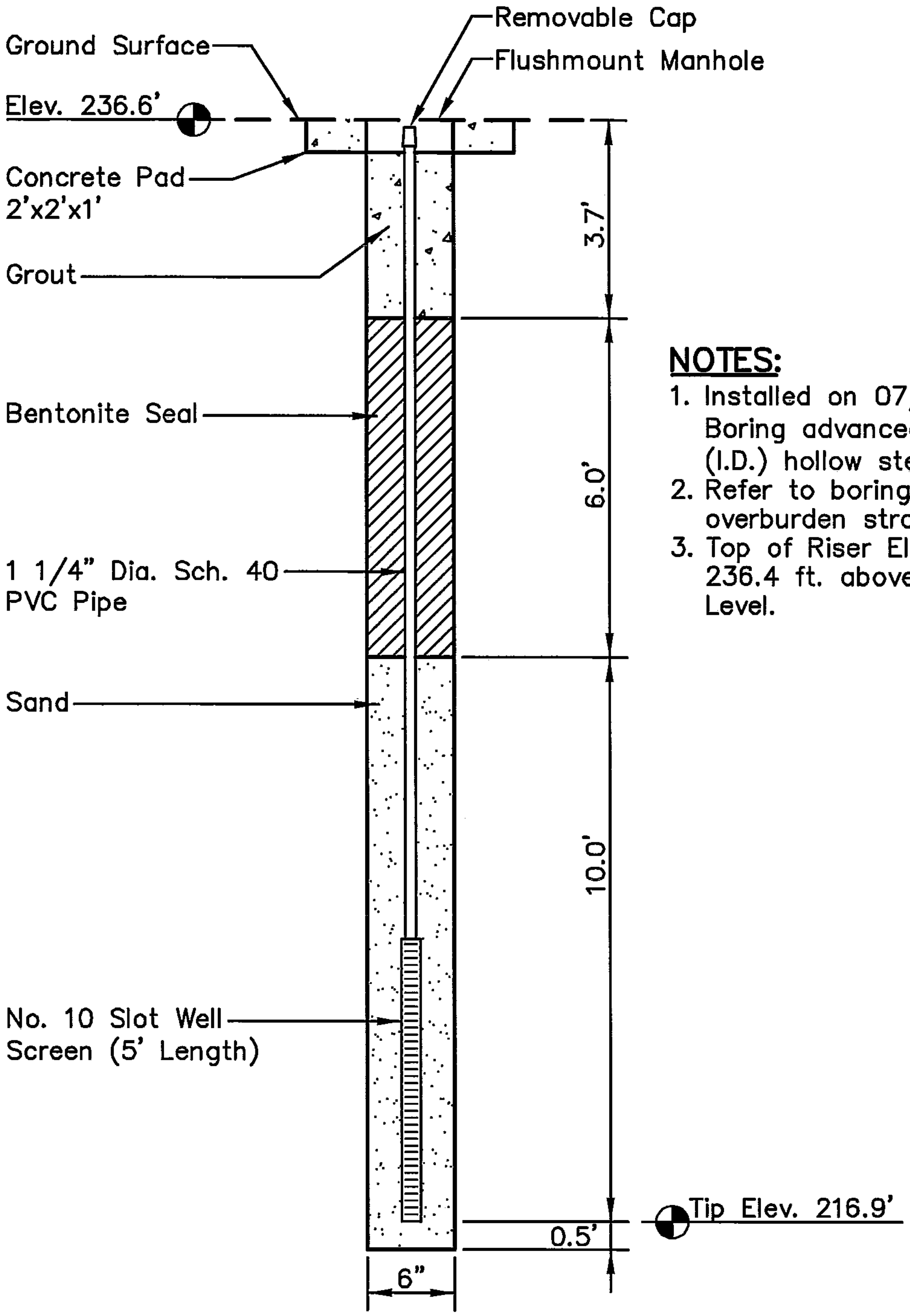
DRAWN BY	PS	DATE	AUG., 2009	REVISED		SHEET
CHECKED BY	PW	PROJ. NO.	172679016	1. 11/04/09	3.	1 OF 1
CHECKED BY	BE	SCALE	NTS	2.	4.	



NOTES:

1. Installed on 07/19/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.
3. Top of Riser Elevation = 236.4 ft. above Mean Sea Level.

PLOT DATE: 11/04/2009 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679016\ENVIRONMENTAL\DRAWING\GEOTECH\INSTRUMENT\79016B-ALF-PZ14.DWG

LOCATION:

Northing: 272761.04
Easting: 763351.79
Ground Elevation: 236.6 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD 29

PIEZOMETER STN-14
EAST FLY ASH POND
ALLEN FOSSIL PLANT

Stantec

Stantec Consulting Services Inc.
100 Westwood Pl., Ste. 420
Nashville, Tennessee
37027-5044
615-885-1144
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DRAWN BY	PS	DATE	AUG., 2009	REVISED		SHEET
CHECKED BY	PW	PROJ. NO.	172679016	1. 11/04/09	3.	1 OF 1
CHECKED BY	BE	SCALE	NTS	2.	4.	

Piezometer Data

Allen Fossil Plant
2574 Steam Plant Rd
Memphis,TN
Stantec Project No. 172679016 and 172679032

					7/20/2009		8/3/2009		8/13/2009		8/31/2009		9/11/2009	
Piezometer	PZ Depth (ft)	Surface Elevation (ft)	TOC Elevation (ft)	PZ Tip Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)
STN-1	40.21	215.47	218.24	178.03	25.85	192.39	26.54	191.70	25.90	192.34	28.78	189.46	29.71	188.53
STN-2	19.65	238.78	238.69	219.04	18.03	220.66	17.56	221.13	17.30	221.39	18.07	220.62	17.94	220.75
STN-3	20.07	234.52	237.44	217.37	13.12	224.32	12.46	224.98	13.50	223.94	14.66	222.78	12.78	224.66
STN-4	19.20	237.55	237.32	218.12	17.85	219.47	17.79	219.53	15.50	221.82	19.09	218.23	19.12	218.20
STN-5	38.18	218.04	220.69	182.51	24.57	196.12	24.64	196.05	23.70	196.99	26.20	194.49	26.58	194.11
STN-6	17.94	238.47	238.41	220.47	17.85	220.56	17.84	220.57	17.80	220.61	17.86	220.55	17.85	220.56
STN-7	15.56	235.53	235.44	219.88	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
STN-8	19.05	237.75	237.67	218.62	Dry	Dry	19.02	218.65	19.03	218.64	19.04	218.63	Dry	Dry
STN-9	41.00	221.15	224.19	183.19	8.41	215.88	10.06	214.13	10.40	213.79	10.76	213.43	10.93	213.26
STN-10	13.05	237.39	237.10	224.05	Dry	Dry	11.00	226.10	11.70	225.40	12.21	224.89	12.42	224.68
STN-11	14.35	237.93	237.81	223.46	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
STN-12	43.10	217.16	220.08	176.98	27.60	192.06	28.32	191.76	27.60	192.48	30.02	190.06	30.77	189.31
STN-13	17.68	237.24	236.96	219.28	15.19	221.42	12.05	224.91	11.60	225.36	Damaged	NM	11.88	225.08
STN-14	19.50	236.64	236.44	216.94	8.27	228.05	6.71	229.73	6.90	229.54	8.07	228.37	8.79	227.65
Mississippi River Gauge MS126 - Memphis						192.35		192.86		190.61		186.56		185.11
McKellar Lake Pool Elevation						189.55		189.05		187.85		184.05		182.65

220.4	Level measured is most likely water trapped in the sump (bottom 0.60') of the PZ and not a measurement of groundwater.
220.47	Dry: depth is where instrument sounded.
Dry	The PZ was dry at depth so no water level was measured.
NM	PZ Not Measured during event

Stantec

Allen Fossil Plant
2574 Steam Plant Rd
Memphis,TN
Stantec Project No. 172679016 and 172679032

					10/12/2009		11/2/2009		11/11/2009		11/17/2009		12/11/2009	
Piezometer	PZ Depth (ft)	Surface Elevation (ft)	TOC Elevation (ft)	PZ Tip Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)
STN-1	40.21	215.47	218.24	178.03	24.19	194.05	15.58	202.66	13.98	204.26	17.19	201.05	19.23	199.01
STN-2	19.65	238.78	238.69	219.04	16.80	221.89	15.97	222.72	16.26	222.43	16.50	222.19	17.68	221.01
STN-3	20.07	234.52	237.44	217.37	11.97	225.47	10.98	226.46	11.68	225.76	11.99	225.45	12.02	225.42
STN-4	19.20	237.55	237.32	218.12	17.27	220.05	15.57	221.75	16.03	221.29	16.11	221.21	17.48	219.84
STN-5	38.18	218.04	220.69	182.51	25.23	195.46	16.02	204.67	14.38	206.31	17.21	203.48	20.45	200.24
STN-6	17.94	238.47	238.41	220.47	17.86	220.55	17.85	220.56	17.94	220.47	17.93	220.48	17.94	220.47
STN-7	15.56	235.53	235.44	219.88	Dry	Dry	Dry	Dry	16.04	219.40	15.58	219.86	15.90	219.54
STN-8	19.05	237.75	237.67	218.62	19.05	218.62	Dry	Dry	19.14	218.53	19.04	218.63	19.06	218.61
STN-9	41.00	221.15	224.19	183.19	11.40	212.79	11.66	212.53	18.80	205.39	18.31	205.88	19.39	204.80
STN-10	13.05	237.39	237.10	224.05	11.25	225.85	10.14	226.96	11.32	225.78	10.68	226.42	11.89	225.21
STN-11	14.35	237.93	237.81	223.46	14.19	223.62	14.22	223.59	14.28	223.53	14.30	223.51	14.20	223.61
STN-12	43.10	217.16	220.08	176.98	30.29	189.79	24.41	195.67	21.90	198.18	23.47	196.61	25.44	194.64
STN-13	17.68	237.24	236.96	219.28	11.42	225.54	10.45	226.51	11.01	225.95	11.09	225.87	12.54	224.42
STN-14	19.50	236.64	236.44	216.94	7.98	228.46	7.63	228.81	8.19	228.25	8.42	228.02	8.98	227.46
Mississippi River Gauge MS126 - Memphis						192.35								
McKellar Lake Pool Elevation						189.55								

220.4	Level measured is most likely water trapped in the sump (bottom 0.60') of the PZ and not a measurement of groundwater.
220.47	Dry: depth is where instrument sounded.
Dry	The PZ was dry at depth so no water level was measured.
NM	PZ Not Measured during event

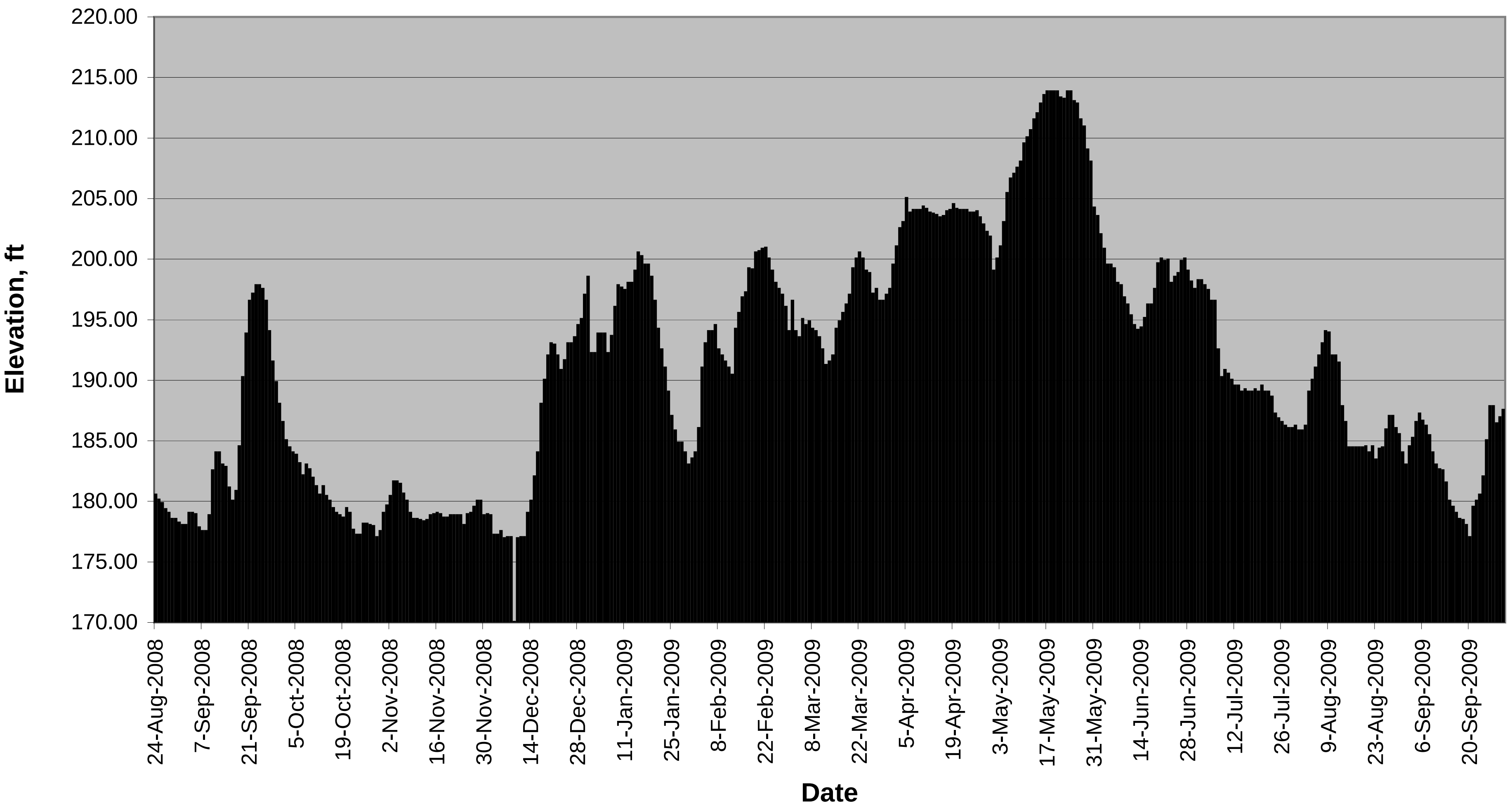
Stantec

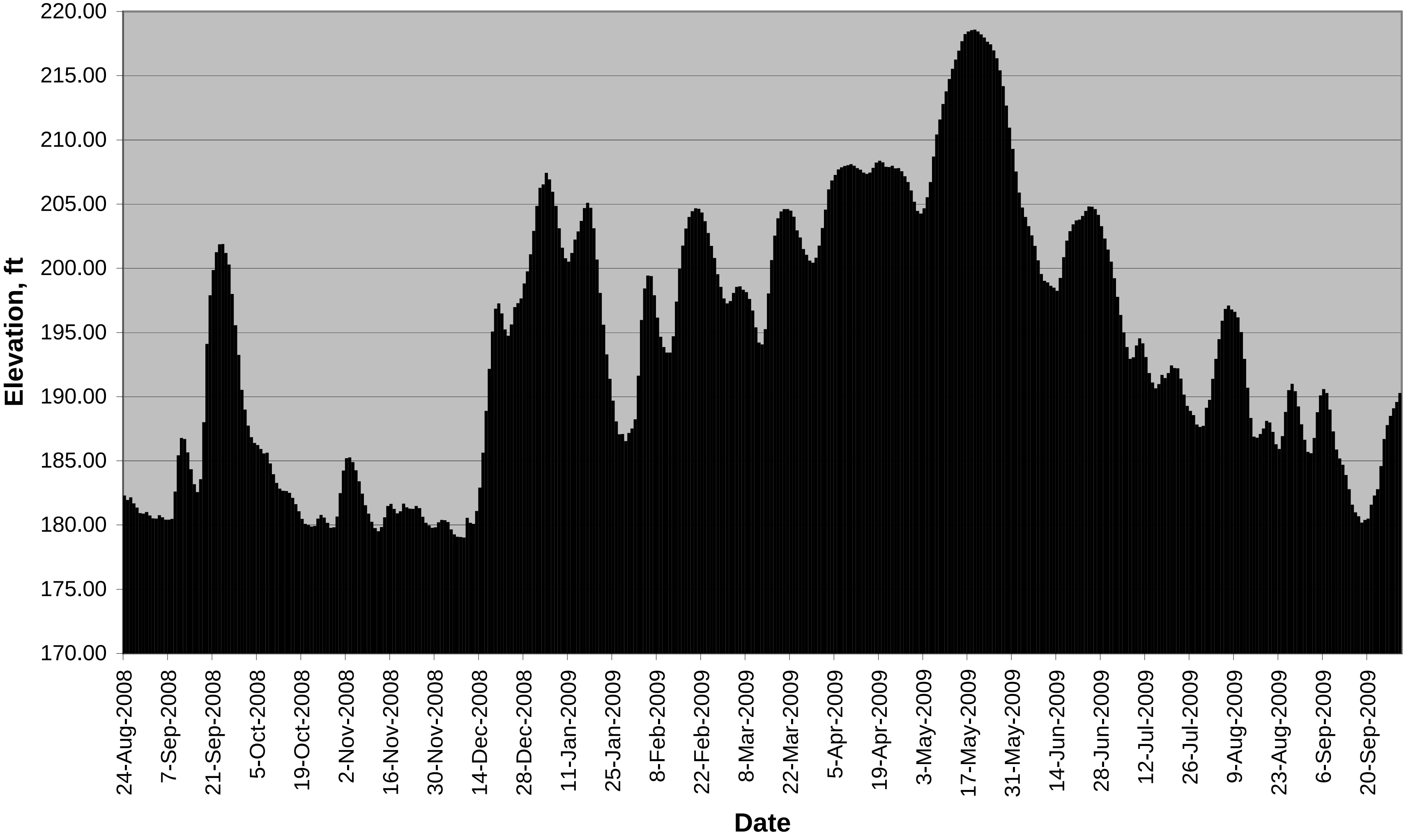
Allen Fossil Plant
2574 Steam Plant Rd
Memphis,TN
Stantec Project No. 172679016 and 172679032

					1/12/2010									
Piezometer	PZ Depth (ft)	Surface Elevation (ft)	TOC Elevation (ft)	PZ Tip Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)
STN-1	40.21	215.47	218.24	178.03	20.98	197.26								
STN-2	19.65	238.78	238.69	219.04	17.87	220.82								
STN-3	20.07	234.52	237.44	217.37	12.48	224.96								
STN-4	19.20	237.55	237.32	218.12	17.61	219.71								
STN-5	38.18	218.04	220.69	182.51	21.57	199.12								
STN-6	17.94	238.47	238.41	220.47	17.97	220.44								
STN-7	15.56	235.53	235.44	219.88	13.52	Dry								
STN-8	19.05	237.75	237.67	218.62	19.07	218.60								
STN-9	41.00	221.15	224.19	183.19	17.81	206.38								
STN-10	13.05	237.39	237.10	224.05	12.12	224.98								
STN-11	14.35	237.93	237.81	223.46	14.24	223.57								
STN-12	43.10	217.16	220.08	176.98	25.05	195.03								
STN-13	17.68	237.24	236.96	219.28	12.46	224.50								
STN-14	19.50	236.64	236.44	216.94	9.28	227.16								
Mississippi River Gauge MS126 - Memphis						192.35								
McKellar Lake Pool Elevation						189.55								

220.4	Level measured is most likely water trapped in the sump (bottom 0.60') of the PZ and not a measurement of groundwater.
220.47	Dry: depth is where instrument sounded.
Dry	The PZ was dry at depth so no water level was measured.
NM	PZ Not Measured during event

McKellar Lake Water Elevation
At Ensley Engineer Yard Gauge MS 129
Source: US Army Corps of Engineers





Mississippi River Water Elevation
At Mississippi River Gauge MS 126
Source: US Army Corps of Engineers

Appendix D

Laboratory Test Data

- Laboratory Classification Testing
- Consolidated Undrained Triaxial Testing
- Laboratory Permeability Testing

Laboratory Classification Testing

Stantec

Summary of Soil Tests

Project Name: Allen Fossil Plant
Source: STN-9, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'
County: Memphis, TN
Sample Type: SPT Comp

Project Number: 172679016
Lab ID: 768
Date Received: 9-9-09
Date Reported: 10-21-09

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	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.7
No. 200	0.075	71.0
	0.02	19.3
	0.005	9.3
	0.002	6.7
estimated	0.001	5.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.2
Medium Sand	0.2	---
Fine Sand	28.7	28.7
Silt	61.7	64.3
Clay	9.3	6.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 23
Plastic Limit: 21
Plasticity Index: 2
Activity Index: 0.29

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

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: ML
Group Name: Silt with sand
AASHTO Classification: A-4 (0)

Comments:

Reviewed by:

File: fm_172679016_sum_768 Sheet: Summary
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant
Source STN-9, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'

Project Number 172679016
Lab ID 768

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: cm
Test Date: 10-15-2009
Date Received 09-09-2009

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

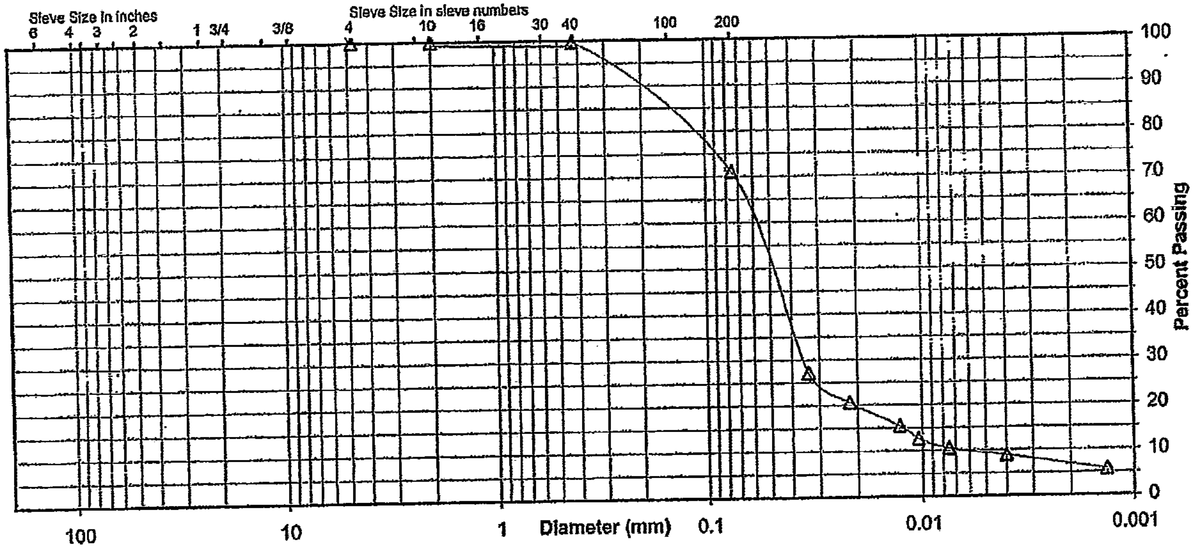
Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.7
No. 200	71.0
0.02 mm	19.3
0.005 mm	9.3
0.002 mm	6.7
0.001 mm	5.0

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 colspan="2">Clay</td></tr>
<tr><td>0.0</td><td>0.0</td><td>0.1</td><td>0.2</td><td>28.7</td><td>61.7</td><td colspan="2">9.3</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">0.1</td><td>0.2</td><td>28.7</td><td colspan="2">64.3</td><td>6.7</td></tr>
</table>



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Allen Fossil Plant (TVA)
Project Number: 172679016
Source: STN-9, 15.0'-17.0'
Lab ID: 497

County: Memphis, TN
Date Received: 8-7-09
Sample Type: ST
Date Reported: 10-22-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 30.0

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	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.2
No. 200	0.075	92.4
	0.02	52.7
	0.005	31.5
	0.002	24.4
estimated	0.001	20.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.7
Medium Sand	0.7	---
Fine Sand	6.8	6.8
Silt	60.9	68.0
Clay	31.5	24.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 31
Plastic Limit: 20
Plasticity Index: 11
Activity Index: 0.46

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 (10)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Allen Fossil Plant (TVA)
Source: STN-9, 15.0'-17.0'
Project Number: 172679016
Lab ID: 497

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: 09-23-2009
Date Received: 08-07-2009

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: 2.69

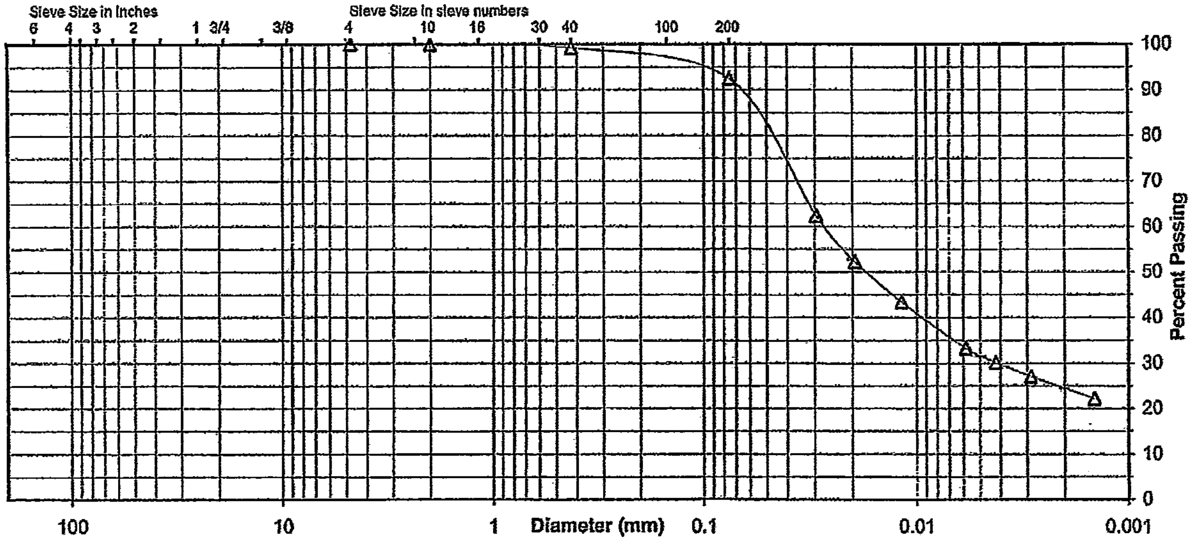
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.2
No. 200	92.4
0.02 mm	52.7
0.005 mm	31.5
0.002 mm	24.4
0.001 mm	20.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	0.7	6.8	60.9	31.5

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.1	0.7	6.8	68.0	24.4



Comments

Reviewed By

File: frm_172679016_sum_497.xls Sheet: Hydro-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: Allen Fossil Plant (TVA)
Project Number: 172679016
Source: STN-9, 23.5'-25.0', 25.0'-26.5', 26.5'-28.0'
Lab ID: 479

County: Memphis, TN
Date Received: 8-7-09
Sample Type: SPT Comp
Date Reported: 10-22-09

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	
No. 4	4.75	100.0
No. 10	2	97.2
No. 40	0.425	97.0
No. 200	0.075	96.1
	0.02	87.6
	0.005	61.0
	0.002	46.0
estimated	0.001	37.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	2.8
Coarse Sand	2.8	0.2
Medium Sand	0.2	---
Fine Sand	0.9	0.9
Silt	35.1	50.1
Clay	61.0	46.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 58
Plastic Limit: 20
Plasticity Index: 38
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: 2.67

Classification

Unified Group Symbol: CH
Group Name: Fat clay
AASHTO Classification: A-7-6 (40)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Allen Fossil Plant (TVA)
Source: STN-9, 23.5'-25.0', 25.0'-26.5', 26.5'-28.0'

Project Number: 172679016
Lab ID: 479

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: cm
Test Date: 09-23-2009
Date Received: 08-07-2009

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	97.2

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

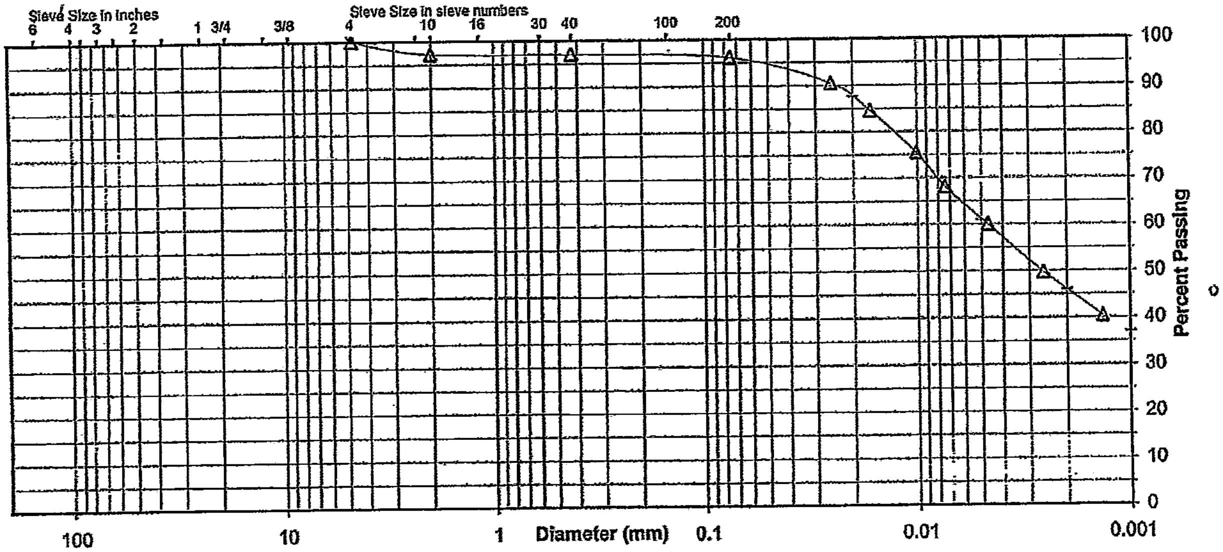
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	97.0
No. 200	96.1
0.02 mm	87.6
0.005 mm	61.0
0.002 mm	46.0
0.001 mm	37.0

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 colspan="2">Clay</td></tr>
<tr><td>0.0</td><td>0.0</td><td>2.8</td><td>0.2</td><td>0.9</td><td>35.1</td><td colspan="2">61.0</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">2.8</td><td>0.2</td><td>0.9</td><td colspan="2">50.1</td><td>46.0</td></tr>
</table>



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Allen Fossil Plant (TVA)
Project Number: 172679016
Source: STN-9, 36.0'-36.5'
Lab ID: 500A

County: Memphis, TN
Date Received: 8-7-09
Sample Type: ST
Date Reported: 10-22-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 63.4

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	81.6
No. 10	2	39.1
No. 40	0.425	38.8
No. 200	0.075	38.2
	0.02	36.0
	0.005	25.8
	0.002	20.3
estimated	0.001	17.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	18.4	60.9
Coarse Sand	42.5	0.3
Medium Sand	0.3	---
Fine Sand	0.6	0.6
Silt	12.4	17.9
Clay	25.8	20.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 73
Plastic Limit: 26
Plasticity Index: 47
Activity Index: 2.35

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: SC
Group Name: Clayey sand with gravel
AASHTO Classification: A-7-6 (10)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Allen Fossil Plant (TVA)
Source: STN-9, 36.0'-36.5'
Project Number: 172679016
Lab ID: 500A

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: AP
Test Date: 10-08-2009
Date Received: 08-07-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	81.6
No. 10	39.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

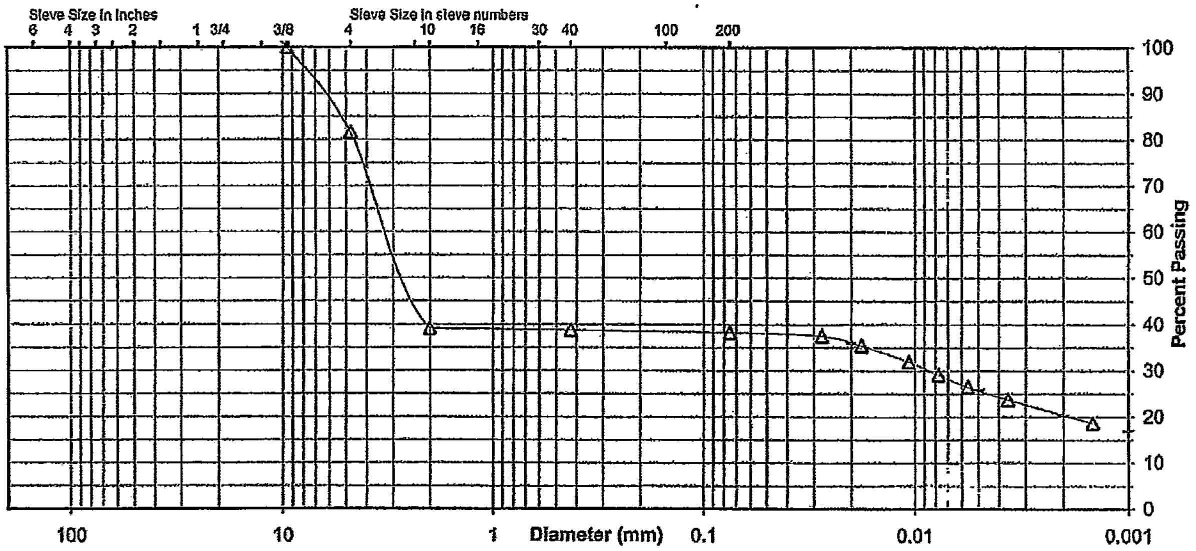
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	38.8
No. 200	38.2
0.02 mm	36.0
0.005 mm	25.8
0.002 mm	20.3
0.001 mm	17.0

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>18.4</td><td>42.5</td><td>0.3</td><td>0.6</td><td colspan="2">12.4</td><td>25.8</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">60.9</td><td>0.3</td><td>0.6</td><td colspan="2">17.9</td><td>20.3</td></tr>
</table>



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name Allen Fossil Plant (TVA)
Project Number 172679016
Source STN-9, 39.1'-39.6'
Lab ID 501B
County Memphis, TN
Date Received 8-7-09
Sample Type ST
Date Reported 10-22-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 27.0

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	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	100.0
No. 200	0.075	96.9
	0.02	37.8
	0.005	19.0
	0.002	15.1
estimated	0.001	13.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.0
Medium Sand	0.0	---
Fine Sand	3.1	3.1
Silt	77.9	81.8
Clay	19.0	15.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 29
Plastic Limit: 23
Plasticity Index: 6
Activity Index: 0.40

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: ML
Group Name: Silt
AASHTO Classification: A-4 (6)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Allen Fossil Plant (TVA)	Project Number	172679016
Source	STN-9, 39.1'-39.6'	Lab ID	501B

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: N/A
Particle Hardness: N/A

Tested By: bwt
Test Date: 09-24-2009
Date Received 08-07-2009

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	
No. 4	
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.67

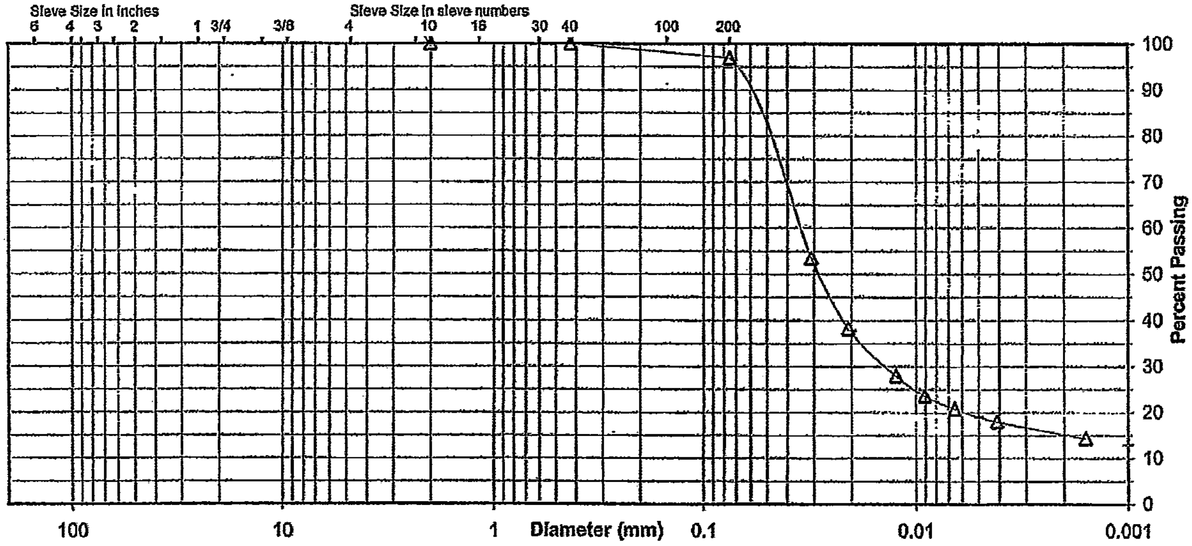
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	100.0
No. 200	96.9
0.02 mm	37.8
0.005 mm	19.0
0.002 mm	15.1
0.001 mm	13.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.0	3.1	77.9	19.0

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	0.0	3.1	81.8	15.1



Comments

Reviewed By

File: frm_172679016_sum_501b.xls Sheet: Hydro-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: Allen Fossil Plant (TVA)
Project Number: 172679016
Source: STN-10, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'
Lab ID: 27

County: Memphis, TN
Date Received: 8-7-09
Sample Type: SPT Comp
Date Reported: 10-20-09

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	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	96.5
No. 200	0.075	58.0
	0.02	23.0
	0.005	13.1
	0.002	10.8
estimated	0.001	9.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.1
Coarse Sand	0.1	3.4
Medium Sand	3.4	---
Fine Sand	38.5	38.5
Silt	44.9	47.2
Clay	13.1	10.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 22
Plastic Limit: 18
Plasticity Index: 4
Activity Index: 0.36

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-ML
Group Name: Sandy silty clay
AASHTO Classification: A-4 (0)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Allen Fossil Plant (TVA)
Source: STN-10, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'
Project Number: 172679016
Lab ID: 27

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: 09-08-2009
Date Received: 08-07-2009

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: 2.68

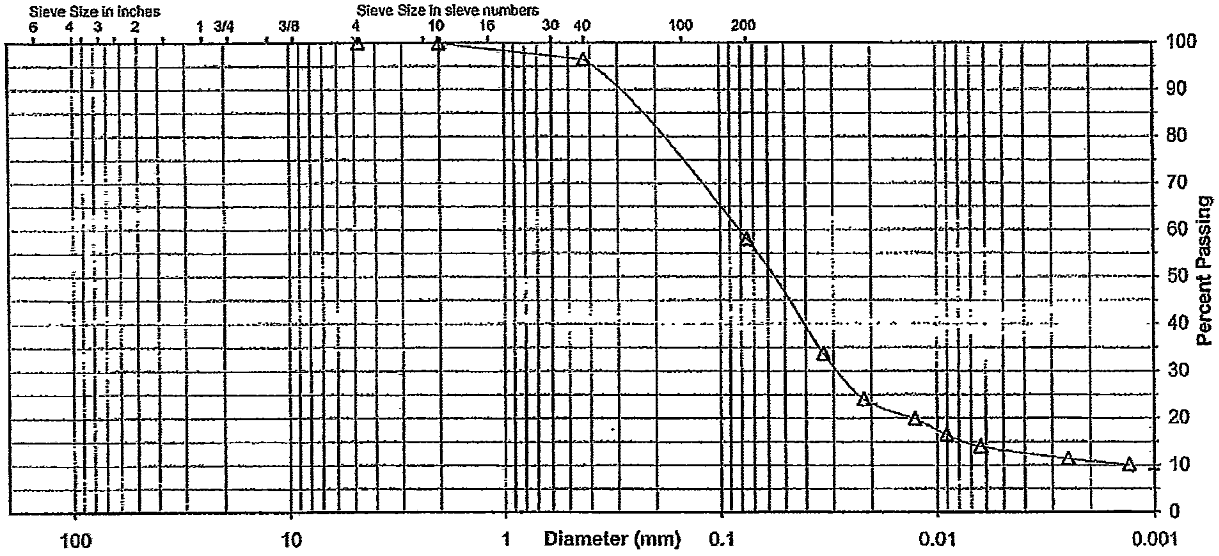
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	96.5
No. 200	58.0
0.02 mm	23.0
0.005 mm	13.1
0.002 mm	10.8
0.001 mm	9.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	3.4	38.5	44.9	13.1

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.1	3.4	38.5	47.2	10.8



Comments

Reviewed By

File: frm_172679016_sum_27 Sheet: Hydro-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: Allen Fossil Plant
Source: STN-10, 16.6'-18.0', 18.0'-19.5', 19.5'-21.0'
County: Memphis, TN
Sample Type: SPT Comp

Project Number: 172679016
Lab ID: 641
Date Received: 9-9-09
Date Reported: 10-21-09

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	90.1
No. 200	0.075	48.0
	0.02	21.7
	0.005	11.3
	0.002	8.8
estimated	0.001	7.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.4	0.8
Coarse Sand	0.4	9.1
Medium Sand	9.1	---
Fine Sand	42.1	42.1
Silt	36.7	39.2
Clay	11.3	8.8

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

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Reviewed by:

File: frm_172679016_sum_641 Sheet: Summary
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant
Source STN-10, 16.5'-18.0', 18.0'-19.5', 19.5'-21.0'

Project Number 172679016
Lab ID 641

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: CM
Test Date: 10-15-2009
Date Received 09-09-2009

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

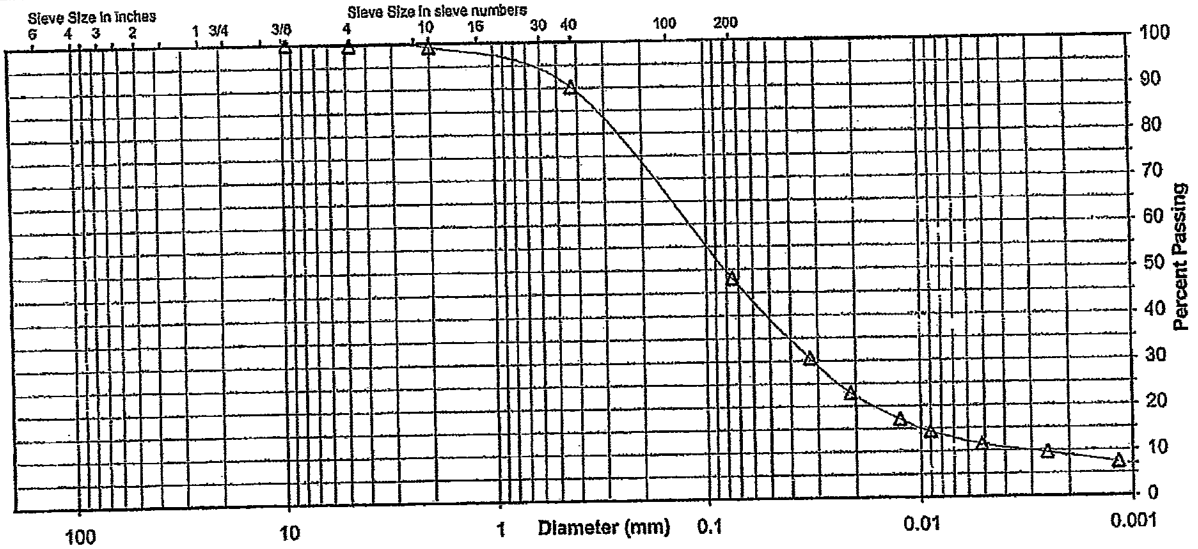
Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	90.1
No. 200	48.0
0.02 mm	21.7
0.005 mm	11.3
0.002 mm	8.8
0.001 mm	7.0

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>0.4</td><td>0.4</td><td>9.1</td><td>42.1</td><td colspan="2">36.7</td><td colspan="2">11.3</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>9.1</td><td>42.1</td><td colspan="3">39.2</td><td>8.8</td></tr>
</table>



Comments

Reviewed By

File: frm_172679016_sum_641 Sheet: Hydro-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: Allen Fossil Plant (TVA)
Source: STN-10, 24.0'-25.5', 25.5'-27.0', 27.0'-28.5'
Project Number: 172679016
Lab ID: 39

County: Memphis, TN
Sample Type: SPT Comp
Date Received: 8-7-09
Date Reported: 10-20-09

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	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.9
No. 200	0.075	78.8
	0.02	22.4
	0.005	13.5
	0.002	10.7
estimated	0.001	10.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.1
Medium Sand	0.1	---
Fine Sand	21.1	21.1
Silt	65.3	68.1
Clay	13.5	10.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 25
Plastic Limit: 22
Plasticity Index: 3
Activity Index: 0.27

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: ML
Group Name: Silt with sand
AASHTO Classification: A-4 (1)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant (TVA)
Source STN-10, 24.0'-25.5', 25.5'-27.0', 27.0'-28.5'

Project Number 172679016
Lab ID 39

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: N/A
Particle Hardness: N/A

Tested By: JF
Test Date: 09-08-2009
Date Received 08-07-2009

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	
No. 4	
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.67

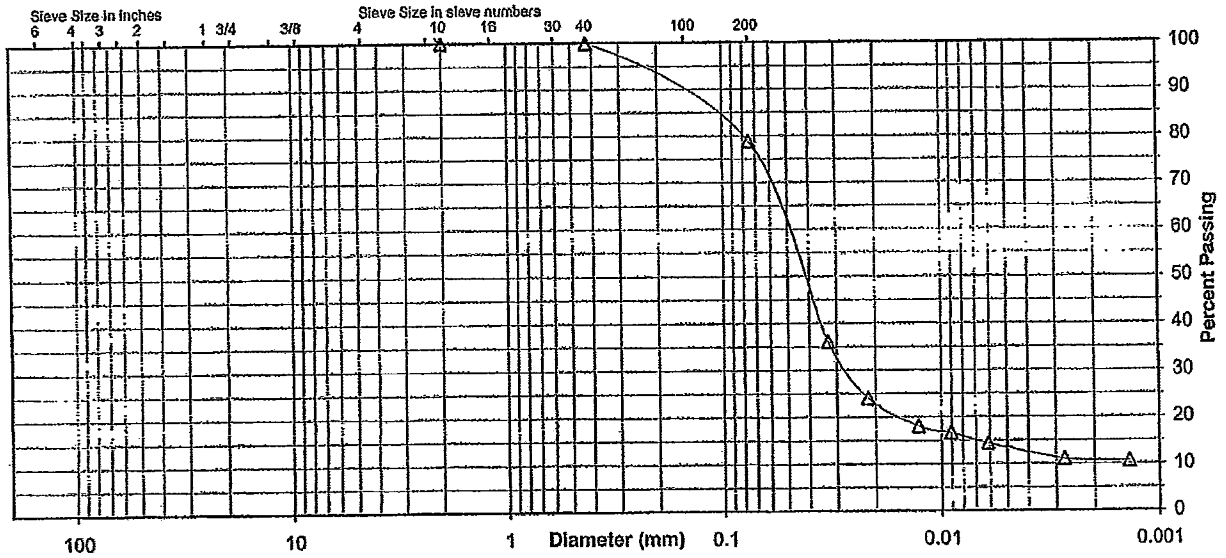
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.9
No. 200	78.8
0.02 mm	22.4
0.005 mm	13.5
0.002 mm	10.7
0.001 mm	10.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.1	21.1	65.3	13.5

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	0.1	21.1	68.1	10.7



Comments

Reviewed By

File: fm_172679016_sum_39 Sheet: Hydro-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: Allen Fossil Plant
Source: STN-10, 33.0'-34.5', 34.5'-36.0', 36.0'-37.5'
County: Memphis, TN
Sample Type: SPT Comp

Project Number: 172679016
Lab ID: 645
Date Received: 9-9-09
Date Reported: 10-21-09

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	
No. 4	4.75	100.0
No. 10	2	99.2
No. 40	0.425	98.6
No. 200	0.075	95.4
	0.02	44.6
	0.005	21.9
	0.002	17.0
estimated	0.001	15.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.8
Coarse Sand	0.8	0.6
Medium Sand	0.6	---
Fine Sand	3.2	3.2
Silt	73.5	78.4
Clay	21.9	17.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 32
Plastic Limit: 23
Plasticity Index: 9
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

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL
Group Name: Lean clay
AASHTO Classification: A-4 (9)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant
Source STN-10, 33.0'-34.5', 34.5'-36.0', 36.0'-37.5'

Project Number 172679016
Lab ID 645

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: CM
Test Date: 10-15-2009
Date Received 09-09-2009

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	99.2

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

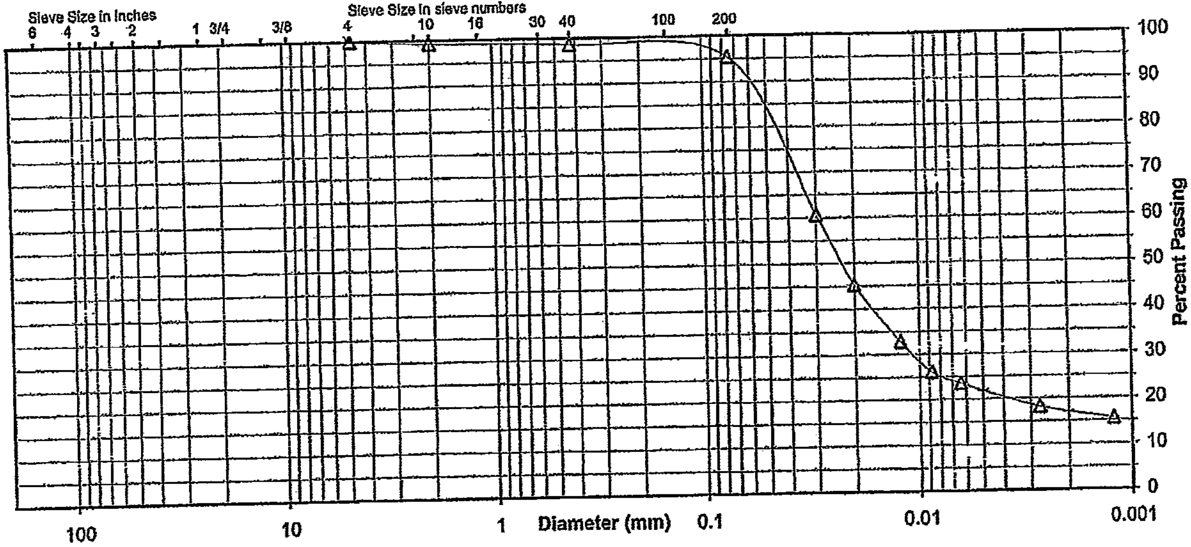
Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.6
No. 200	95.4
0.02 mm	44.6
0.005 mm	21.9
0.002 mm	17.0
0.001 mm	15.0

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>0.0</td><td>0.8</td><td>0.6</td><td>3.2</td><td colspan="2">73.5</td><td>21.9</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">0.8</td><td>0.6</td><td>3.2</td><td colspan="2">78.4</td><td>17.0</td></tr>
</table>



Comments

Reviewed By

File: fm_172679016_sum_645 Sheet: Hydro-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 Allen Fossil Plant
Source STN-10, 42.0'-43.5', 43.5'-45.0', 45.0'-46.5'
County Memphis, TN
Sample Type SPT Comp

Project Number 172679016
Lab ID 649
Date Received 9-9-09
Date Reported 10-21-09

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	
No. 4	4.75	100.0
No. 10	2	83.0
No. 40	0.425	82.8
No. 200	0.075	82.3
	0.02	78.5
	0.005	59.1
	0.002	45.8
estimated	0.001	39.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	17.0
Coarse Sand	17.0	0.2
Medium Sand	0.2	---
Fine Sand	0.5	0.5
Silt	23.2	36.5
Clay	59.1	45.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 72
Plastic Limit: 21
Plasticity Index: 51
Activity Index: 1.11

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

Estimated
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 (44)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name Allen Fossil Plant
Source STN-10, 42.0'-43.5', 43.5'-45.0', 45.0'-46.5'

Project Number 172679016
Lab ID 649

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: cm
Test Date: 10-15-2009
Date Received 09-09-2009

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	83.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

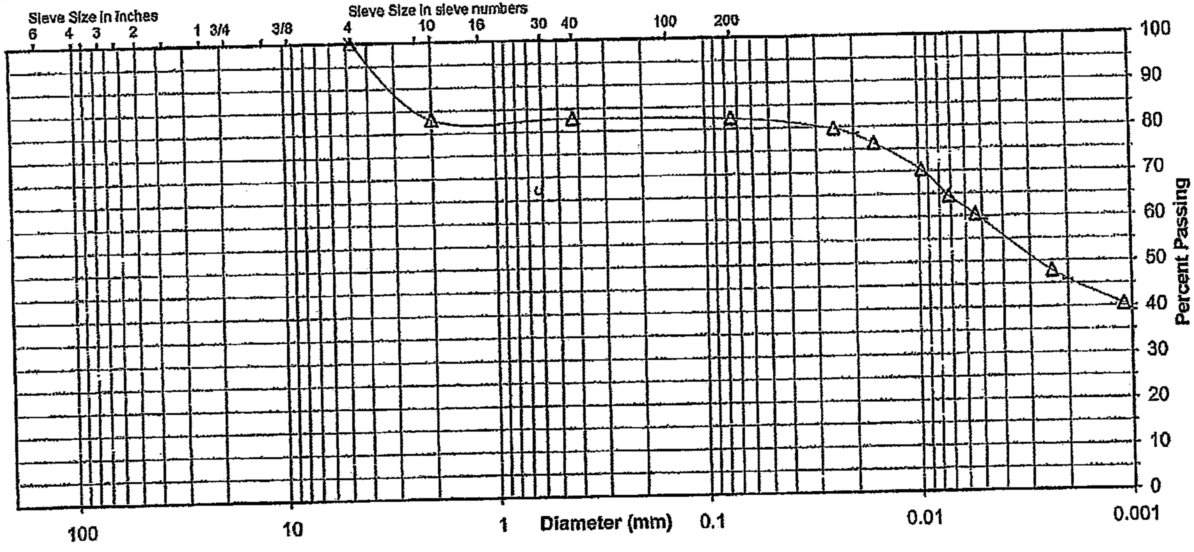
Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	82.8
No. 200	82.3
0.02 mm	78.5
0.005 mm	59.1
0.002 mm	45.8
0.001 mm	39.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	17.0	0.2	0.5	23.2	59.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	17.0			0.2	0.5	36.5	45.8



Comments

Reviewed By

File: frm_172679016_sum_649 Sheet: Hydro-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 Allen Fossil Plant
Source STN-10, 51.0'-52.5', 52.5'-54.0'
County Memphis, TN
Sample Type SPT Comp

Project Number 172679016
Lab ID 653
Date Received 9-9-09
Date Reported 10-21-09

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	99.3
No. 4	4.75	99.3
No. 10	2	98.9
No. 40	0.425	98.7
No. 200	0.075	80.2
	0.02	27.0
	0.005	13.7
	0.002	11.2
estimated	0.001	9.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.7	1.1
Coarse Sand	0.4	0.2
Medium Sand	0.2	---
Fine Sand	18.5	18.5
Silt	66.5	69.0
Clay	13.7	11.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 26
Plastic Limit: 24
Plasticity Index: 2
Activity Index: 0.18

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

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: ML
Group Name: Silt with sand
AASHTO Classification: A-4 (1)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant
Source STN-10, 51.0'-52.5', 52.5'-54.0'

Project Number 172679016
Lab ID 653

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: 10-15-2009
Date Received 09-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.3
No. 4	99.3
No. 10	98.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.7

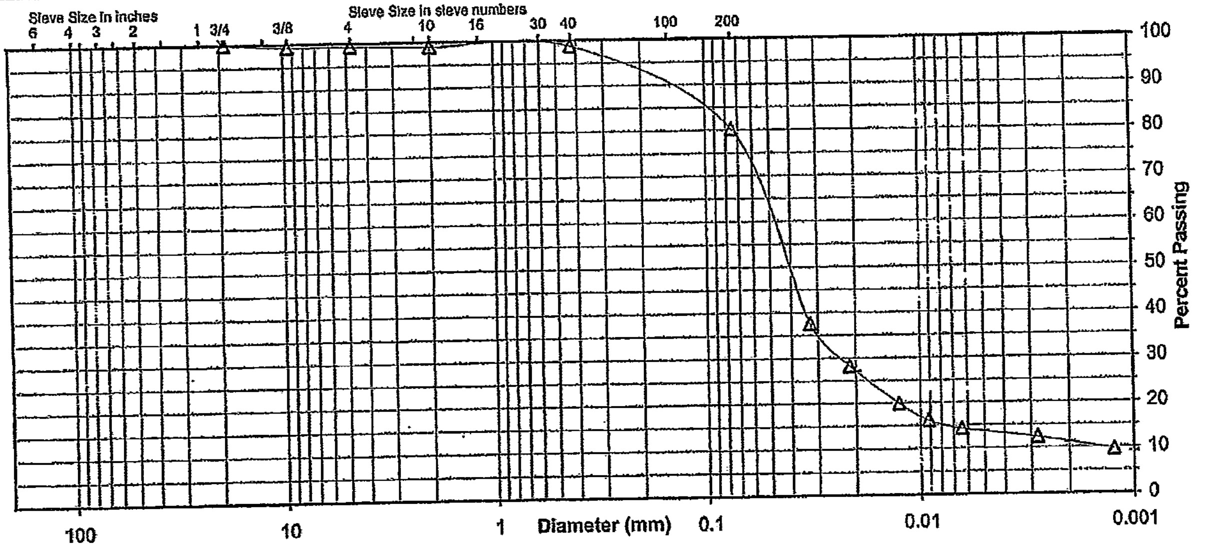
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.7
No. 200	80.2
0.02 mm	27.0
0.005 mm	13.7
0.002 mm	11.2
0.001 mm	9.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.7	0.4	0.2	18.5	66.5	13.7

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	1.1	0.2	18.5	69.0	11.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Allen Fossil Plant (TVA)
Project Number: 172679016
Source: STN-11, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'
Lab ID: 69

County: Memphis, TN
Date Received: 8-7-09
Sample Type: SPT Comp
Date Reported: 10-20-09

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	99.9
No. 10	2	99.6
No. 40	0.425	91.5
No. 200	0.075	42.3
	0.02	17.1
	0.005	11.3
	0.002	8.4
estimated	0.001	8.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.1	0.4
Coarse Sand	0.3	8.1
Medium Sand	8.1	---
Fine Sand	49.2	49.2
Silt	31.0	33.9
Clay	11.3	8.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 20
Plastic Limit: 16
Plasticity Index: 4
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: 2.67

Classification

Unified Group Symbol: SC-SM
Group Name: Silty, clayey sand
AASHTO Classification: A-4 (0)

Comments:

Reviewed by:

File: frm_172679016_sum_69 Sheet: Summary
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant (TVA)
Source STN-11, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'

Project Number 172679016
Lab ID 69

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: 09-08-2009
Date Received 08-07-2009

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	99.6

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

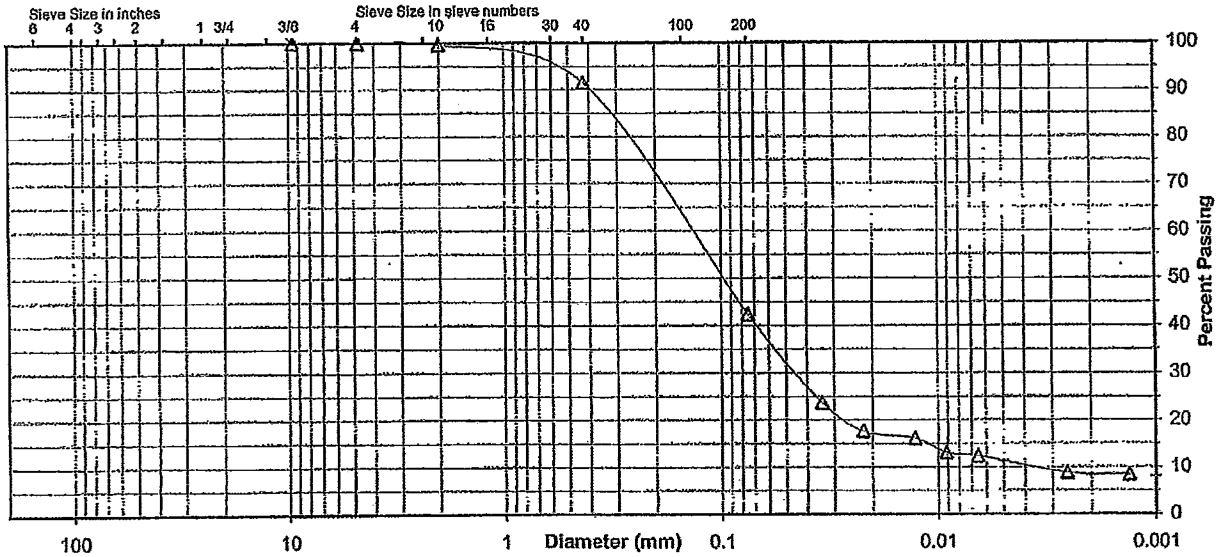
Specific Gravity 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	91.5
No. 200	42.3
0.02 mm	17.1
0.005 mm	11.3
0.002 mm	8.4
0.001 mm	8.0

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 colspan="2">Clay</td></tr>
<tr><td>0.0</td><td>0.1</td><td>0.3</td><td>8.1</td><td>49.2</td><td>31.0</td><td colspan="2">11.3</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">0.4</td><td>8.1</td><td>49.2</td><td colspan="2">33.9</td><td>8.4</td></tr>
</table>



Comments

Reviewed By

File: fm_172679016_sum_69 Sheet: Hydro-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: Allen Fossil Plant
Project Number: 172679016
Source: STN-11, 19.5'-21.0', 21.0'-22.5', 22.5'-24.0'
Lab ID: 656

County: Memphis, TN
Date Received: 9-9-09
Sample Type: SPT Comp
Date Reported: 10-22-09

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	99.7
No. 10	2	99.5
No. 40	0.425	88.0
No. 200	0.075	40.5
	0.02	18.1
	0.005	10.6
	0.002	8.0
estimated	0.001	6.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.3	0.5
Coarse Sand	0.2	11.5
Medium Sand	11.5	---
Fine Sand	47.5	47.5
Silt	29.9	32.5
Clay	10.6	8.0

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

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant
Source STN-11, 19.5'-21.0', 21.0'-22.5', 22.5'-24.0'

Project Number 172679016
Lab ID 656

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: CM
Test Date: 10-15-2009
Date Received 09-09-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.7
No. 10	99.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.7

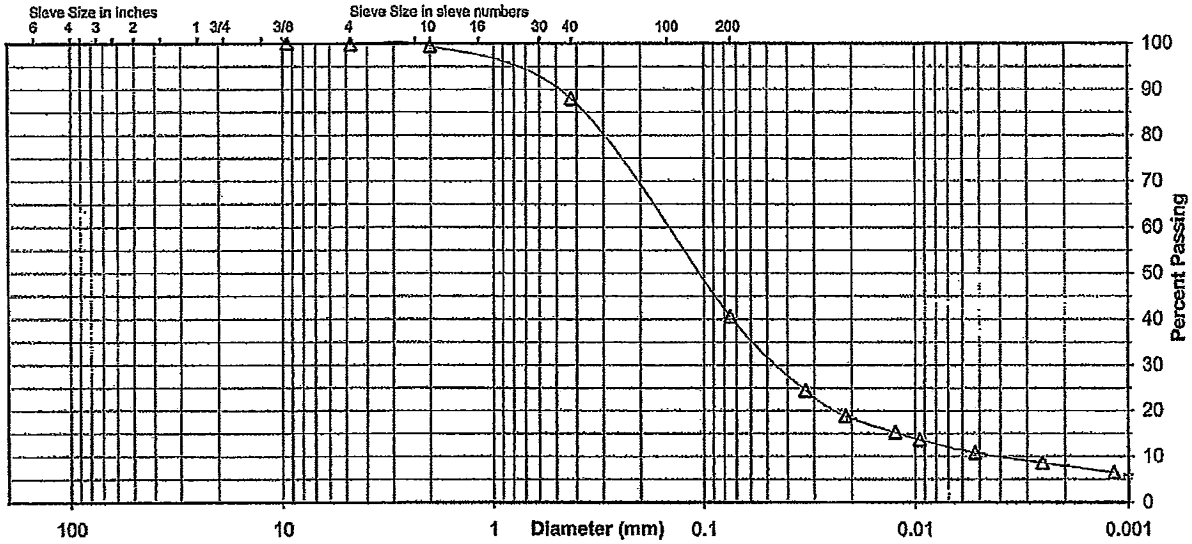
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	88.0
No. 200	40.5
0.02 mm	18.1
0.005 mm	10.6
0.002 mm	8.0
0.001 mm	6.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.3	0.2	11.5	47.5	29.9	10.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.5	11.5	47.5	32.5	8.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Allen Fossil Plant
Source: STN-11, 28.5'-30.0', 30.0'-31.5', 31.5'-33.0'
County: Memphis, TN
Sample Type: SPT Comp

Project Number: 172679016
Lab ID: 660
Date Received: 9-9-09
Date Reported: 10-22-09

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	
No. 4	4.75	100.0
No. 10	2	99.8
No. 40	0.425	99.6
No. 200	0.075	88.7
	0.02	37.9
	0.005	21.0
	0.002	16.0
estimated	0.001	13.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.2
Coarse Sand	0.2	0.2
Medium Sand	0.2	---
Fine Sand	10.9	10.9
Silt	67.7	72.7
Clay	21.0	16.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 29
Plastic Limit: 22
Plasticity Index: 7
Activity Index: 0.44

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

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL-ML
Group Name: Silty clay
AASHTO Classification: A-4 (6)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant
Source STN-11, 28.5'-30.0', 30.0'-31.5', 31.5'-33.0'

Project Number 172679016
Lab ID 660

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: 10-16-2009
Date Received 09-09-2009

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	99.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

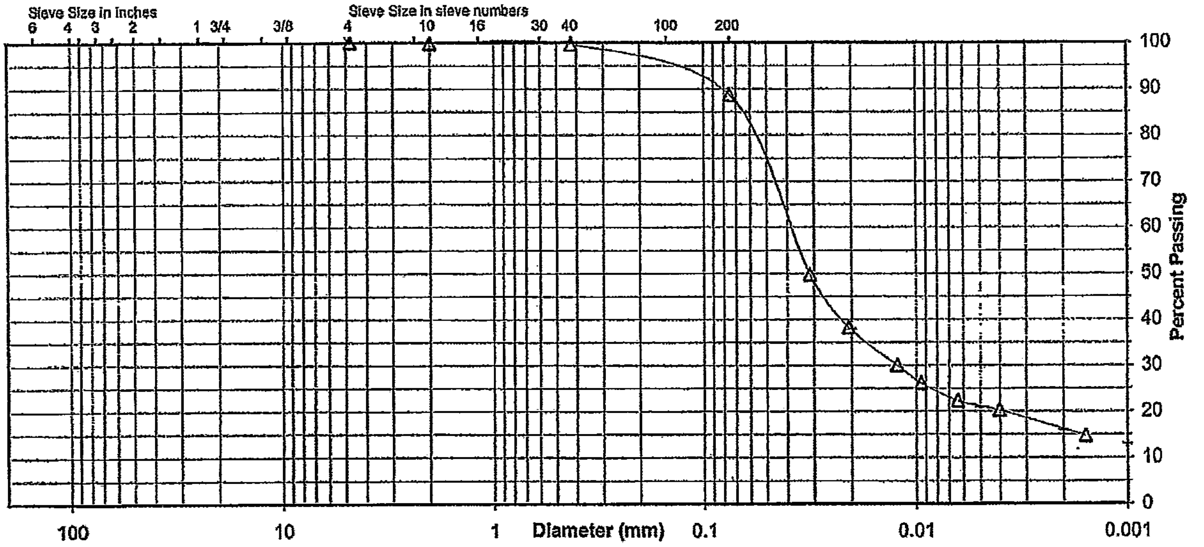
Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.6
No. 200	88.7
0.02 mm	37.9
0.005 mm	21.0
0.002 mm	16.0
0.001 mm	13.0

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 colspan="2">Clay</td></tr>
<tr><td>0.0</td><td>0.0</td><td>0.2</td><td>0.2</td><td>10.9</td><td>67.7</td><td colspan="2">21.0</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">0.2</td><td>0.2</td><td>10.9</td><td colspan="2">72.7</td><td>16.0</td></tr>
</table>



Comments

Reviewed By

File: fm_172679016_sum_660.xls Sheet: Hydro-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: Allen Fossil Plant (TVA)
Source: STN-11, 36.0'-37.5', 37.5'-39.0', 39.0'-40.5'
Project Number: 172679016
Lab ID: 89

County: Memphis, TN
Sample Type: SPT Comp
Date Received: 8-7-09
Date Reported: 10-20-09

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	
No. 4	4.75	100.0
No. 10	2	89.2
No. 40	0.425	88.6
No. 200	0.075	87.7
	0.02	81.8
	0.005	62.7
	0.002	48.1
estimated	0.001	41.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	10.8
Coarse Sand	10.8	0.6
Medium Sand	0.6	---
Fine Sand	0.9	0.9
Silt	25.0	39.6
Clay	62.7	48.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 70
Plastic Limit: 24
Plasticity Index: 46
Activity Index: 0.96

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: CH
Group Name: Fat clay

AASHTO Classification: A-7-6 (45)

Comments:

Reviewed by:

File: frm_172679016_sum_89 Sheet: Summary
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant (TVA)
Source STN-11, 36.0'-37.5', 37.5'-39.0', 39.0'-40.5'

Project Number 172679016
Lab ID 89

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: 09-09-2009
Date Received 08-07-2009

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	89.2

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

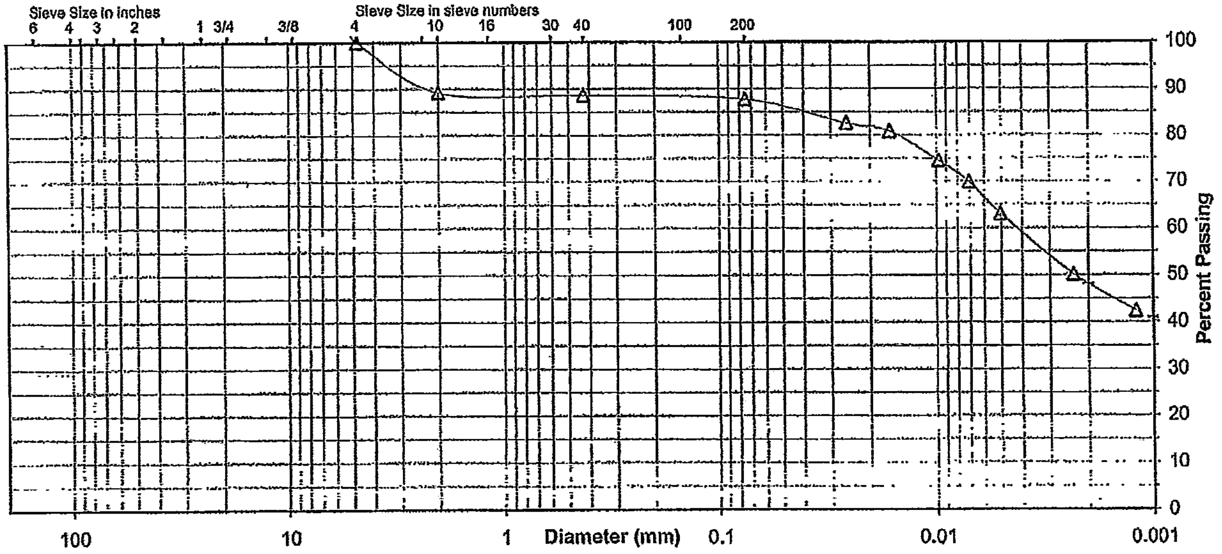
Specific Gravity 2.73

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	88.6
No. 200	87.7
0.02 mm	81.8
0.005 mm	62.7
0.002 mm	48.1
0.001 mm	41.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	10.8	0.6	0.9	25.0	62.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	10.8			0.6	0.9	39.6	48.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name Allen Fossil Plant
Source STN-11, 55.5'-57.0', 57.0'-58.5', 58.5'-60.0'
Project Number 172679016
Lab ID 664

County Memphis, TN
Sample Type SPT Comp
Date Received 9-9-09
Date Reported 10-21-09

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	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.8
No. 200	0.075	89.2
	0.02	40.7
	0.005	25.0
	0.002	19.7
estimated	0.001	18.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.1
Medium Sand	0.1	---
Fine Sand	10.6	10.6
Silt	64.2	69.5
Clay	25.0	19.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 30
Plastic Limit: 22
Plasticity Index: 8
Activity Index: 0.40

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

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL
Group Name: Lean clay
AASHTO Classification: A-4 (7)

Comments:

Reviewed by:

File: frm_172679016_sum_664 Sheet: Summary
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Allen Fossil Plant
Source: STN-11, 55.5'-57.0', 57.0'-58.5', 58.5'-60.0'

Project Number: 172679016
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: Rounded
Particle Hardness: Hard and Durable

Tested By: jf
Test Date: 10-15-2009
Date Received: 09-09-2009

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

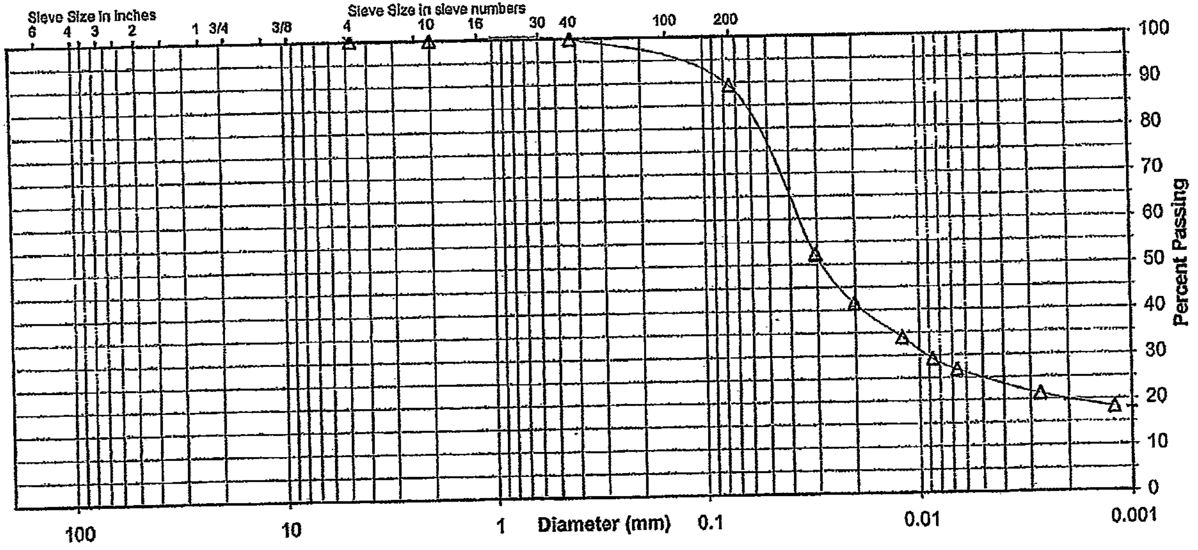
Specific Gravity: 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.8
No. 200	89.2
0.02 mm	40.7
0.005 mm	25.0
0.002 mm	19.7
0.001 mm	18.0

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>0.0</td><td>0.0</td><td>0.1</td><td>0.1</td><td>10.6</td><td>64.2</td><td>25.0</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">0.1</td><td>0.1</td><td>10.6</td><td>69.5</td><td>19.7</td></tr>
</table>



Comments

Reviewed By

File: frm_172679016_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

Summary of Soil Tests

Project Name: Allen Fossil Plant
Source: STN-12, 1.5'-3.0', 3.0'-4.5', 4.5'-6.0'
Project Number: 172679016
Lab ID: 668

County: Memphis, TN
Sample Type: SPT Comp
Date Received: 9-9-09
Date Reported: 10-22-09

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	99.7
No. 10	2	98.8
No. 40	0.425	96.7
No. 200	0.075	64.9
	0.02	26.9
	0.005	14.2
	0.002	11.0
estimated	0.001	8.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.3	1.2
Coarse Sand	0.9	2.1
Medium Sand	2.1	---
Fine Sand	31.8	31.8
Silt	50.7	53.9
Clay	14.2	11.0

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

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: ML
Group Name: Sandy silt
AASHTO Classification: A-4 (0)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Allen Fossil Plant	Project Number	172679016
Source	STN-12, 1.5'-3.0', 3.0'-4.5', 4.5'-6.0'	Lab ID	668

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: JF
Test Date: 10-16-2009
Date Received 09-09-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.7
No. 10	98.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.7

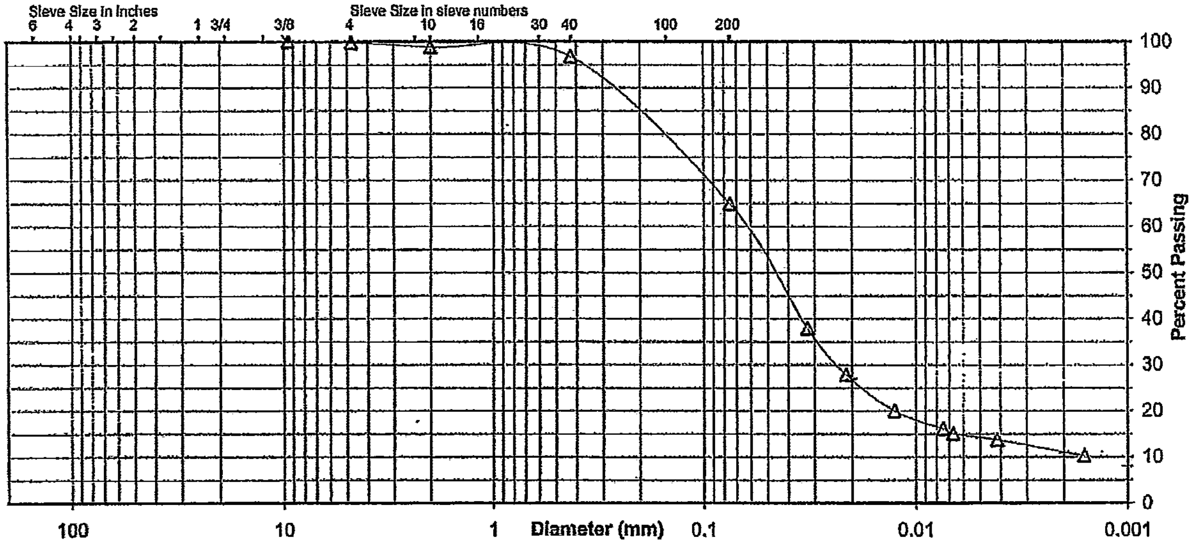
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	96.7
No. 200	64.9
0.02 mm	26.9
0.005 mm	14.2
0.002 mm	11.0
0.001 mm	8.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.3	0.9	2.1	31.8	50.7	14.2

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	1.2	2.1	31.8	63.9	11.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Allen Fossil Plant
Source: STN-12, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'
Project Number: 172679016
Lab ID: 672

County: Memphis, TN
Sample Type: SPT Comp
Date Received: 9-9-09
Date Reported: 10-21-09

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	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	99.7
No. 40	0.425	96.1
No. 200	0.075	53.2
	0.02	23.5
	0.005	13.2
	0.002	10.2
estimated	0.001	8.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.3
Coarse Sand	0.3	3.6
Medium Sand	3.6	---
Fine Sand	42.9	42.9
Silt	40.0	43.0
Clay	13.2	10.2

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

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: ML
Group Name: Sandy silt

AASHTO Classification: A-4 (0)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Allen Fossil Plant
Source: STN-12, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'

Project Number: 172679016
Lab ID: 672

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: 10-15-2009
Date Received: 09-09-2009

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	99.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

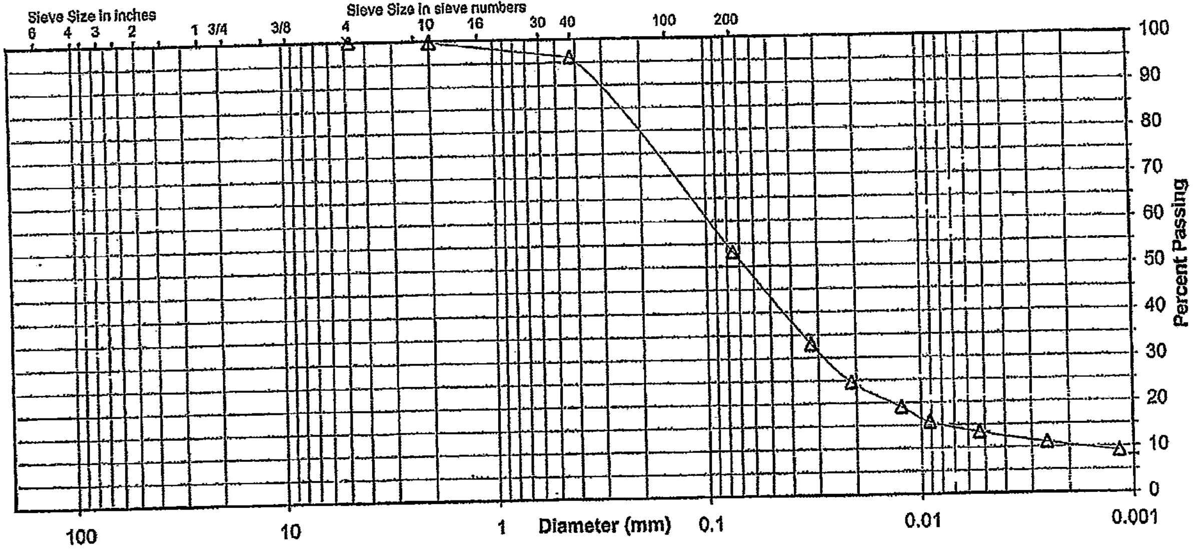
Specific Gravity: 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	96.1
No. 200	53.2
0.02 mm	23.5
0.005 mm	13.2
0.002 mm	10.2
0.001 mm	8.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.3	3.6	42.9	40.0	13.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.3			3.6	42.9	43.0	10.2



Comments

Reviewed By

File: frm_172679016_sum_672 Sheet: Hydro-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: Allen Fossil Plant
Source: STN-12, 24.0'-25.5', 25.5'-27.0', 27.0'-28.5'

County: Memphis, TN
Sample Type: SPT Comp

Project Number: 172679016
Lab ID: 676

Date Received: 9-9-09
Date Reported: 10-21-09

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	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.4
No. 200	0.075	84.0
	0.02	28.5
	0.005	16.3
	0.002	12.8
estimated	0.001	11.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.6
Medium Sand	0.6	---
Fine Sand	15.4	15.4
Silt	67.7	71.2
Clay	16.3	12.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 27
Plastic Limit: 23
Plasticity Index: 4
Activity Index: 0.31

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

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: ML
Group Name: Silt with sand

AASHTO Classification: A-4 (2)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant
Source STN-12, 24.0'-25.5', 25.5'-27.0', 27.0'-28.5'

Project Number 172679016
Lab ID 676

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: N/A
Particle Hardness: N/A

Tested By: cm
Test Date: 10-15-2009
Date Received 09-09-2009

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	
No. 4	
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

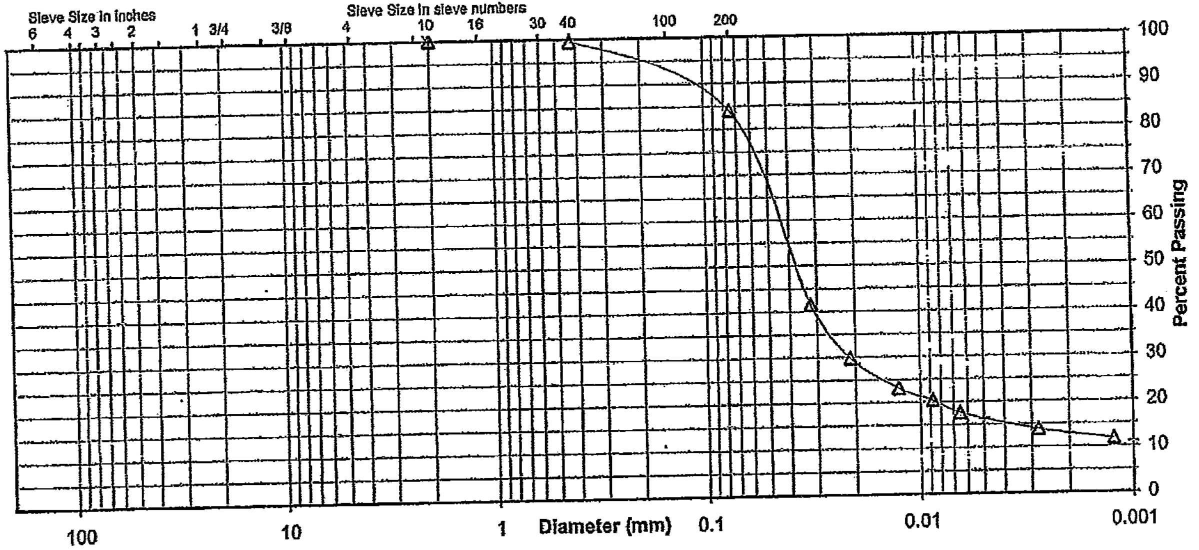
Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.4
No. 200	84.0
0.02 mm	28.5
0.005 mm	16.3
0.002 mm	12.8
0.001 mm	11.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.6	15.4	67.7	16.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.6	15.4	71.2	12.8



Comments

Reviewed By

File: fm_172679016_sum_676 Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2006

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Summary of Soil Tests

Project Name: Allen Fossil Plant (TVA)
Project Number: 172679016
Source: STN-12, 36.0'-37.5', 37.5'-39.0', 39.0'-40.5'
Lab ID: 130

County: Memphis, TN
Date Received: 8-7-09
Sample Type: SPT Comp
Date Reported: 10-20-09

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	99.8
No. 10	2	99.8
No. 40	0.425	99.8
No. 200	0.075	87.8
	0.02	34.9
	0.005	20.1
	0.002	15.5
estimated	0.001	12.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.2	0.2
Coarse Sand	0.0	0.0
Medium Sand	0.0	---
Fine Sand	12.0	12.0
Silt	67.7	72.3
Clay	20.1	15.5

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 30
Plastic Limit: 23
Plasticity Index: 7
Activity Index: 0.44

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: ML
Group Name: Silt

AASHTO Classification: A-4 (6)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant (TVA)
Source STN-12, 36.0'-37.5', 37.5'-39.0', 39.0'-40.5'

Project Number 172679016
Lab ID 130

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: 09-08-2009
Date Received 08-07-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.8
No. 10	99.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

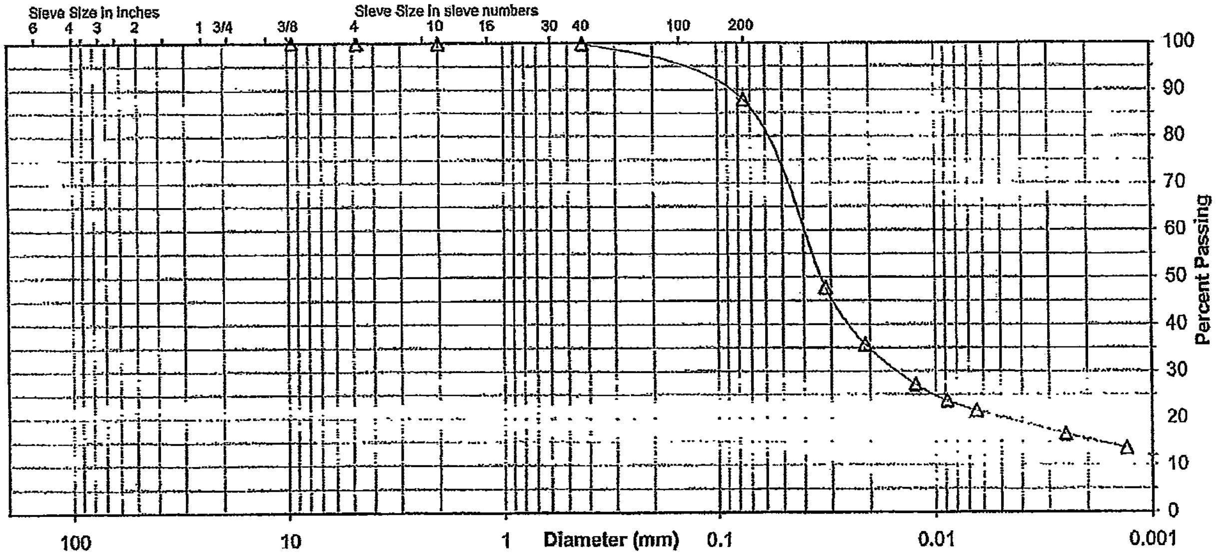
Specific Gravity 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.8
No. 200	87.8
0.02 mm	34.9
0.005 mm	20.1
0.002 mm	15.5
0.001 mm	12.0

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>0.2</td><td>0.0</td><td>0.0</td><td>12.0</td><td colspan="2">67.7</td><td colspan="2">20.1</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">0.2</td><td>0.0</td><td>12.0</td><td colspan="3">72.3</td><td>15.5</td></tr>
</table>



Comments

Reviewed By

File: frm_172679016_sum_130 Sheet: Hydro-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: Allen Fossil Plant
Source: STN-13, 6.0'-7.5', 7.5'-9.0', 9.0'-10.5'
County: Memphis, TN
Sample Type: SPT Comp

Project Number: 172679016
Lab ID: 680
Date Received: 9-9-09
Date Reported: 10-21-09

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	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	98.2
No. 200	0.075	69.2
	0.02	31.7
	0.005	16.6
	0.002	13.2
estimated	0.001	11.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.0
Coarse Sand	0.0	1.8
Medium Sand	1.8	---
Fine Sand	29.0	29.0
Silt	52.6	56.0
Clay	16.6	13.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 23
Plastic Limit: 19
Plasticity Index: 4
Activity Index: 0.31

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

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL-ML
Group Name: Sandy silty clay

AASHTO Classification: A-4 (1)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant
Source STN-13, 6.0'-7.5', 7.5'-9.0', 9.0'-10.5'

Project Number 172679016
Lab ID 680

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: ps
Test Date: 10-15-2009
Date Received 09-09-2009

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	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.7

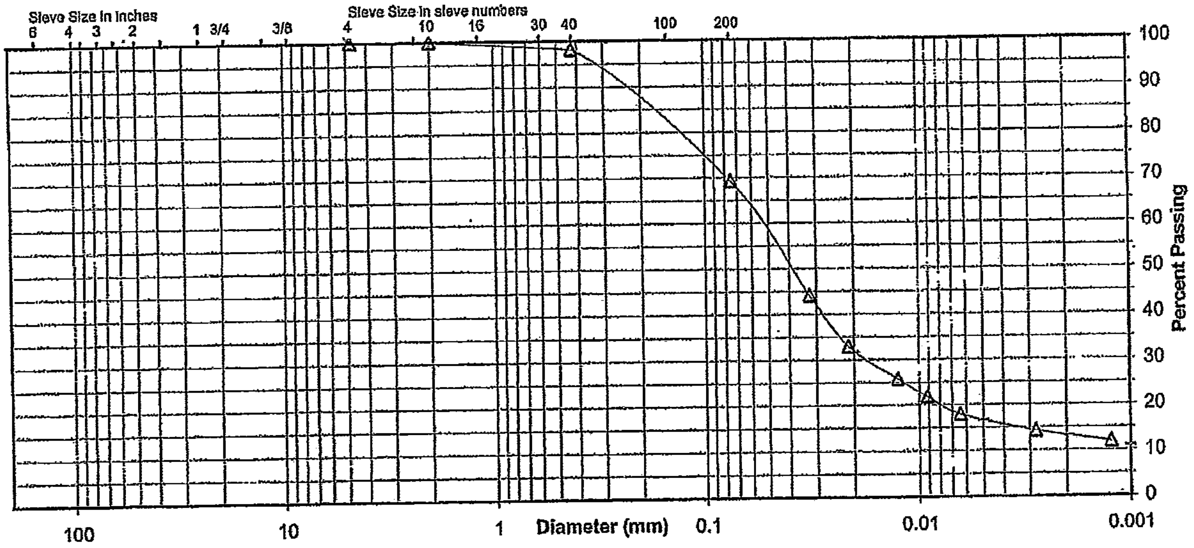
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.2
No. 200	69.2
0.02 mm	31.7
0.005 mm	16.6
0.002 mm	13.2
0.001 mm	11.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	1.8	29.0	62.6	16.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	1.8	29.0	56.0	13.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Allen Fossil Plant (TVA)
Project Number: 172679016
Source: STN-13, 16.5'-18.0', 18.0'-19.5', 19.5'-21.0'
Lab ID: 145

County: Memphis, TN
Date Received: 8-7-09
Sample Type: SPT Comp
Date Reported: 10-20-09

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	
3/8"	9.5	100.0
No. 4	4.75	99.9
No. 10	2	99.5
No. 40	0.425	97.5
No. 200	0.075	56.7
	0.02	22.3
	0.005	12.1
	0.002	8.2
estimated	0.001	7.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.1	0.5
Coarse Sand	0.4	2.0
Medium Sand	2.0	---
Fine Sand	40.8	40.8
Silt	44.6	48.5
Clay	12.1	8.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 21
Plastic Limit: 18
Plasticity Index: 3
Activity Index: 0.38

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: Sandy silt

AASHTO Classification: A-4 (0)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant (TVA)
Source STN-13, 16.5'-18.0', 18.0'-19.5', 19.5'-21.0'

Project Number 172679016
Lab ID 145

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: 09-09-2009
Date Received 08-07-2009

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	99.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.66

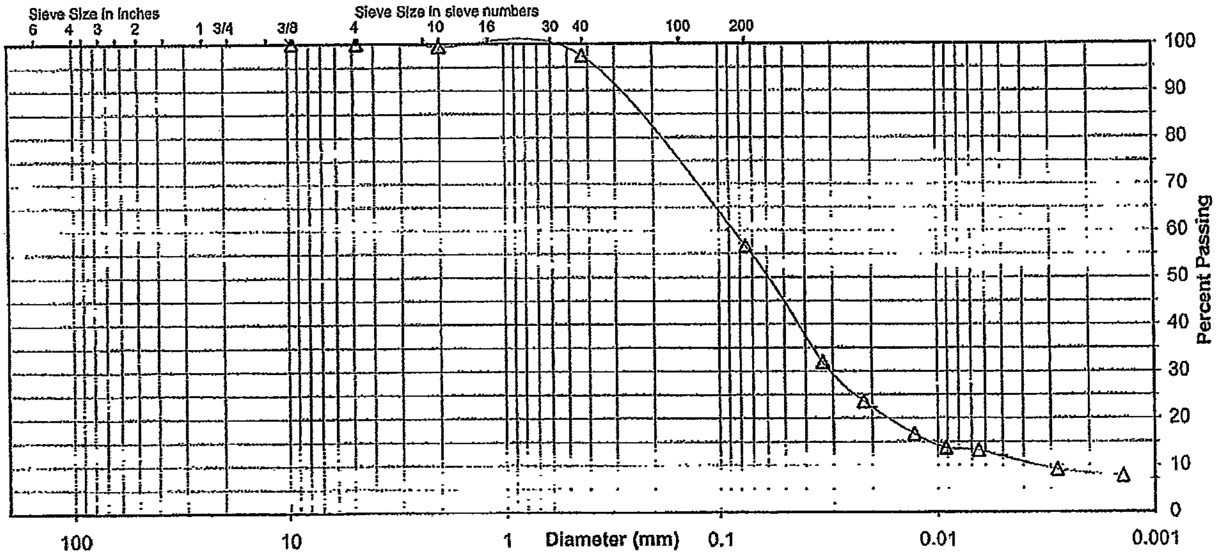
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	97.5
No. 200	56.7
0.02 mm	22.3
0.005 mm	12.1
0.002 mm	8.2
0.001 mm	7.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.1	0.4	2.0	40.8	44.6	12.1

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.5	2.0	40.8	48.5	8.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Allen Fossil Plant (TVA)
Source: STN-13, 33.0'-34.5', 34.5'-36.0', 36.0'-37.5'
Project Number: 172679016
Lab ID: 157

County: Memphis, TN
Sample Type: SPT Comp
Date Received: 8-7-09
Date Reported: 10-22-09

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	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	99.7
No. 40	0.425	97.8
No. 200	0.075	91.3
	0.02	38.3
	0.005	20.9
	0.002	15.3
estimated	0.001	12.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.3
Coarse Sand	0.3	1.9
Medium Sand	1.9	---
Fine Sand	6.5	6.5
Silt	70.4	76.0
Clay	20.9	15.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 30
Plastic Limit: 24
Plasticity Index: 6
Activity Index: 0.40

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: ML
Group Name: Silt
AASHTO Classification: A-4 (5)

Comments:

Reviewed by:

File: fm_172679016_sum_157.xls Sheet: Summary
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant (TVA)
Source STN-13, 33.0'-34.5', 34.5'-36.0', 36.0'-37.5'

Project Number 172679016
Lab ID 157

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: 10-19-2009
Date Received 08-07-2009

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	99.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.68

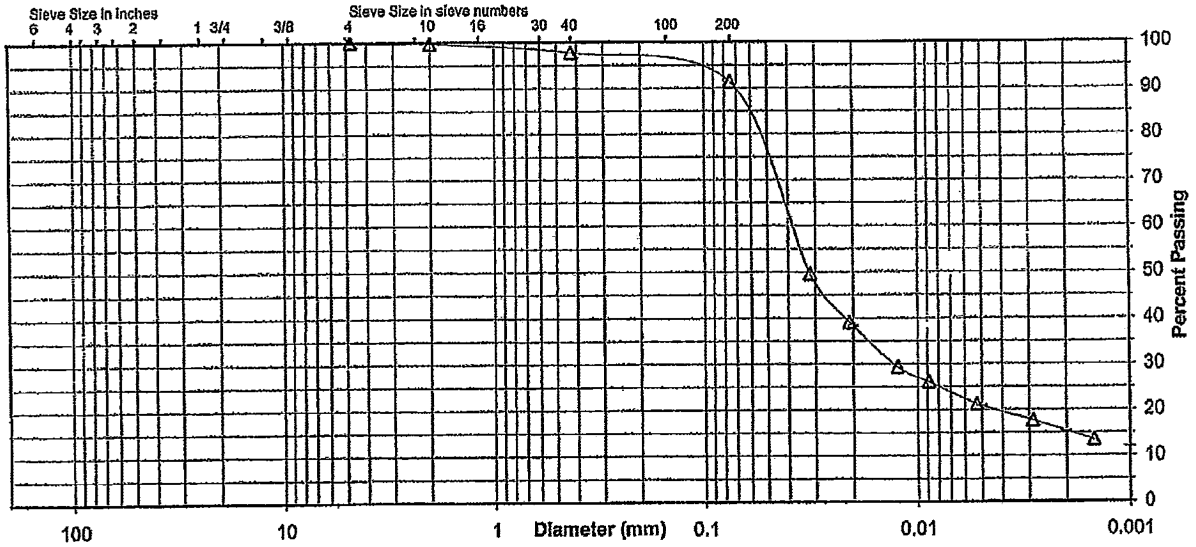
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	97.8
No. 200	91.3
0.02 mm	38.3
0.005 mm	20.9
0.002 mm	15.3
0.001 mm	12.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.3	1.9	6.5	70.4	20.9

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.3	1.9	6.6	76.0	15.3



Comments

Reviewed By

File: frm_172679016_sum_157.xls Sheet: Hydro-Report
Preparation Date: 1998
Revision Daté: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Summary of Soil Tests

Project Name: Allen Fossil Plant (TVA)
Source: STN-13, 43.5'-45.0', 45.0'-46.5', 46.5'-48.0'
Project Number: 172679016
Lab ID: 165

County: Memphis, TN
Sample Type: SPT Comp
Date Received: 8-7-09
Date Reported: 10-20-09

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	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	99.8
No. 200	0.075	73.8
	0.02	24.6
	0.005	15.8
	0.002	12.5
estimated	0.001	11.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.2
Medium Sand	0.2	---
Fine Sand	26.0	26.0
Silt	58.0	61.3
Clay	15.8	12.5

Atterberg Limits
Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 26
Plastic Limit: 23
Plasticity Index: 3
Activity Index: 0.25

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: ML
Group Name: Silt with sand
AASHTO Classification: A-4 (1)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant (TVA)
Source STN-13, 43.5'-45.0', 45.0'-46.5', 46.5'-48.0'

Project Number 172679016
Lab ID 165

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: 09-14-2009
Date Received 08-07-2009

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	100.0

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	99.8
No. 200	73.8
0.02 mm	24.6
0.005 mm	15.8
0.002 mm	12.5
0.001 mm	11.0

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>0.0</td><td>0.0</td><td>0.2</td><td>26.0</td><td colspan="2">58.0</td><td colspan="2">15.8</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">0.0</td><td>0.2</td><td>26.0</td><td colspan="3">61.3</td><td>12.5</td></tr>
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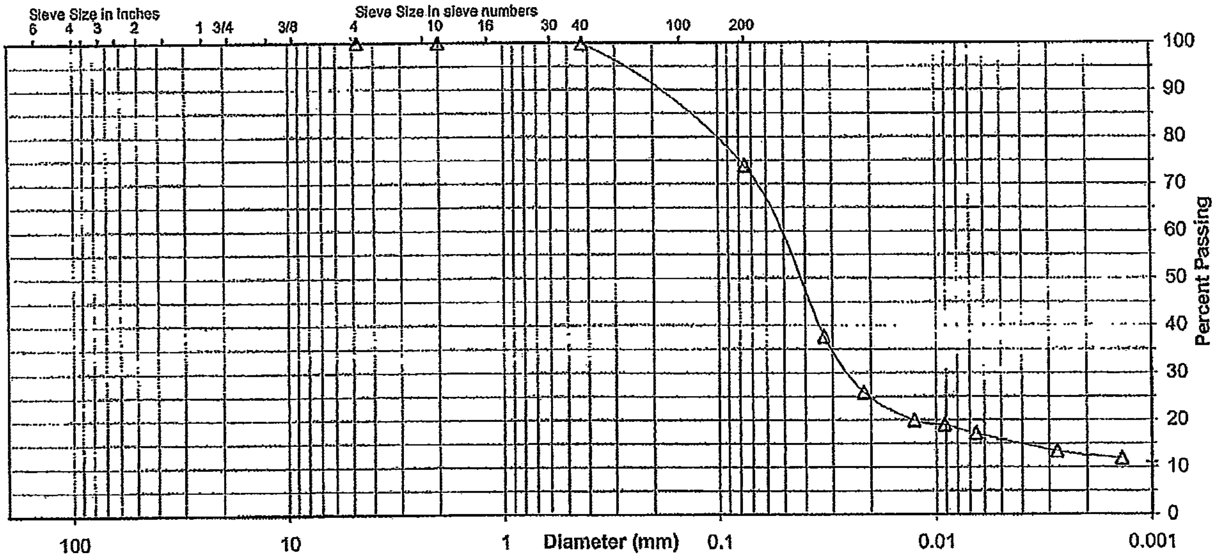


Comments

Reviewed By

File: frm_172679016_sum_165 Sheet: Hydro-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: Allen Fossil Plant (TVA)
Source: STN-14, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'
Project Number: 172679016
Lab ID: 182

County: Memphis, TN
Sample Type: SPT Comp
Date Received: 8-7-09
Date Reported: 10-20-09

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	99.9
No. 10	2	99.7
No. 40	0.425	96.4
No. 200	0.075	62.3
	0.02	30.0
	0.005	17.4
	0.002	13.0
estimated	0.001	11.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.1	0.3
Coarse Sand	0.2	3.3
Medium Sand	3.3	---
Fine Sand	34.1	34.1
Silt	44.9	49.3
Clay	17.4	13.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 24
Plastic Limit: 19
Plasticity Index: 5
Activity Index: 0.38

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: CL-ML
Group Name: Sandy silty clay

AASHTO Classification: A-4 (1)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Allen Fossil Plant (TVA)	Project Number	172679016
Source	STN-14, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'	Lab ID	182

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: 09-09-2009
Date Received 08-07-2009

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	99.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

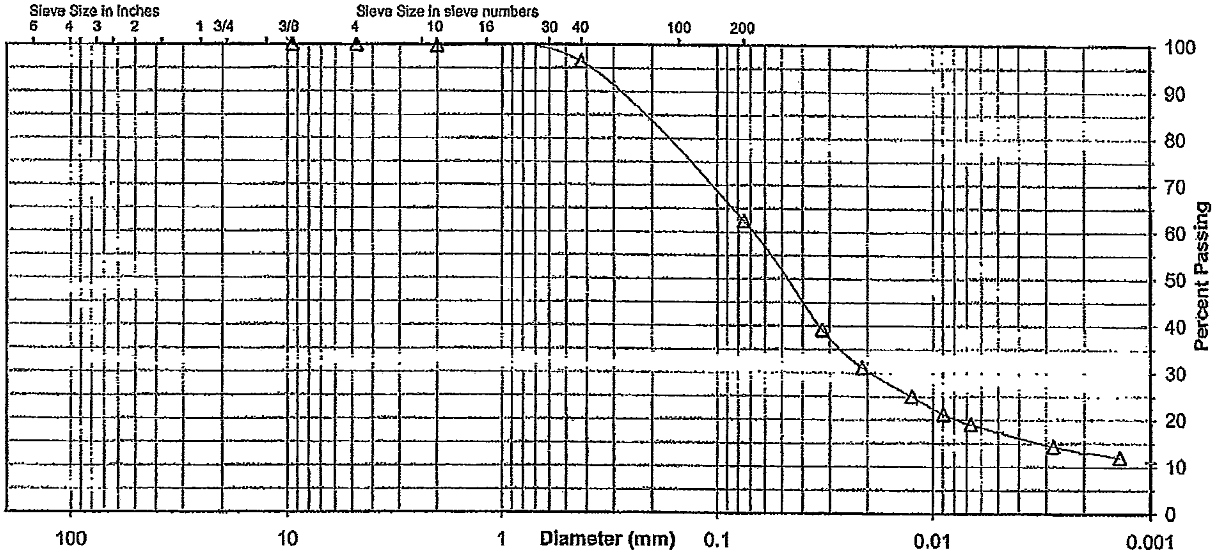
Specific Gravity 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	96.4
No. 200	62.3
0.02 mm	30.0
0.005 mm	17.4
0.002 mm	13.0
0.001 mm	11.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.1	0.2	3.3	34.1	44.9	17.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.3			3.3	34.1	49.3	13.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Allen Fossil Plant
Source: STN-14, 19.5'-21.0', 21.0'-22.5', 22.5'-24.0'
Project Number: 172679016
Lab ID: 684

County: Memphis, TN
Sample Type: SPT Comp
Date Received: 9-9-09
Date Reported: 10-22-09

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	
No. 4	4.75	100.0
No. 10	2	98.8
No. 40	0.425	98.4
No. 200	0.075	85.2
	0.02	67.3
	0.005	46.6
	0.002	36.3
estimated	0.001	32.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	1.2
Coarse Sand	1.2	0.4
Medium Sand	0.4	---
Fine Sand	13.2	13.2
Silt	38.6	48.9
Clay	46.6	36.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 43
Plastic Limit: 17
Plasticity Index: 26
Activity Index: 0.72

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

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL
Group Name: Lean clay
AASHTO Classification: A-7-6 (22)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant
Source STN-14, 19.5'-21.0', 21.0'-22.5', 22.5'-24.0'

Project Number 172679016
Lab ID 684

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: 10-16-2009
Date Received 09-09-2009

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	98.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.7

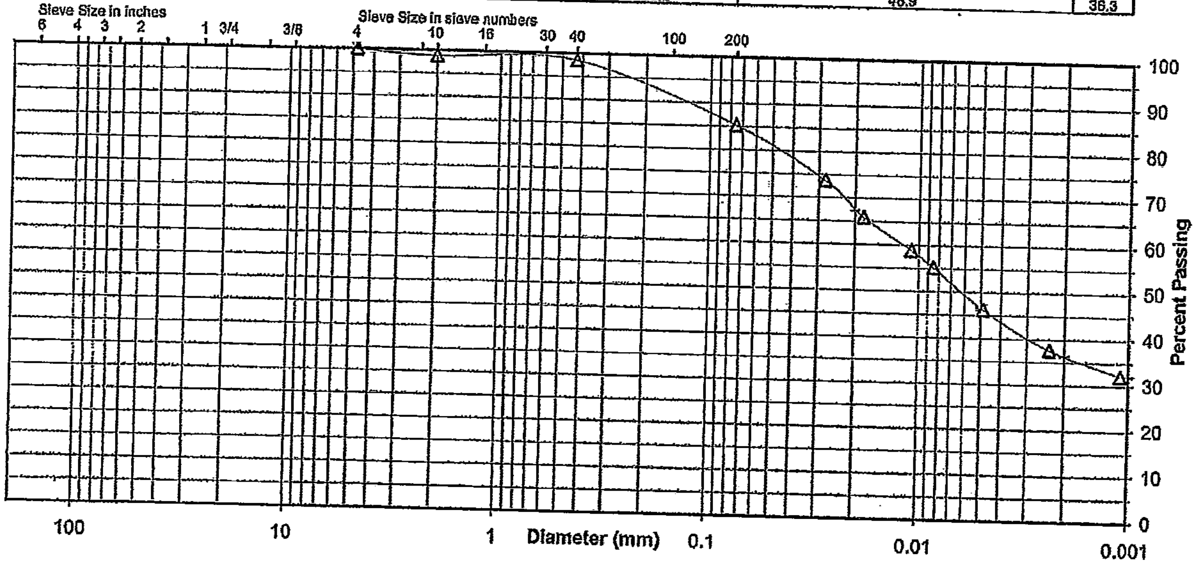
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.4
No. 200	85.2
0.02 mm	67.3
0.005 mm	46.6
0.002 mm	36.3
0.001 mm	32.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	1.2	0.4	13.2	38.6	46.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	1.2	0.4	13.2	48.9	36.3



Comments

Reviewed By

File: frm_172679016_sum_684.xls Sheet: Hydro-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: Allen Fossil Plant
Source: STN-14, 46.5'-48.0', 48.0'-49.5', 49.5'-51.0'
County: Memphis, TN
Sample Type: SPT Comp

Project Number: 172679016
Lab ID: 688
Date Received: 9-9-09
Date Reported: 10-21-09

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	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	98.9
No. 200	0.075	40.5
	0.02	12.8
	0.005	6.2
	0.002	5.2
estimated	0.001	4.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.0
Coarse Sand	0.0	1.1
Medium Sand	1.1	---
Fine Sand	58.4	58.4
Silt	34.3	35.3
Clay	6.2	5.2

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

Estimated

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Reviewed by:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant
Source STN-14, 46.5'-48.0', 48.0'-49.5', 49.5'-51.0'

Project Number 172679016
Lab ID 688

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: N/A
Particle Hardness: N/A

Tested By: JF
Test Date: 10-15-2009
Date Received 09-09-2009

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	
No. 4	
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.7

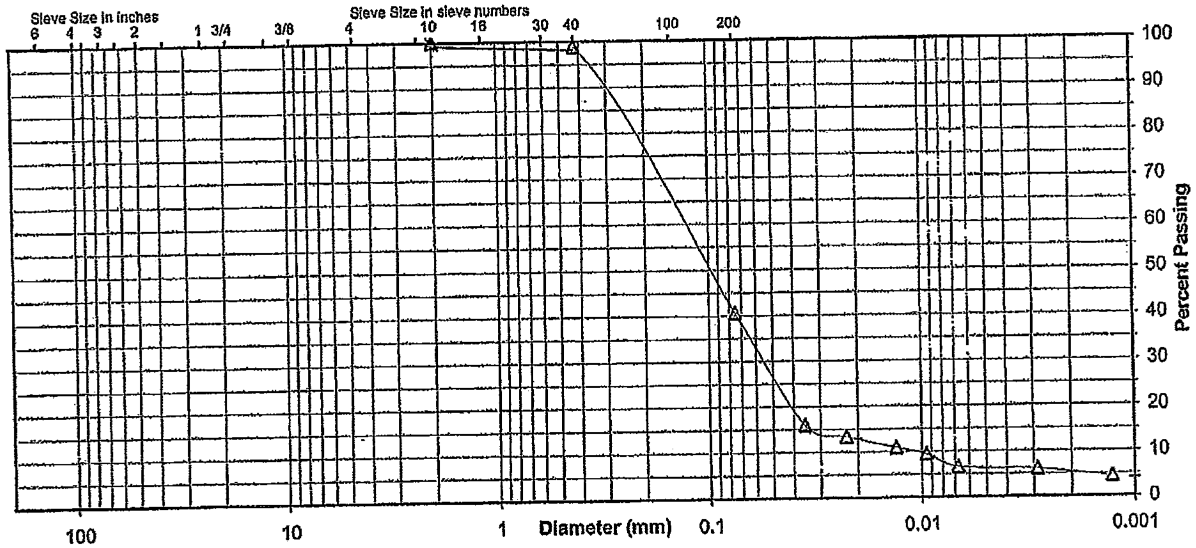
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.9
No. 200	40.5
0.02 mm	12.8
0.005 mm	6.2
0.002 mm	5.2
0.001 mm	4.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	1.1	58.4	34.3	6.2

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	1.1	58.4	35.3	5.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

9032

Project Name: Allen Fossil Plant East Ash Pond
Project Number: 172679016
Source: HA-9, 2.0'-3.0'
Lab ID: 39

County: Shelby, TN
Date Received: 10-15-09
Sample Type: Bag
Date Reported: 10-19-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 15.6

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	100.0
3/8"	9.5	98.6
No. 4	4.75	98.5
No. 10	2	98.4
No. 40	0.425	97.9
No. 200	0.075	62.2
	0.02	27.7
	0.005	15.7
	0.002	13.2
estimated	0.001	11.6

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	1.5	1.6
Coarse Sand	0.1	0.5
Medium Sand	0.5	---
Fine Sand	35.7	35.7
Silt	46.5	49.0
Clay	15.7	13.2

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: ML
Group Name: Sandy silt
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Allen Fossil Plant East Ash Pond	Project Number	172679016
Source	HA-9, 2.0'-3.0'	Lab ID	39

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: MD
Test Date: 10-16-2009
Date Received 10-15-2009

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	98.5
No. 10	98.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

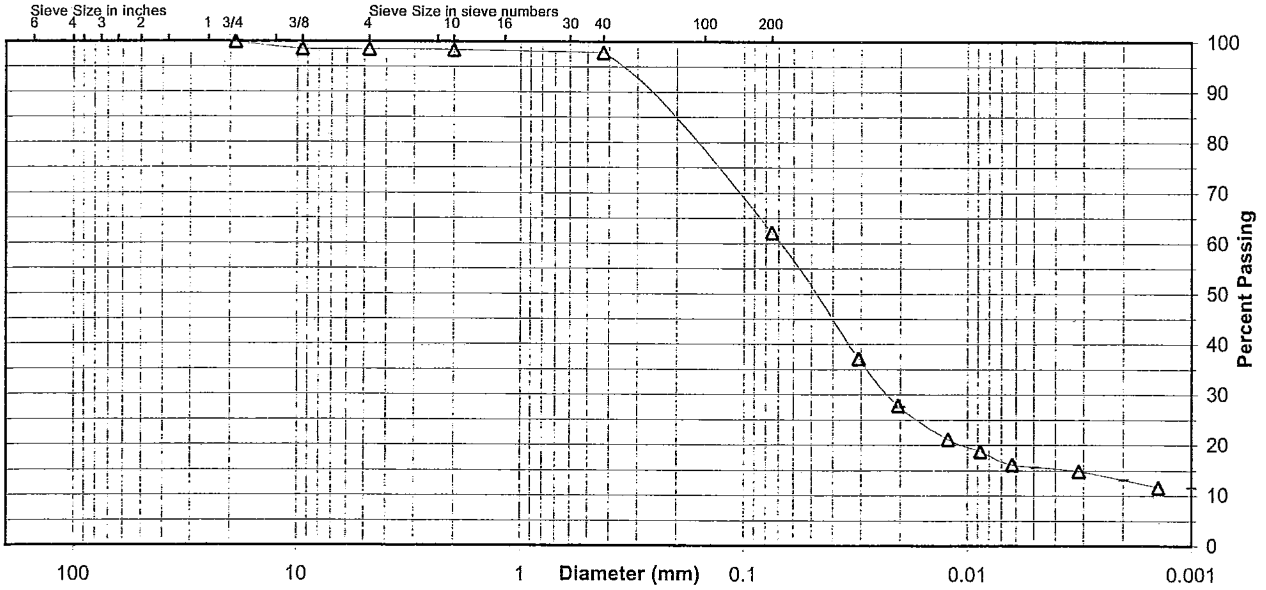
Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	97.9
No. 200	62.2
0.02 mm	27.7
0.005 mm	15.7
0.002 mm	13.2
0.001 mm	11.6

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	1.5	0.1	0.5	35.7	46.5	15.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	1.6			0.5	35.7	49.0	13.2



Comments

Reviewed By RHB

File: frm_172679016_sum_39 Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Summary of Soil Tests

9032

Project Name: Allen Fossil Plant East Ash Pond
Project Number: 172679~~016~~
Source: HA-9, 4.0'-5.0'
Lab ID: 41
County: Shelby, TN
Date Received: 10-15-09
Sample Type: Bag
Date Reported: 10-20-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 12.4

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	97.3
No. 10	2	96.5
No. 40	0.425	95.1
No. 200	0.075	70.5
	0.02	36.0
	0.005	20.8
	0.002	16.0
estimated	0.001	14.6

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	2.7	3.5
Coarse Sand	0.8	1.4
Medium Sand	1.4	---
Fine Sand	24.6	24.6
Silt	49.7	54.5
Clay	20.8	16.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 29
Plastic Limit: 19
Plasticity Index: 10
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

Estimated
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-4 (5)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Allen Fossil Plant East Ash Pond
Source: HA-9, 4.0'-5.0'
Project Number: 172679016
Lab ID: 41

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: MD
Test Date: 10-16-2009
Date Received: 10-15-2009

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	97.3
No. 10	96.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

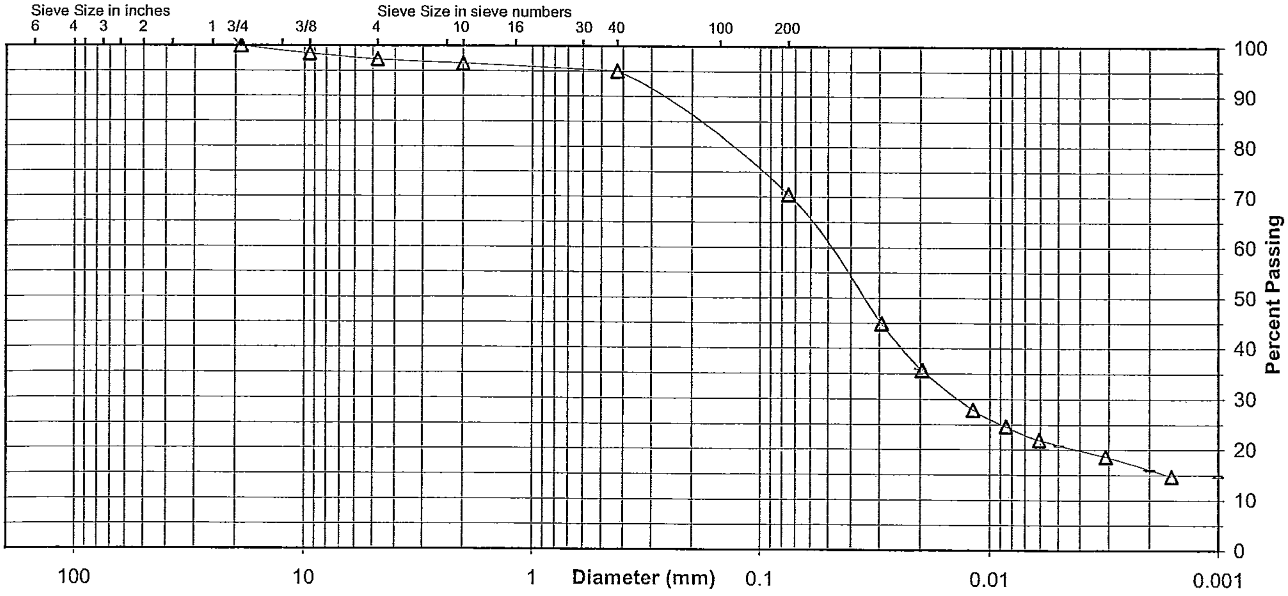
Specific Gravity: 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	95.1
No. 200	70.5
0.02 mm	36.0
0.005 mm	20.8
0.002 mm	16.0
0.001 mm	14.6

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	2.7	0.8	1.4	24.6	49.7	20.8
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	3.5			1.4	24.6	54.5	16.0



Comments

Reviewed By: RHB

File: frm_172679016_sum_41 Sheet: Hydro-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

9032

Project Name: Allen Fossil Plant East Ash Pond
Project Number: 17267~~9016~~
Source: HA-10, 2.0'-3.0'
Lab ID: 46

County: Shelby, TN
Date Received: 10-15-09
Sample Type: Bag
Date Reported: 10-19-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 20.2

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	99.4
No. 4	4.75	98.9
No. 10	2	98.2
No. 40	0.425	97.2
No. 200	0.075	44.2
	0.02	20.1
	0.005	12.3
	0.002	10.8
estimated	0.001	9.4

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	1.1	1.8
Coarse Sand	0.7	1.0
Medium Sand	1.0	---
Fine Sand	53.0	53.0
Silt	31.9	33.4
Clay	12.3	10.8

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

Estimated
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

File: frm_172679016_sum_46 Sheet: Summary
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant East Ash Pond
Source HA-10, 2.0'-3.0'

Project Number 172679016
Lab ID 46

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: JMB
Test Date: 10-16-2009
Date Received 10-15-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.4
No. 4	98.9
No. 10	98.2

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.68

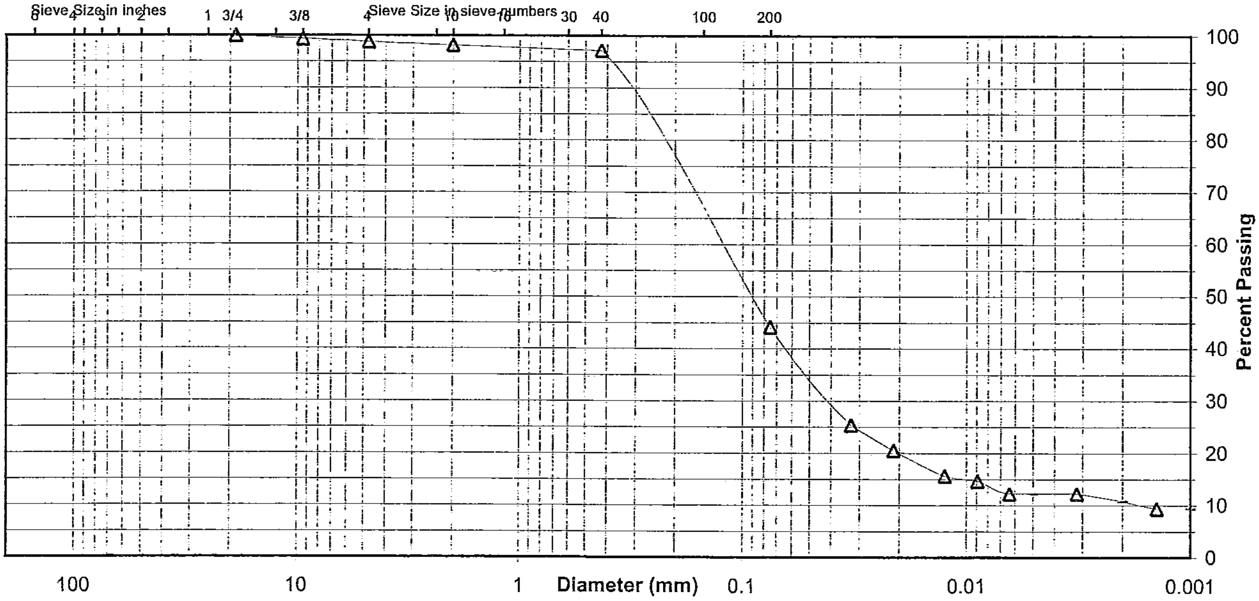
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	97.2
No. 200	44.2
0.02 mm	20.1
0.005 mm	12.3
0.002 mm	10.8
0.001 mm	9.4

Particle Size Distribution

ASTM	Coarse Gravel 0.0	Fine Gravel 1.1	C. Sand 0.7	Medium Sand 1.0	Fine Sand 53.0	Silt 31.9	Clay 12.3

AASHTO	Gravel 1.8	Coarse Sand 1.0	Fine Sand 53.0	Silt 33.4	Clay 10.8



Comments

Reviewed By RHB

File: frm_172679016_sum_46 Sheet: Hydro-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 Allen Fossil Plant East Ash Pond

Source HA-10, 4.0'-5.0'

Project Number 172679~~016~~ 032

Lab ID 48

County Shelby, TN

Sample Type Bag

Date Received 10-15-09

Date Reported 10-20-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 29.4

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	99.5
No. 40	0.425	96.8
No. 200	0.075	74.7
	0.02	37.9
	0.005	21.6
	0.002	16.2
estimated	0.001	14.8

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.5
Coarse Sand	0.5	2.7
Medium Sand	2.7	---
Fine Sand	22.1	22.1
Silt	53.1	58.5
Clay	21.6	16.2

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Dry

Liquid Limit: 26

Plastic Limit: 19

Plasticity Index: 7

Activity Index: 0.44

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

Estimated

Particle Size: No. 10

Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL-ML

Group Name: Silty clay with sand

AASHTO Classification: A-4 (3)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Allen Fossil Plant East Ash Pond
Source HA-10, 4.0'-5.0'

Project Number 172679016
Lab ID 48

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: MD
Test Date: 10-16-2009
Date Received 10-15-2009

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	99.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.7

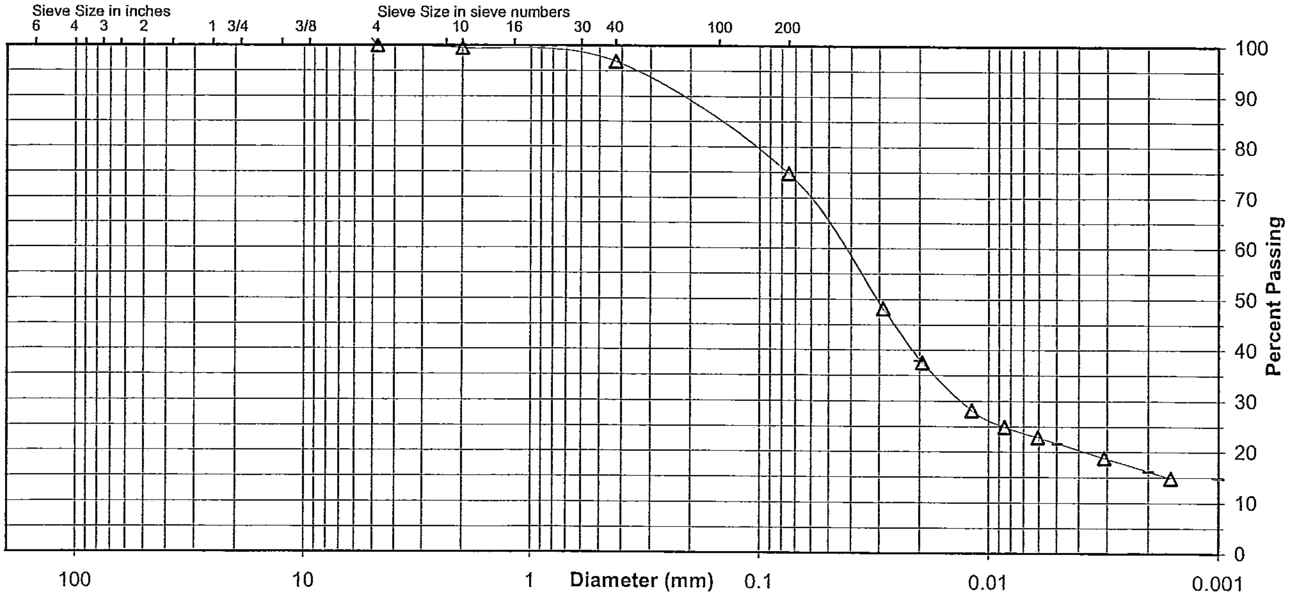
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	96.8
No. 200	74.7
0.02 mm	37.9
0.005 mm	21.6
0.002 mm	16.2
0.001 mm	14.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.5	2.7	22.1	53.1	21.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.5	2.7	22.1	58.5	16.2



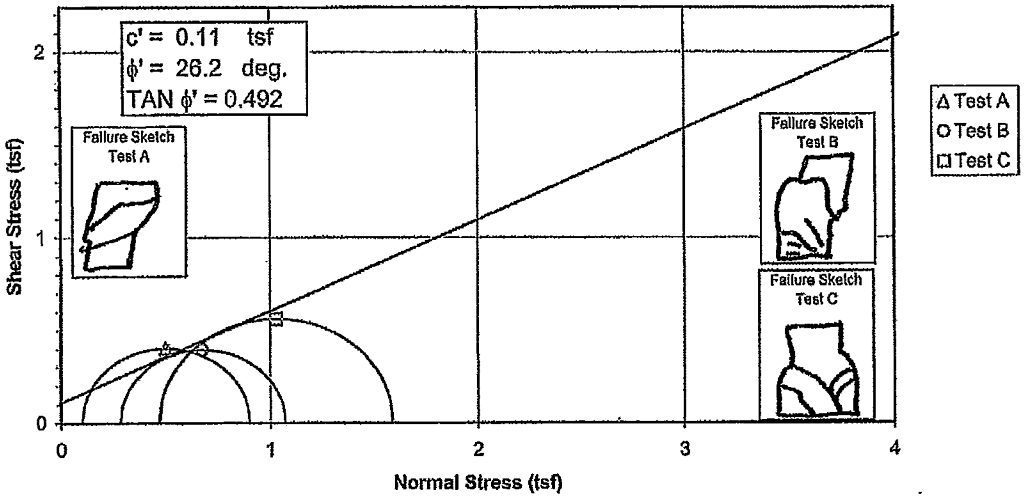
Comments

Reviewed By RHB

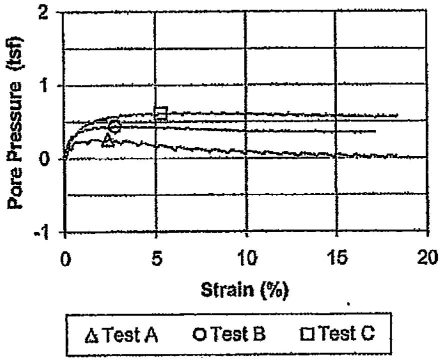
Consolidated Undrained Triaxial Testing

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	42.3	63.5	53.5	
	Dry Density PCF	γ_{d_o}	77.6	60.8	67.5	
	Saturation %	S_o	96.8	96.2	96.1	
	Void Ratio	e_o	1.188	1.795	1.514	
After Shear	Water content %	W_f	41.7	62.4	50.8	
	Dry Density PCF	γ_{d_f}	79.6	63.0	71.3	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	1.134	1.696	1.381	
	Final Back Pressure TSF	u_c	6.12	5.76	5.40	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.10	0.28	0.47	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	0.80	0.79	1.12	
Time to (σ1'-σ3')max min.		t_f	33.9	79.7	107.9	
Ultimate Deviator Stress, t/sq ft		$(\sigma1'-\sigma3')_{ult}$	n/a	0.57	0.91	
Initial Diameter, in.		D_o	2.878	2.877	2.876	
Initial Height, in.		H_o	6.013	6.035	6.000	

Controlled - Strain Test

Description of Specimens Fat Clay (CH), gray brown, moist, firm

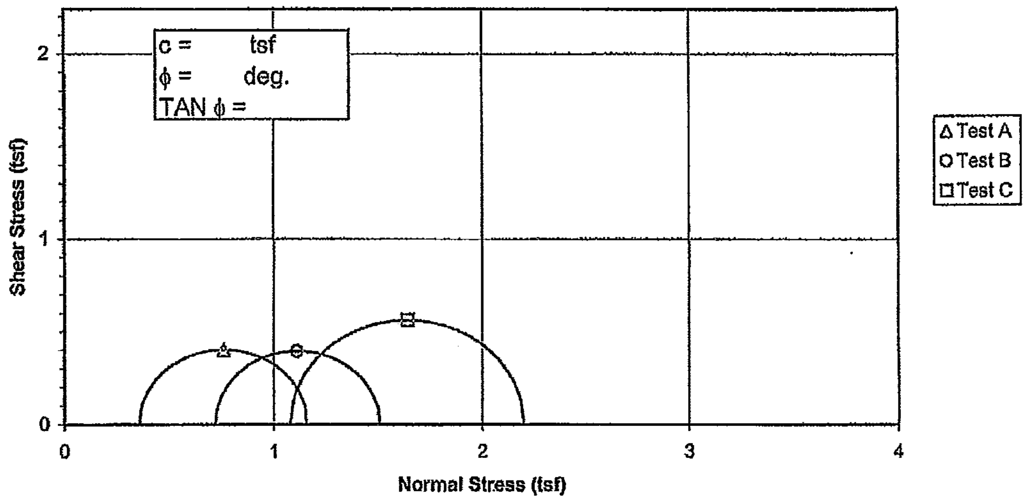
				Type of Specimen	Undisturbed	Type of test $\bar{R}$
LL 92	PL 28	PI 64	Gs 2.72	Project	Allen Fossil Plant (TVA)	
Remarks:						
				Boring No.	STN-1	Sample No. 3
				Depth Elev.	15.0'-15.5', 15.7'-16.2', 16.3'-16.8'	
				Laboratory	Stantec	Date 9-25-09
				TRIAXIAL COMPRESSION TEST REPORT		

Laboratory Document
Prepared By: MW
Approved BY: TLK

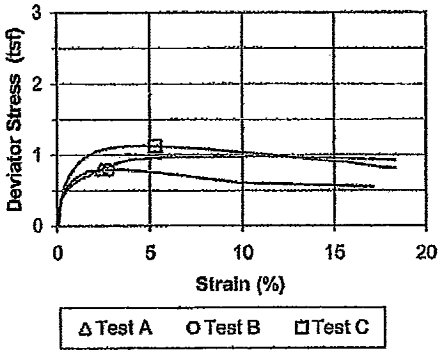
EM 1110-2-1906
Appendix X
30 Nov. 70

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	42.3	63.5	53.5	
	Dry Density PCF	γ_{d_o}	77.6	60.8	67.5	
	Saturation %	S_o	96.8	96.2	96.1	
	Void Ratio	e_o	1.188	1.795	1.514	
After Shear	Water content %	W_f	41.7	62.4	50.8	
	Dry Density PCF	γ_{d_f}	79.6	63.0	71.3	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	1.134	1.696	1.381	
	Final Back Pressure TSF	u_c	6.12	5.76	5.40	
Minor Principal Stress TSF		σ_3	0.36	0.72	1.08	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	0.80	0.79	1.12	
Time to $(\sigma_1-\sigma_3)_{Max.}$ min.		t_f	33.9	79.7	107.9	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	0.57	0.91	
Initial Diameter, in.		D_o	2.878	2.877	2.876	
Initial Height, in.		H_o	6.013	6.035	6.000	

Controlled - Strain Test

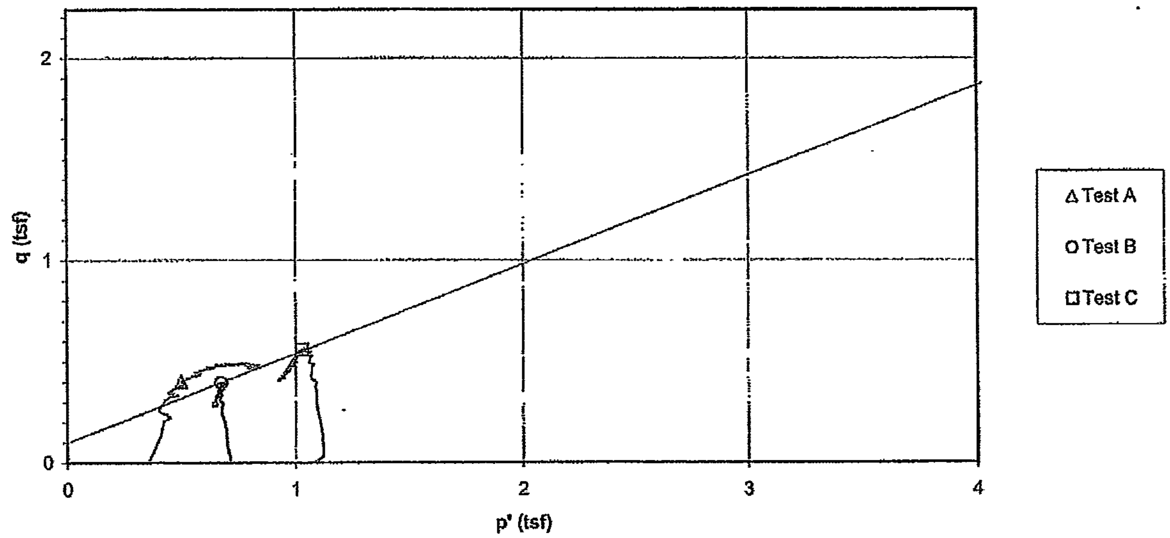
Description of Specimens Fat Clay (CH), gray brown, moist, firm

							Type of Specimen Undisturbed	Type of test $\bar{R}$
LL	92	PL	28	PI	64	Gs 2.72	Project Allen Fossil Plant (TVA)	
Remarks:								
							Boring No. STN-1	Sample No. 3
							Depth Elev. 15.0'-15.5', 15.7'-16.2', 16.3'-16.8'	
							Laboratory Stantec	Date 9-25-09
							TRIAXIAL COMPRESSION TEST REPORT	

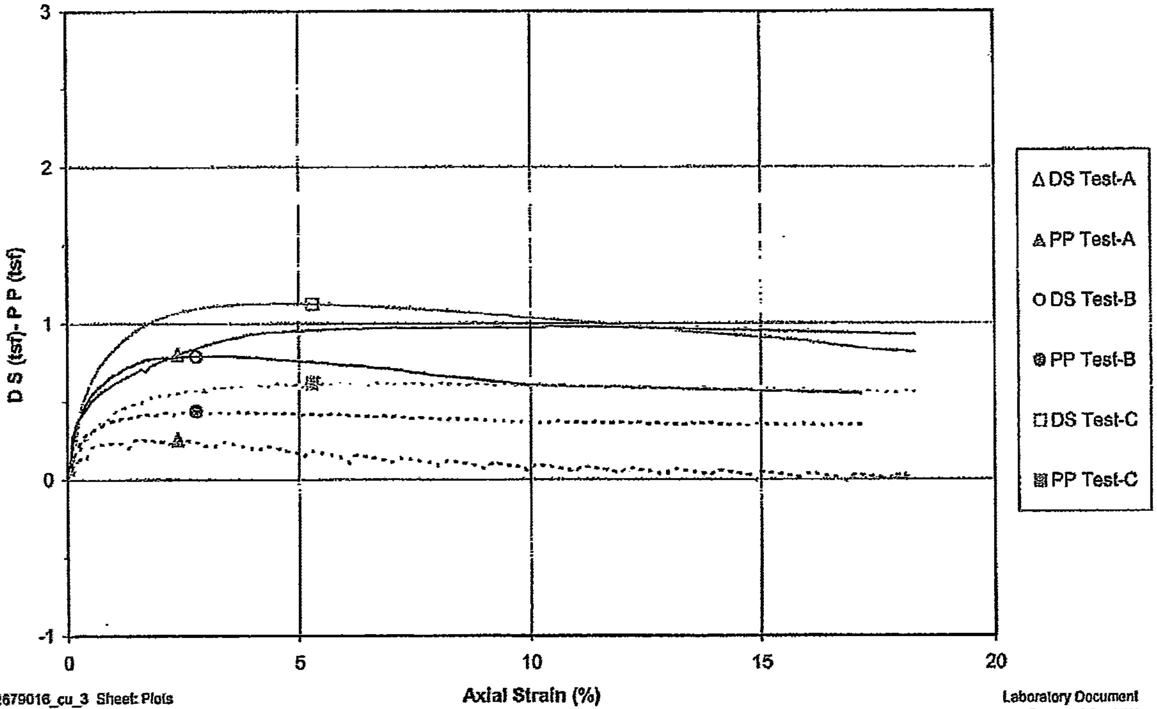
Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

Project	Allen Fossil Plant (TVA)	Project No.	172679016
Sample ID	STN-1, 15.0'-15.5' & STN-1, 15.7'-16.2' & STN-1, 16.3'-16.8'	Test Number	3
Failure Criterion:	Maximum Effective Principal Stress Ratio $\phi' =$ 26.2 deg.	$c' =$	0.11 tsf

p' vs. q Plot

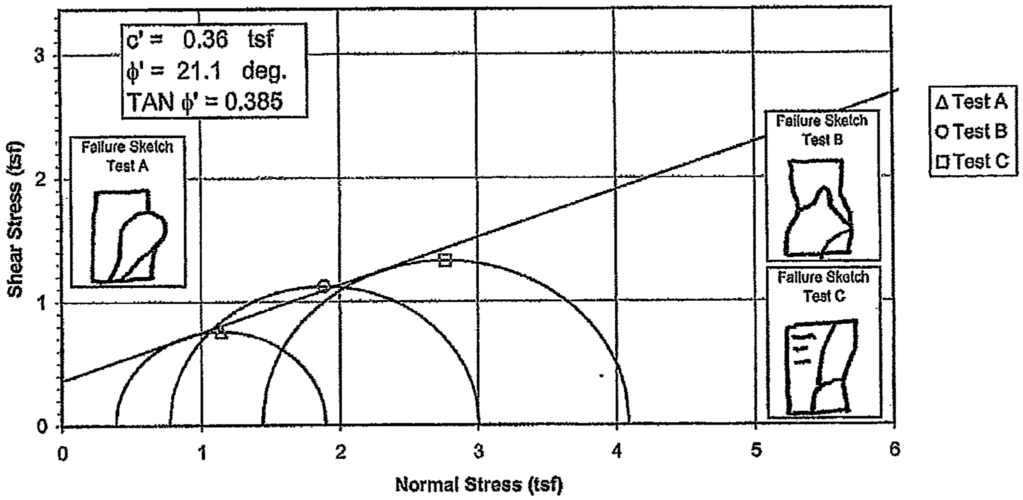


Deviator Stress and Induced Pore Pressure vs. Axial Strain

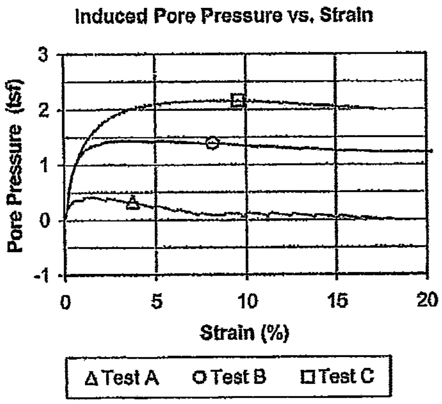


Stantec Consulting Services Inc.

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	32.2	35.1	27.2	
	Dry Density PCF	γ_{d_o}	87.6	83.9	86.6	
	Saturation %	S_o	95.2	95.1	78.5	
	Void Ratio	e_o	0.903	0.986	0.924	
After Shear	Water content %	W_f	27.9	29.9	29.7	
	Dry Density PCF	γ_{d_f}	95.6	92.7	93.0	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.744	0.799	0.792	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		σ_3'f	0.39	0.77	1.44	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	1.51	2.23	2.65	
Time to (σ1'-σ3')max min.		t_f	45.6	49.7	667.8	
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.867	2.871	2.882	
Initial Height, in.		H_o	6.037	5.953	6.141	

Controlled - Strain Test

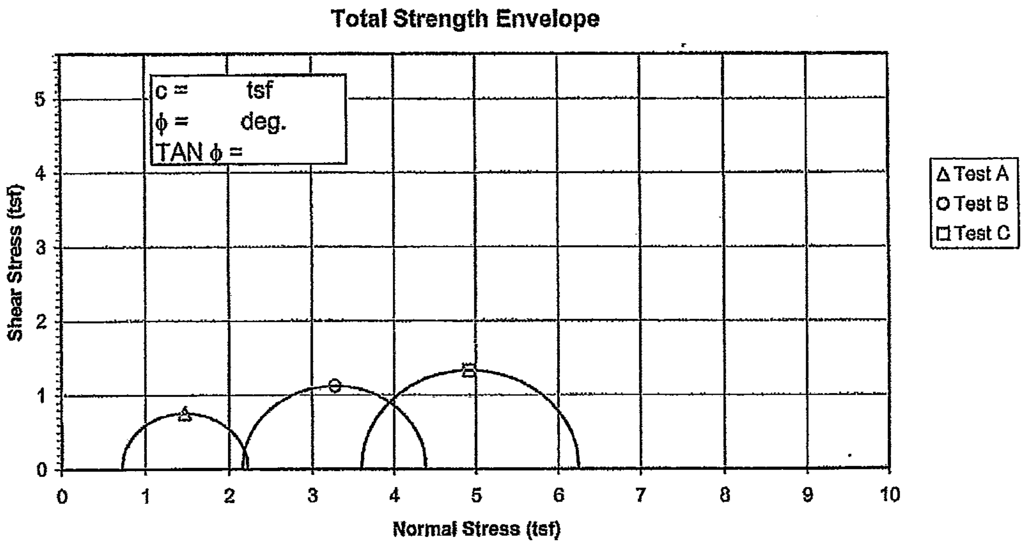
Description of Specimens Lean Clay (CL), gray, moist, firm

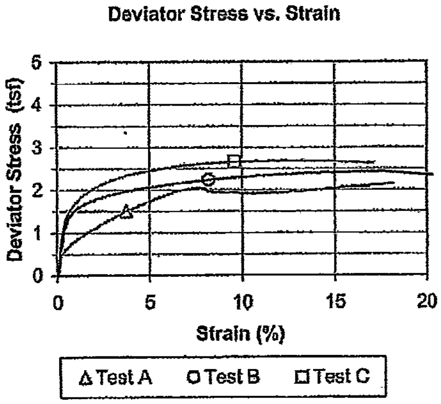
			Type of Specimen	Undisturbed	Type of test $\bar{R}$
LL	PL	PI	Gs 2.67	Project	Allen Fossil Plant (TVA)
Remarks:					
			Boring No.	STN-1, STN-2	Sample No. 1
			Depth Elev.	20.1'-20.6', 20.7'-21.2', 36.0'-36.5'	
			Laboratory	Stantec	Date 9-25-09

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	32.2	35.1	27.2	
	Dry Density PCF	γ_{d_o}	87.6	83.9	86.6	
	Saturation %	S_o	95.2	95.1	78.5	
	Void Ratio	e_o	0.903	0.986	0.924	
After Shear	Water content %	W_f	27.9	29.9	29.7	
	Dry Density PCF	γ_{d_f}	95.6	92.7	93.0	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.744	0.799	0.792	
	Final Back Pressure TSF	u_o	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1\text{-}\sigma_3)_{max}$	1.51	2.23	2.65	
Time to $(\sigma_1\text{-}\sigma_3)_{Max.}$ min.		t_f	45.6	49.7	667.8	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1\text{-}\sigma_3)_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.867	2.871	2.882	
Initial Height, in.		H_o	6.037	5.953	6.141	

Controlled - Strain Test

Description of Specimens Lean Clay (CL), gray, moist, firm

			Type of Specimen Undisturbed		Type of test $\overline{R}$
LL	PL	PI	Gs 2.67	Project Allen Fossil Plant (TVA)	
Remarks:					
			Boring No. STN-1, STN-2		Sample No. 1
			Depth Elev. 20.1'-20.6', 20.7'-21.2', 36.0'-36.5'		
			Laboratory Stantec		Date 9-25-09
			TRIAXIAL COMPRESSION TEST REPORT		

File: 172679016_cu_1 Sheet: CE_Final-T
Preparation Date: 1996
Revision Date: 1-2008

Stantec Consulting Services Inc.

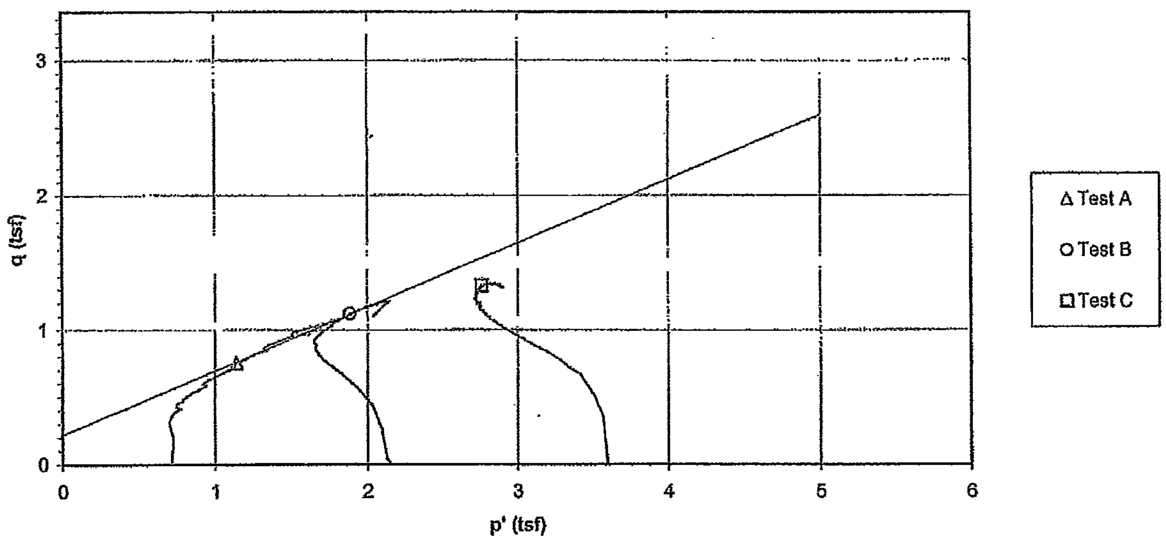
HPG

Laboratory Document
Prepared By: MW
Approved BY: TLK

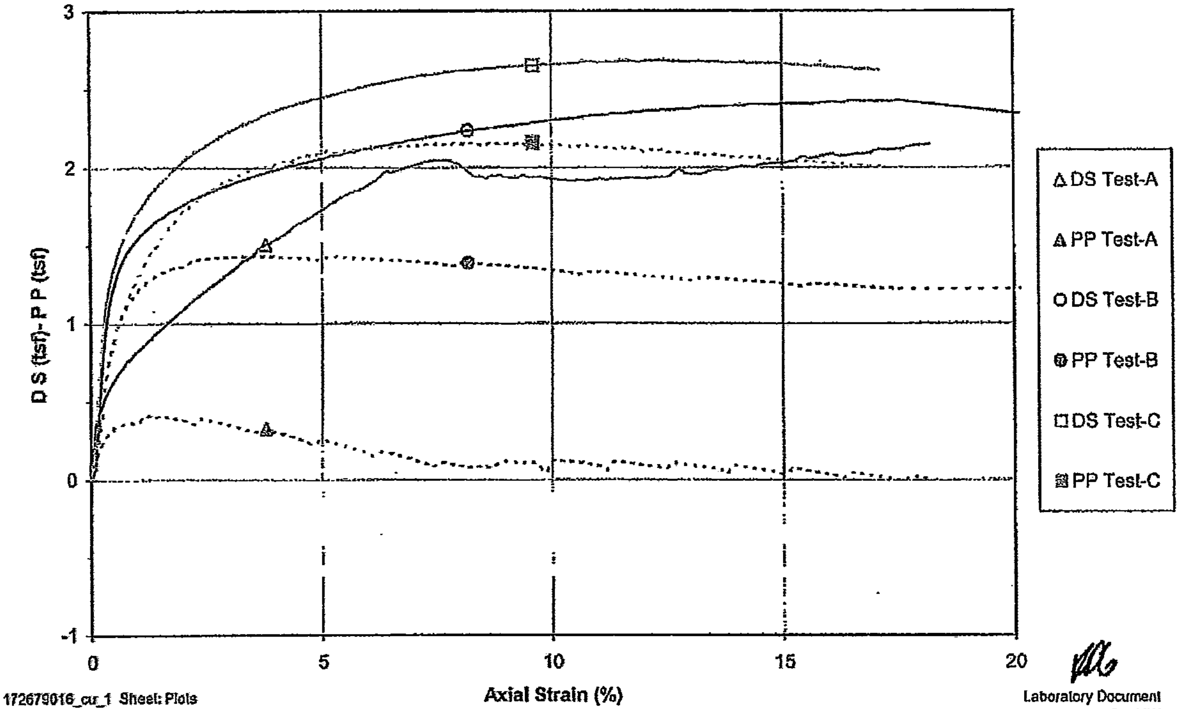
Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

Project Allen Fossil Plant (TVA) Project No. 172679016
Sample ID STN-1, 20.1'-20.6' & STN-1, 20.7'-21.2' & STN-2, 36.0'-36.5' Test Number 1
Failure Criterion: Maximum Effective Principal Stress Ratio ϕ' = 28.4 deg. c' = 0.25 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



File: 172679016_cu_1 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2008

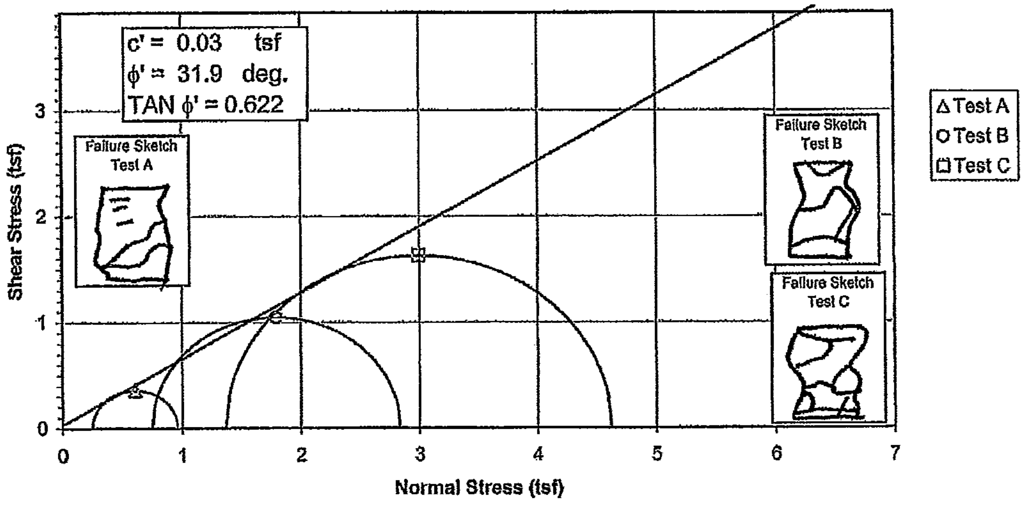
Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

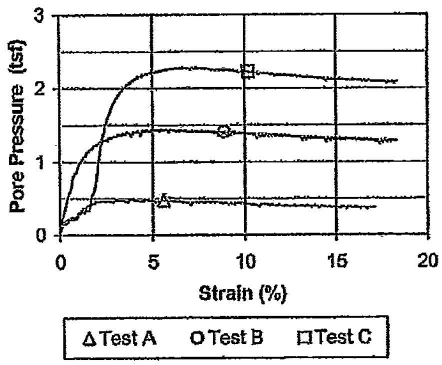
EM 1110-2-1906
Appendix X
30 Nov. 70

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	41.3	41.2	35.4	
	Dry Density PCF	γd_o	78.3	78.8	85.2	
	Saturation %	S_o	97.3	98.4	98.3	
	Void Ratio	e_o	1.137	1.122	0.965	
After Shear	Water content %	W_f	32.7	29.5	25.8	
	Dry Density PCF	γd_f	89.1	93.4	98.9	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.877	0.792	0.691	
	Final Back Pressure TSF	u_o	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.25	0.75	1.37	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	0.72	2.08	3.25	
Time to (σ1'-σ3')max min.		t_f	769.3	382.4	457.2	
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.848	2.843	2.860	
Initial Height, in.		H_o	5.954	5.940	5.976	

Controlled - Strain Test

Description of Specimens Lean Clay (CL), gray, moist, soft

							Type of Specimen	Undisturbed	Type of test $\bar{R}$
LL	38	PL	20	PI	18	Gs 2.68	Project	Allen Fossil Plant (TVA)	
Remarks:									
							Boring No.	STN-1	Sample No. 2
							Depth Elev.	26.5'-27.0', 27.0'-27.5', 27.5'-28.0'	
							Laboratory	Stantec	Date 9-25-09
							TRIAXIAL COMPRESSION TEST REPORT		

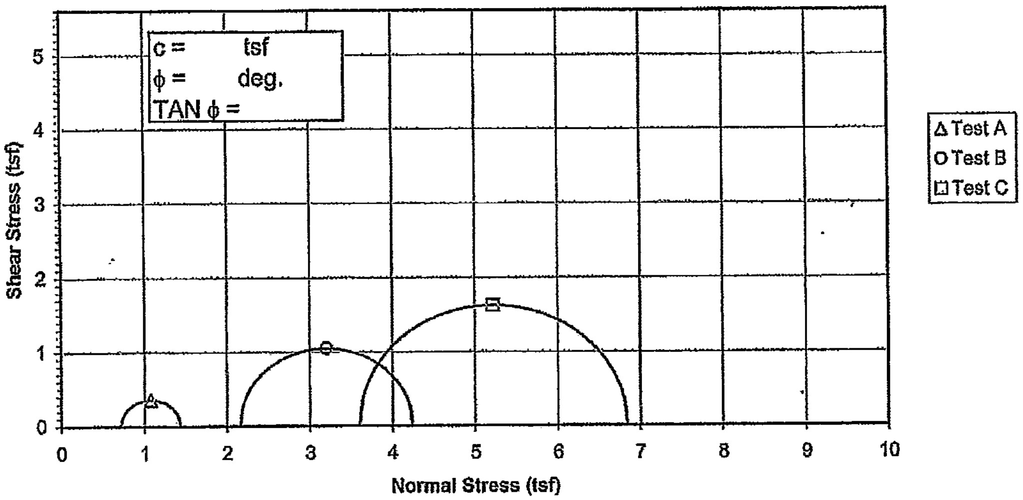
File: 172679016_cu_2 Sheet: CE_Final-E
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

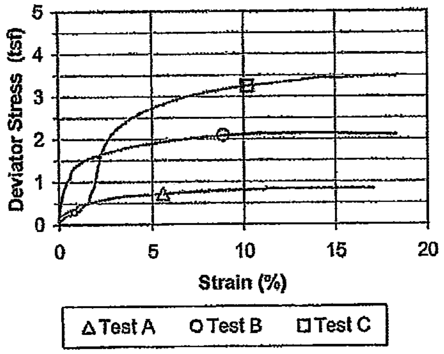
Laboratory Document
Prepared By: MW
Approved BY: TLK

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	41.3	41.2	35.4	
	Dry Density PCF	γ_{d_o}	78.3	78.8	85.2	
	Saturation %	S_o	97.3	98.4	98.3	
	Void Ratio	e_o	1.137	1.122	0.965	
After Shear	Water content %	W_f	32.7	29.5	25.8	
	Dry Density PCF	γ_{d_f}	89.1	93.4	98.9	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.877	0.792	0.691	
	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		$(\sigma_1-\sigma_3)_{max}$	0.72	2.08	3.25	
Time to $(\sigma_1-\sigma_3)_{Max.}$ min.		t_f	769.3	382.4	457.2	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.848	2.843	2.860	
Initial Height, in.		H_o	5.954	5.940	5.976	

Controlled - Strain Test

Description of Specimens Lean Clay (CL), gray, moist, soft

							Type of Specimen	Undisturbed	Type of test $\bar{R}$
LL	38	PL	20	PI	18	Gs	2.68	Project	Allen Fossil Plant (TVA)

Remarks:

Boring No. STN-1 Sample No. 2
Depth Elev. 26.5'-27.0', 27.0'-27.5', 27.5'-28.0'
Laboratory Stantec Date 9-25-09

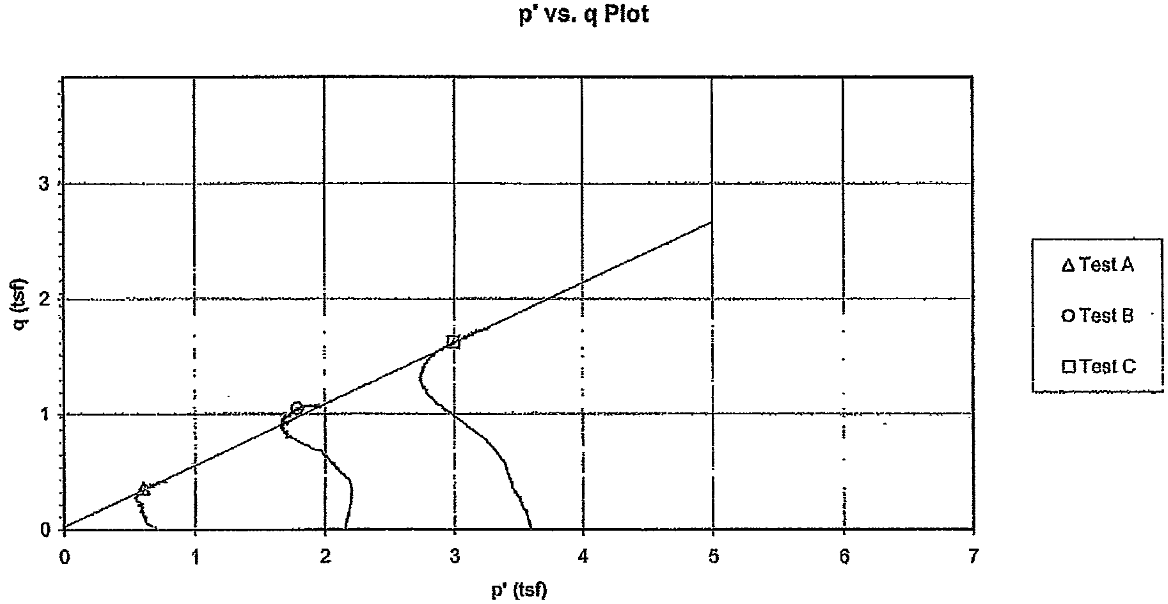
TRIAXIAL COMPRESSION TEST REPORT

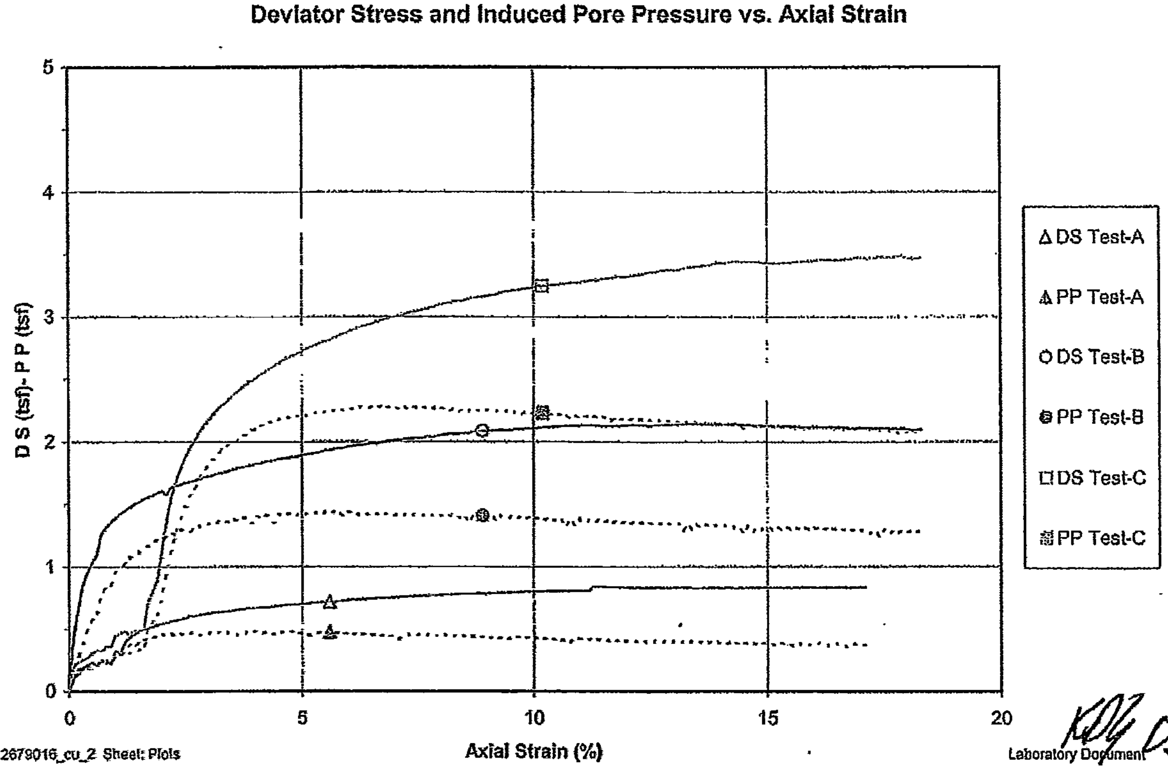
Laboratory Document
Prepared By: MW
Approved BY: TLK

Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

Project Allen Fossil Plant (TVA)
Sample ID STN-1, 26.5'-27.0' & STN-1, 27.0'-27.5' & STN-1, 27.5'-28.0'
Failure Criterion: Maximum Effective Principal Stress Ratio $\phi' =$ 31.9 deg.

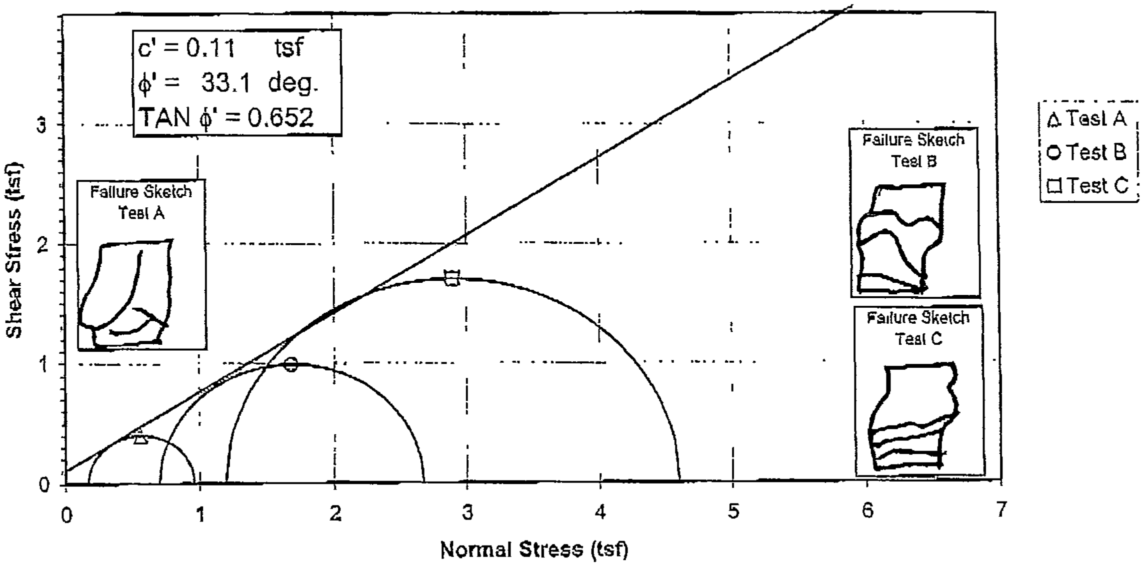
Project No. 172679016
Test Number 2
$c' =$ 0.03 tsf



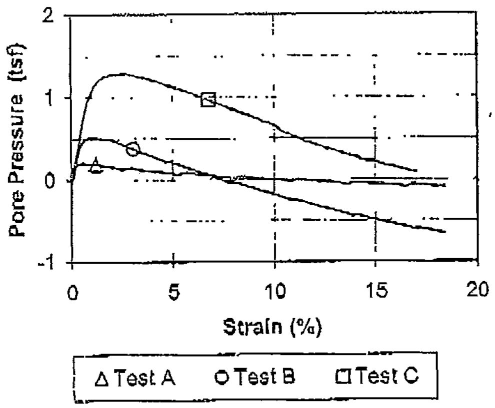


Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C
Initial Data	Water content %	W_o	22.7	23.3	25.0
	Dry Density PCF	γd_o	98.3	102.7	96.7
	Saturation %	S_o	88.7	101.8	93.7
	Void Ratio	e_o	0.676	0.604	0.704
After Shear	Water content %	W_f	24.7	23.1	23.1
	Dry Density PCF	γd_f	99.7	102.4	102.4
	Saturation %	S_f	100.0	100.0	100.0
	Void Ratio	e_f	0.653	0.609	0.610
	Final Back Pressure TSF	u_c	6.12	5.40	4.32
Minor Principal Stress TSF @ failure		σ_3'f	0.16	0.70	1.20
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	0.79	1.97	3.40
Time to (σ1'-σ3')max min.		t_f	8.1	15.8	155.0
Ultimate Deviator Stress, t/sq ft		$(\sigma1'-\sigma3')_{ult}$	n/a	n/a	n/a
Initial Diameter, in.		D_o	2.862	2.845	2.859
Initial Height, in.		H_o	5.903	6.250	5.760

Controlled - Strain Test

Description of Specimens Sandy Lean Clay (CL), brown, moist, firm

LL	PL	PI	Gs 2.64	Type of Specimen Undisturbed	Type of test $\overline{R}$
				Project	Allen Fossil Plant - TVA, Memphis, Tennessee

Remarks:

Boring No. STN-3A Sample No. 5

Depth Elev. 4.0'-4.5', 4.6'-5.1', 6.6'-7.1'

Laboratory Stantec Date 1-12-10

TRIAXIAL COMPRESSION TEST REPORT

406

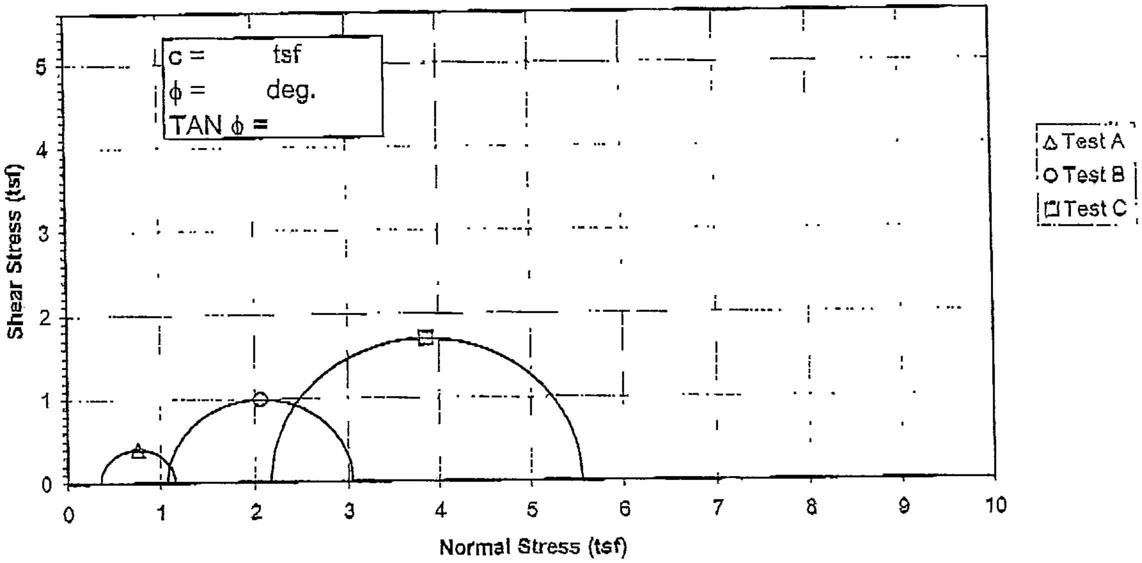
File: 172679016_cu_5 Sheet: CE_Final-E
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

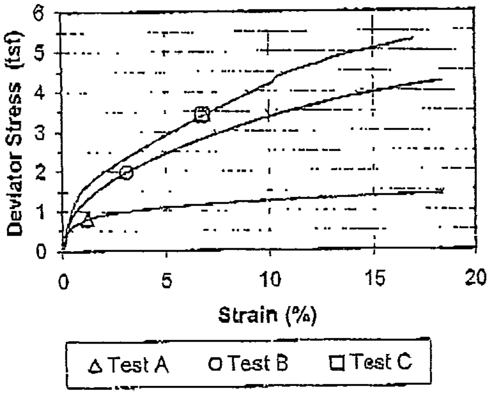
Laboratory Document
Prepared By: MW
Approved BY TLK

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	22.7	23.3	25.0	
	Dry Density PCF	γ_{d_0}	98.3	102.7	96.7	
	Saturation %	S_o	88.7	101.6	93.7	
	Void Ratio	e_o	0.676	0.604	0.704	
After Shear	Water content %	W_f	24.7	23.1	23.1	
	Dry Density PCF	γ_{d_f}	99.7	102.4	102.4	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.653	0.609	0.610	
	Final Back Pressure TSF	u_c	6.12	5.40	4.32	
Minor Principal Stress TSF		σ_3	0.36	1.08	2.16	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	0.79	1.97	3.40	
Time to $(\sigma_1-\sigma_3)_{Max}$ min.		t_f	8.1	15.8	155.0	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.862	2.845	2.859	
Initial Height, in.		H_o	5.903	6.250	5.760	

Controlled - Strain Test

Description of Specimens Sandy Lean Clay (CL), brown, moist, firm

				Type of Specimen Undisturbed	Type of test R
LL	PL	PI	Gs 2.64	Project	Allen Fossil Plant - TVA, Memphis, Tennessee
Remarks:					
				Boring No. STN-3A	Sample No. 5
				Depth Elev.	4.0'-4.5', 4.6'-5.1', 6.6'-7.1'
				Laboratory Stantec	Date 1-12-10
				TRIAXIAL COMPRESSION TEST REPORT	

File: 172679016_cu_5 Sheet: CE_Final-T
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

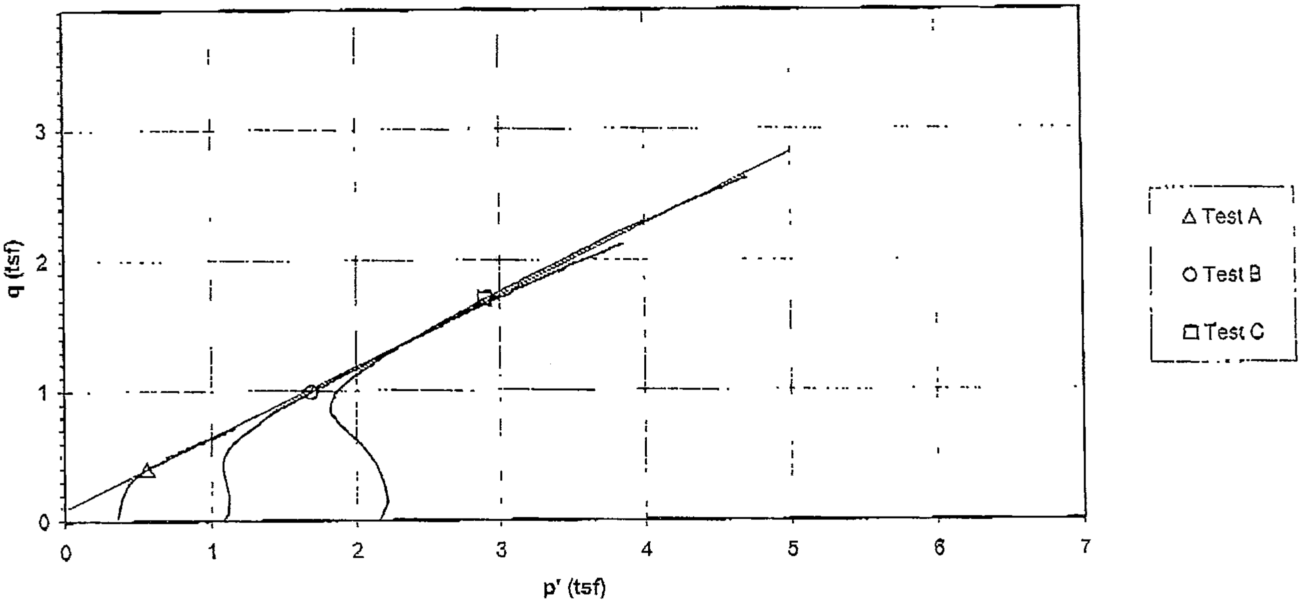
Laboratory Document
Prepared By: MW
Approved BY: TLK

Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

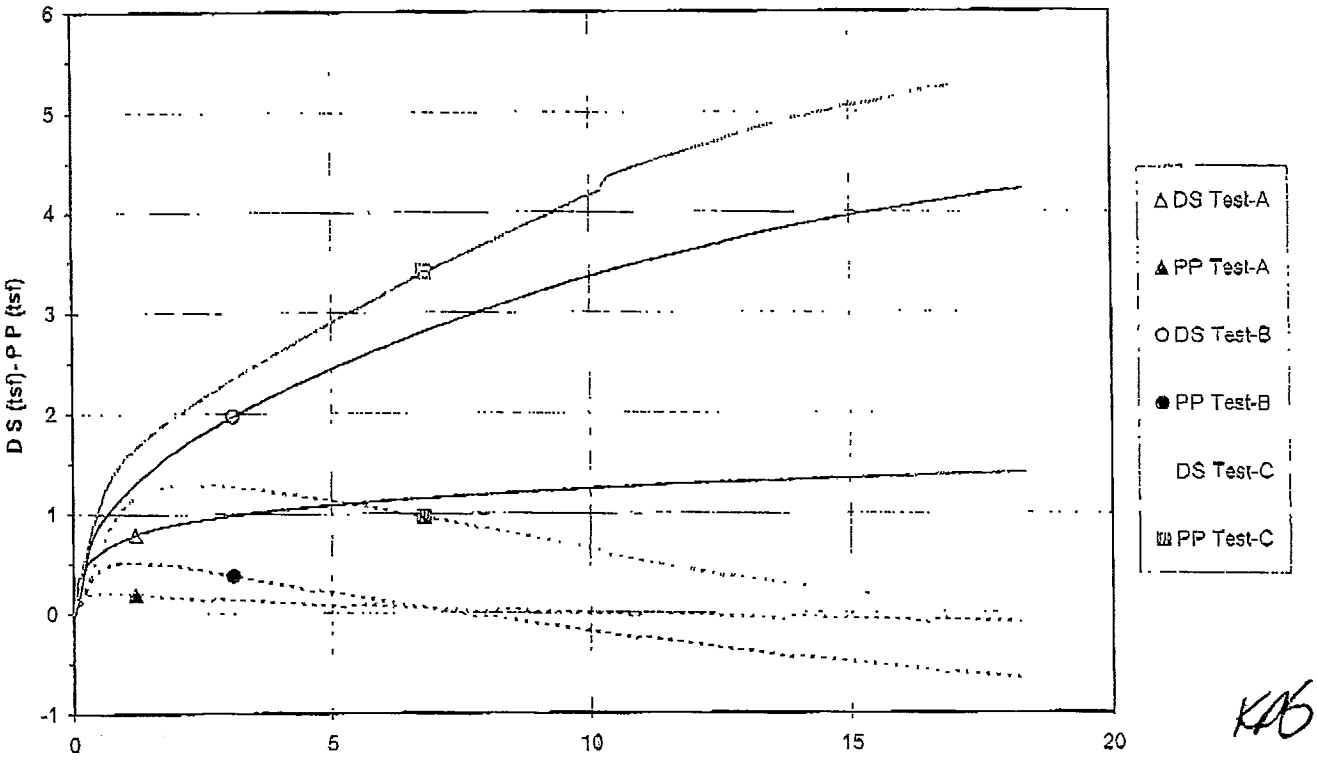
Project: Allen Fossil Plant - TVA, Memphis, Tennessee
Sample ID: STN-3A, 4.0'-4.5' & STN-3A, 4.6'-5.1' & STN-3A, 6.6'-7.1'
Failure Criterion: Maximum Effective Principal Stress Ratio ϕ' = 33.1 deg.

Project No. 172679016
Test Number 5
c' = 0.11 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



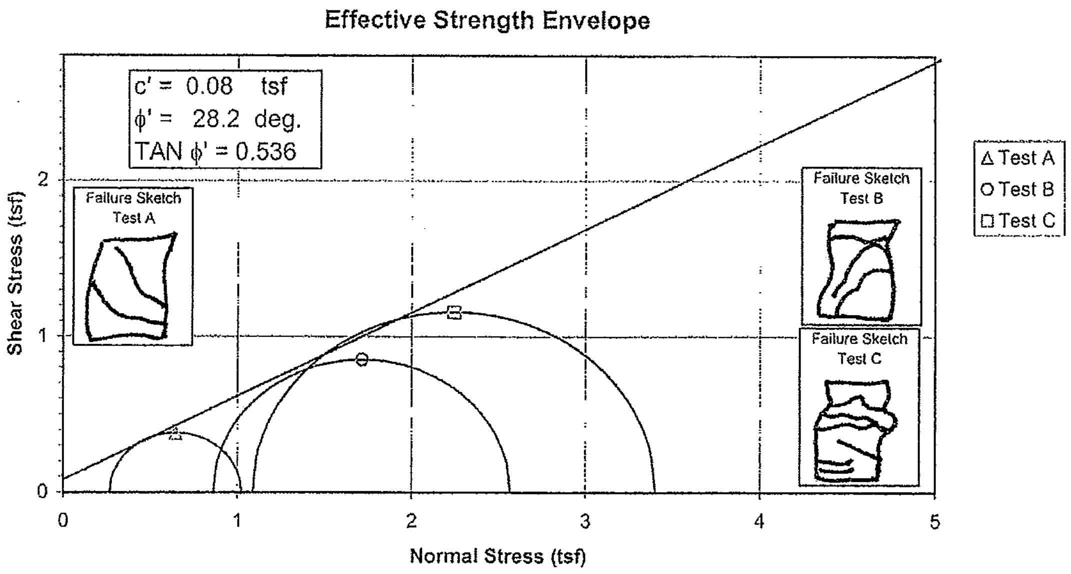
KAB

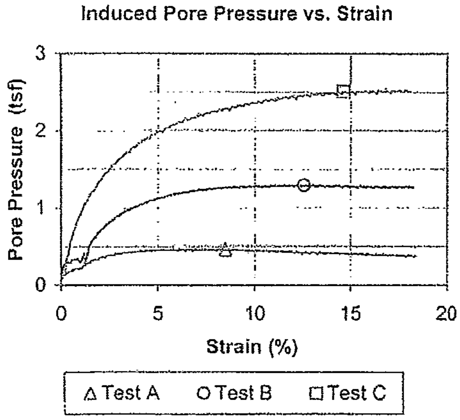
File. 172679016_cu_5 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2006

Stantec Consulting Services Inc.

Laboratory Document
Prepared By. MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio





Specimen No.			A	B	C	
Initial Data	Water content %	W_o	45.3	54.1	55.5	
	Dry Density PCF	γ_{d_o}	80.4	67.1	65.1	
	Saturation %	S_o	113.9	98.0	95.7	
	Void Ratio	e_o	1.051	1.457	1.532	
After Shear	Water content %	W_f	36.5	42.4	38.1	
	Dry Density PCF	γ_{d_f}	83.9	77.8	82.1	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.964	1.119	1.006	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.27	0.86	1.09	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	0.76	1.70	2.31	
Time to $(\sigma1'-\sigma3')$max min.		t_f	231.3	377.1	413.6	
Ultimate Deviator Stress, t/sq ft		$(\sigma1'-\sigma3')_{ult}$	n/a	1.67	2.30	
Initial Diameter, In.		D_o	2.866	2.866	2.873	
Initial Height, In.		H_o	6.038	6.033	5.994	

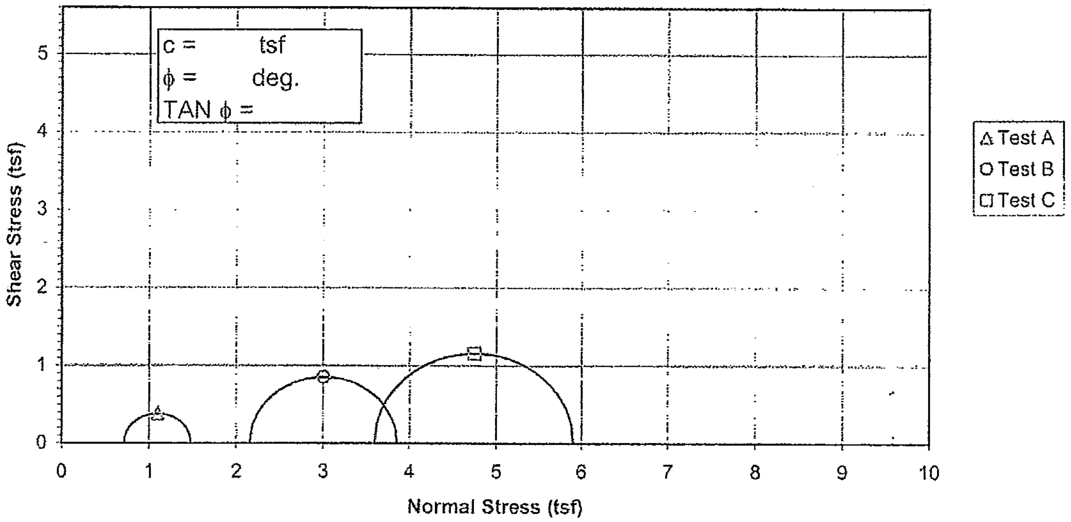
Controlled - Strain Test

Description of Specimens Lean Clay (CL), gray, moist, firm

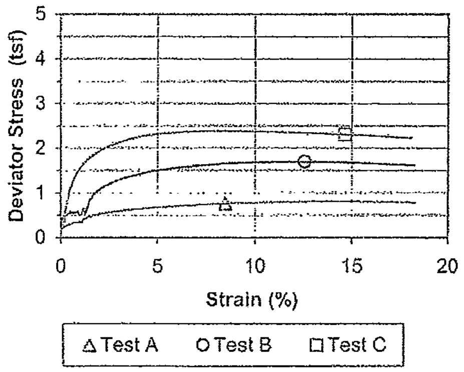
				Type of Specimen	Undisturbed	Type of test $\overline{R}$
LL	PL	PI	Gs 2.64	Project	Allen Fossil Plant (TVA)	
Remarks:						
				Boring No.	STN-9	Sample No. 4
				Depth Elev.	28.0'-28.5', 36.0'-36.5', 36.5'-37.0'	
				Laboratory	Stantec	Date 10-6-09
				TRIAXIAL COMPRESSION TEST REPORT		

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	45.3	54.1	55.5
	Dry Density PCF	γ_{d_o}	80.4	67.1	65.1
	Saturation %	S_o	113.9	98.0	95.7
	Void Ratio	e_o	1.051	1.457	1.532
After Shear	Water content %	W_f	36.5	42.4	38.1
	Dry Density PCF	γ_{d_f}	83.9	77.8	82.1
	Saturation %	S_f	100.0	100.0	100.0
	Void Ratio	e_f	0.964	1.119	1.006
	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		$(\sigma_1-\sigma_3)_{max}$	0.76	1.70	2.31
Time to $(\sigma_1-\sigma_3)_{Max.}$ min.		t_f	231.3	377.1	413.6
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	1.67	2.30
Initial Diameter, in.		D_o	2.866	2.866	2.873
Initial Height, in.		H_o	6.038	6.033	5.994

Controlled - Strain Test

Description of Specimens Lean Clay (CL), gray, moist, firm

Type of Specimen Undisturbed

Type of test $\overline{R}$

LL

PL

PI

Gs 2.64

Project Allen Fossil Plant (TVA)

Remarks:

Boring No. STN-9

Sample No. 4

Depth Elev. 28.0'-28.5', 36.0'-36.5', 36.5'-37.0'

Laboratory Stantec

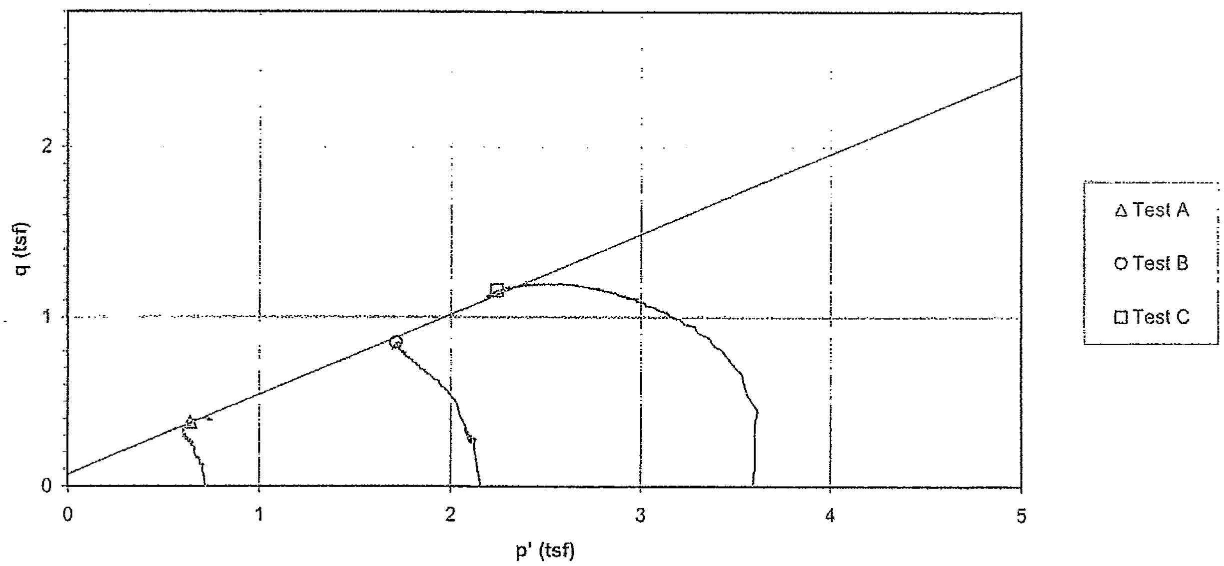
Date 10-6-09

TRIAXIAL COMPRESSION TEST REPORT

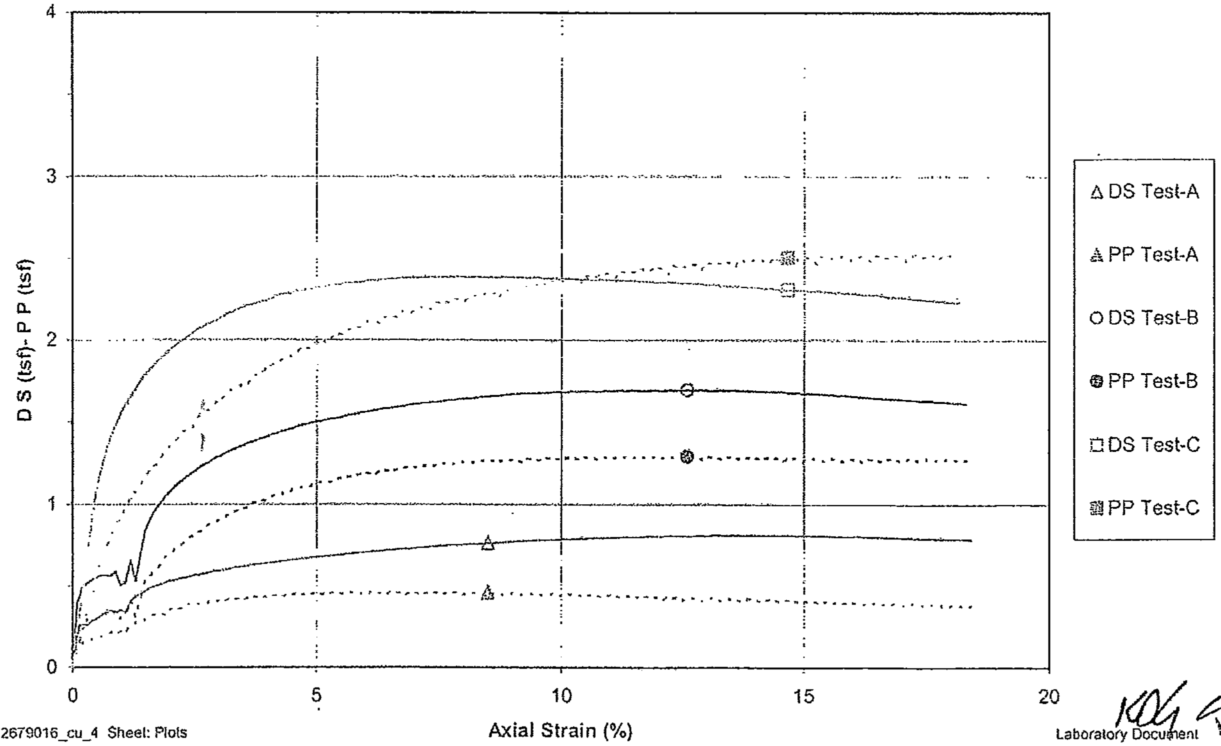
Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

Project Allen Fossil Plant (TVA)
Project No. 172679016
Sample ID STN-9, 28.0'-28.5' & STN-9, 36.0'-36.5' & STN-9, 36.5'-37.0'
Test Number 4
Failure Criterion: Maximum Effective Principal Stress Ratio ϕ' = 28.2 deg. c' = 0.08 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



File: 172679016_cu_4 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Laboratory Permeability Testing

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Allen Fossil Plant (TVA)
Project No. 172679016
Source STN-1, 34.5'-36.5'
Test ID 490
Visual Classification Lean Clay (CL), gray brown, wet, soft
Prepared By KDG
Undisturbed XX
Specific Gravity 2.67 ASTM D854-A
Date 9-14-09
Maximum Dry Density (pcf) ________
Percent of Maximum ________
Permeant: De-aired tap water
Selection and Preparation Comments: ________

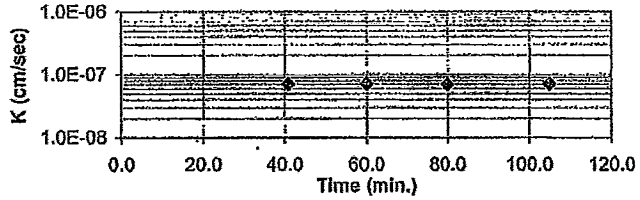
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 19 blows per layer. The density was varied by reducing the height 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.)	1.4891	1.3690	1.3691	Chamber	75
Diameter (in.)	2.7977		2.8062	Influent	70
Moisture Content (%)	36.4		31.3	Effluent	65
Dry Unit Weight (pcf)	84.0		90.8		
Void Ratio	0.985		0.836		
Degree of Saturation (%)	98.6		100.0		
Trimmings MC (%)	37.9				

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)
9-17-09	7:59	70.0	22.21	3.36	0	---	---	---	---
9-17-09	8:40	70.0	21.40	4.32	2.46E+03	7.2E-10	7.2E-08	7.0E-10	7.0E-08
9-17-09	8:59	70.0	21.03	4.77	1.14E+03	7.3E-10	7.3E-08	7.1E-10	7.1E-08
9-17-09	9:19	70.0	20.63	5.21	1.20E+03	7.1E-10	7.1E-08	7.0E-10	7.0E-08
9-17-09	9:44	70.0	20.14	5.78	1.50E+03	7.3E-10	7.3E-08	7.1E-10	7.1E-08

Corrected Permeability vs. Time



A gradient of approximately 92.7 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 7.04E-10 cm/s 7.04E-08
Average Hydraulic Conductivity @ 20° C (last run) m/s 7.04E-10 cm/s 7.04E-08

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name Allen Fossil Plant (TVA)
Project No. 172679016
Source STN-2, 36.0'-38.0'
Test ID 492B
Visual Classification Lean Clay (CL), gray brown, moist, firm
Prepared By KDG
Undisturbed XX
Specific Gravity 2.69 ASTM D854-A
Date 9-14-09
Maximum Dry Density (pcf) ____
Percent of Maximum ____

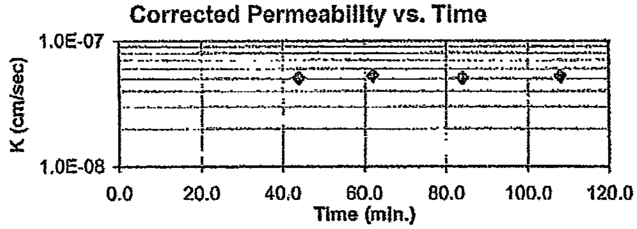
Permeant: De-aired tap water
Selection and Preparation Comments: ____

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.)	1.4779	1.4586	1.4586	Chamber	75
Diameter (in.)	2.8033		2.7945	Influent	70
Moisture Content (%)	34.6		34.9	Effluent	65
Dry Unit Weight (pcf)	85.3		86.9		
Void Ratio	0.970		0.932		
Degree of Saturation (%)	95.9		100.7		
Trimmings MC (%)	37.7				

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)
9-17-09	7:55	70.0	22.44	3.33	0	---	---	---	---
9-17-09	8:39	70.0	21.85	4.02	2.64E+03	5.2E-10	5.2E-08	5.1E-10	5.1E-08
9-17-09	8:57	70.0	21.61	4.32	1.08E+03	5.4E-10	5.4E-08	5.3E-10	5.3E-08
9-17-09	9:19	70.0	21.32	4.66	1.32E+03	5.2E-10	5.2E-08	5.1E-10	5.1E-08
9-17-09	9:43	70.0	20.99	5.04	1.44E+03	5.4E-10	5.4E-08	5.3E-10	5.3E-08



A gradient of approximately 93.4 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	5.17E-10	cm/s	5.17E-08
Average Hydraulic Conductivity @ 20° C (last run)	m/s	5.17E-10	cm/s	5.17E-08

Reviewed by:

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Allen Fossil Plant - TVA, Memphis, Tennessee
Source STN-2A, 10.0'-12.0', TI - 10.0'-10.5'
Visual Classification Silty Clay (CL-ML), gray, moist, firm
Undisturbed XX
Specific Gravity 2.68 ASTM D854-A
Maximum Dry Density (pcf) ______
Project No. 172679016
Test ID 789
Prepared By KDG
Date 1-7-10
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.

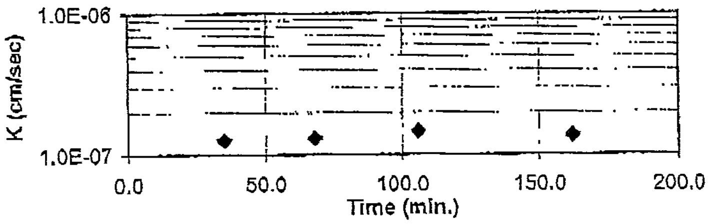
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (In.)	2.4529	2.4182	2.4228
Diameter (in.)	2.8030		2.7798
Moisture Content (%)	25.4		25.6
Dry Unit Weight (pcf)	96.2		99.0
Void Ratio	0.740		0.690
Degree of Saturation (%)	92.1		99.6
Trimmings MC (%)	27.8		

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

						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)
1-8-10	12:40	72.0	21.32	4.16	0	—	—	—	—
1-8-10	13:15	72.0	21.13	4.36	2.10E+03	1.3E-09	1.3E-07	1.3E-09	1.3E-07
1-8-10	13:48	72.0	20.93	4.54	1.98E+03	1.4E-09	1.4E-07	1.3E-09	1.3E-07
1-8-10	14:26	72.0	20.69	4.79	2.28E+03	1.6E-09	1.6E-07	1.5E-09	1.5E-07
1-8-10	15:22	72.0	20.36	5.13	3.36E+03	1.4E-09	1.4E-07	1.4E-09	1.4E-07

Corrected Permeability vs. Time



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 1.35E-09 cm/s 1.35E-07
Average Hydraulic Conductivity @ 20° C (last run) m/s 1.35E-09 cm/s 1.35E-07

Reviewed by: KDG

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Allen Fossil Plant East Ash Pond
Project No. 172679016
Source STN-6, 9.0'-10.5', 10.5'-12.0', 12.0'-13.5', 13.5'-15.0'
Test ID 93
Visual Classification Silty, Clayey Sand (SC-SM), brown
Prepared By KDG
Compacted 0 in. spacer
Specific Gravity 2.64 ASTM D854-A
Date 10-22-09
Maximum Dry Density (pcf) 94.3
Percent of Maximum 99.5
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.

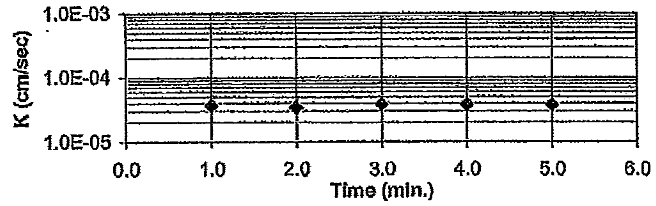
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	1.3811	1.3349	1.3369
Diameter (in.)	2.8013		2.7863
Moisture Content (%)	22.0		26.3
Dry Unit Weight (pcf)	93.9		98.0
Void Ratio	0.756		0.682
Degree of Saturation (%)	76.8		101.7
Trimmings MC (%)	24.0		

Final Pressures (psi)	
Chamber	72
Influent	67
Effluent	65

Applied Head Difference (psi) 2
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 7
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)
10-23-09	11:18	70.0	14.75	10.33	0	---	---	---	---
10-23-09	11:19	70.0	13.64	11.46	6.00E+01	3.7E-07	3.7E-05	3.6E-07	3.6E-05
10-23-09	11:20	70.0	12.64	12.46	6.00E+01	3.5E-07	3.5E-05	3.4E-07	3.4E-05
10-23-09	11:21	70.0	11.59	13.55	6.00E+01	3.9E-07	3.9E-05	3.8E-07	3.8E-05
10-23-09	11:22	70.0	10.56	14.56	6.00E+01	3.9E-07	3.9E-05	3.8E-07	3.8E-05
10-23-09	11:23	70.0	9.58	15.52	6.00E+01	3.8E-07	3.8E-05	3.7E-07	3.7E-05

Corrected Permeability vs. Time



A gradient of approximately 99.9 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 3.66E-07 cm/s 3.66E-05
Average Hydraulic Conductivity @ 20° C (last run) m/s 3.66E-07 cm/s 3.66E-05

Reviewed by: KDG

Stantec

Hydraulic Conductivity of Saturated Porous Materials
Using a Flexible Wall Permeameter
ASTM D 5084-03

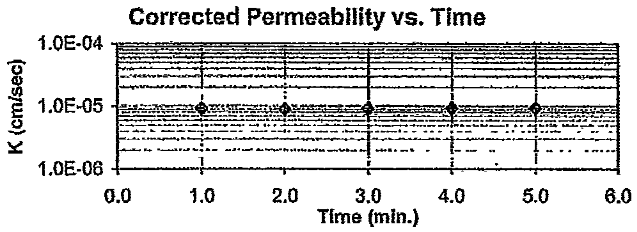
Project Name Allen Fossil Plant (TVA) Project No. 172679016
Source STN-7, 30.0'-32.0' Test ID 495
Visual Classification Sandy Lean Clay with Gravel (CL), gray, wet, soft Prepared By KDG
Undisturbed XX Specific Gravity 2.66 ASTM D854-A Date 9-14-09
Maximum Dry Density (pcf) ____ Percent of Maximum ____
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.)	2.4535	2.3895	2.3909	Chamber	75
Diameter (in.)	2.7903		2.7747	Influent	70
Moisture Content (%)	16.3		16.1	Effluent	65
Dry Unit Weight (pcf)	110.5		114.6		
Void Ratio	0.503		0.449		
Degree of Saturation (%)	85.9		95.3		
Trimmings MC (%)	22.9				

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)
9-16-09	12:55	70.0	18.94	5.99	0	---	---	---	---
9-16-09	12:56	70.0	18.55	6.39	6.00E+01	9.4E-08	9.4E-06	9.1E-08	9.1E-06
9-16-09	12:57	70.0	18.16	6.77	6.00E+01	9.2E-08	9.2E-06	8.9E-08	8.9E-06
9-16-09	12:58	70.0	17.77	7.16	6.00E+01	9.4E-08	9.4E-06	9.1E-08	9.1E-06
9-16-09	12:59	70.0	17.38	7.55	6.00E+01	9.4E-08	9.4E-06	9.2E-08	9.2E-06
9-16-09	13:00	70.0	16.99	7.94	6.00E+01	9.5E-08	9.5E-06	9.2E-08	9.2E-06



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 9.11E-08 cm/s 9.11E-06
Average Hydraulic Conductivity @ 20° C (last run) m/s 9.11E-08 cm/s 9.11E-06

Reviewed by:

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Allen Fossil Plant - TVA, Memphis, Tennessee
Project No. 172679016
Source STN-8A, 5.0'-7.0', TI - 5.0'-5.5'
Test ID 794A
Visual Classification Silty Clay (CL), gray, moist, firm
Prepared By KDG
Undisturbed XX
Specific Gravity 2.64 ASTM D854-A
Date 1-7-10
Maximum Dry Density (pcf)
Percent of Maximum

Permeant: De-aired tap water
Selection and Preparation Comments:

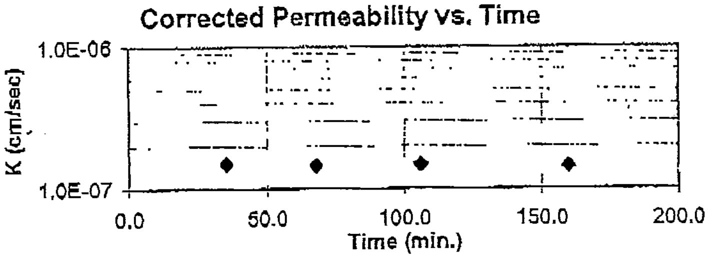
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height 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
Height (in.)	2.4588	2.4324	2.4345
Diameter (in.)	2.8050		2.8088
Moisture Content (%)	17.8		18.9
Dry Unit Weight (pcf)	109.4		110.2
Void Ratio	0.506		0.496
Degree of Saturation (%)	93.0		100.8
Trimmings MC (%)	17.2		

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)
1-8-10	12:40	72.0	21.23	4.35	0	—	—	---	---
1-8-10	13:15	72.0	21.03	4.62	2.10E+03	1.6E-09	1.6E-07	1.5E-09	1.5E-07
1-8-10	13:48	72.0	20.82	4.84	1.98E+03	1.5E-09	1.5E-07	1.5E-09	1.5E-07
1-8-10	14:26	72.0	20.57	5.09	2.28E+03	1.6E-09	1.6E-07	1.5E-09	1.5E-07
1-8-10	15:20	72.0	20.25	5.46	3.24E+03	1.5E-09	1.5E-07	1.4E-09	1.4E-07



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 1.47E-09 cm/s 1.47E-07
Average Hydraulic Conductivity @ 20° C (last run) m/s 1.47E-09 cm/s 1.47E-07

Reviewed by: KDG

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

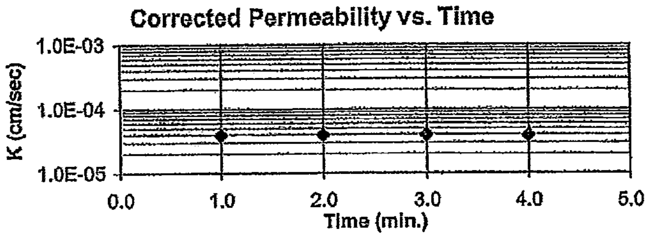
Project Name Allen Fossil Plant East Ash Pond
Project No. 172679016
Source HA-1, 2.0'-3.0', 3.0'-4.0'
Test ID 94
Visual Classification Poorly Graded Sand with Silt (SP-SM), brown
Prepared By KDG
Compacted 0 in. spacer
Specific Gravity 2.67 ASTM D854-A
Date 10-22-09
Maximum Dry Density (pcf) 95.8
Percent of Maximum 99.4
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.)	1.3921	1.3552	1.3556	Chamber	71
Diameter (in.)	2.8017		2.7666	Influent	66
Moisture Content (%)	19.7		25.4	Effluent	65
Dry Unit Weight (pcf)	95.2		100.3		
Void Ratio	0.750		0.662		
Degree of Saturation (%)	70.1		102.4		
Trimmings MC (%)	19.8				

Applied Head Difference (psi) 1
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 6
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)
10-23-09	12:43	70.0	19.17	6.24	0	---	---	---	---
10-23-09	12:44	70.0	18.59	6.82	6.00E+01	4.0E-07	4.0E-05	3.9E-07	3.9E-05
10-23-09	12:45	70.0	18.03	7.38	6.00E+01	4.0E-07	4.0E-05	3.9E-07	3.9E-05
10-23-09	12:46	70.0	17.52	7.94	6.00E+01	4.0E-07	4.0E-05	3.9E-07	3.9E-05
10-23-09	12:47	70.0	17.00	8.43	6.00E+01	4.0E-07	4.0E-05	3.9E-07	3.9E-05



A gradient of approximately 99.1 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 3.89E-07 cm/s 3.89E-05
Average Hydraulic Conductivity @ 20° C (last run) m/s 3.89E-07 cm/s 3.89E-05

Reviewed by:

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Allen Fossil Plant East Ash Pond
Project No. 172679016
Source HA-4, 2.0'-3.0', 4.0'-5.0'
Test ID 95
Visual Classification Poorly Graded Sand with Silt (SP-SM), brown
Prepared By KDG
Compacted 0 in. spacer
Specific Gravity 2.65 ASTM D854-A
Date 10-22-09
Maximum Dry Density (pcf) 95.8
Percent of Maximum 99.0
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.

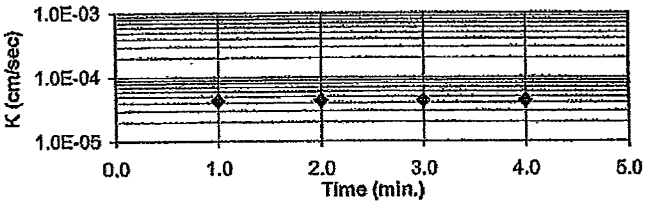
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	1.3821	1.3274	1.3276
Diameter (in.)	2.8030		2.7740
Moisture Content (%)	21.0		24.1
Dry Unit Weight (pcf)	94.8		100.8
Void Ratio	0.744		0.641
Degree of Saturation (%)	74.8		99.6
Trimmings MC (%)	20.2		

Final Pressures (psi)	
Chamber	71
Influent	66
Effluent	65

Applied Head Difference (psi) 1
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 6
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)
10-23-09	10:34	68.0	17.76	7.73	0	---	---	---	---
10-23-09	10:35	68.0	17.13	8.36	6.00E+01	4.2E-07	4.2E-05	4.2E-07	4.2E-05
10-23-09	10:36	68.0	16.53	8.98	6.00E+01	4.3E-07	4.3E-05	4.3E-07	4.3E-05
10-23-09	10:37	68.0	15.94	9.54	6.00E+01	4.2E-07	4.2E-05	4.2E-07	4.2E-05
10-23-09	10:38	68.0	15.38	10.08	6.00E+01	4.3E-07	4.3E-05	4.3E-07	4.3E-05

Corrected Permeability vs. Time



A gradient of approximately 99.8 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 4.26E-07 cm/s 4.26E-05
Average Hydraulic Conductivity @ 20° C (last run) m/s 4.26E-07 cm/s 4.26E-05

Reviewed by:

File: 172679016_fhp_95 Sheet: Report
Preparation Date 2-20-98
Revision Date 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By:JW
Approved By: TLK

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

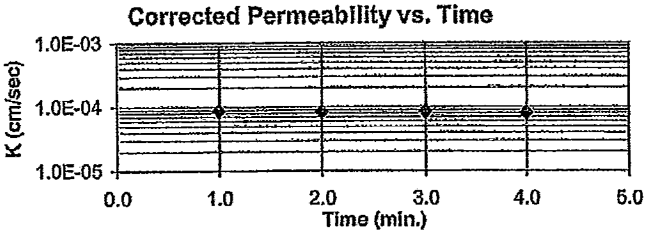
Project Name Allen Fossil Plant East Ash Pond
Project No. 172679016
Source HA-5, 1.0'-2.0', 2.0'-3.0'
Test ID 96
Visual Classification Poorly Graded Sand (SP), brown
Prepared By KDG
Compacted 0 in. spacer
Specific Gravity 2.66 ASTM D854-A
Date 10-22-09
Maximum Dry Density (pcf) 95.8
Percent of Maximum 99.7
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.)	1.3809	1.3494	1.3500	Chamber	71
Diameter (in.)	2.8010		2.7761	Influent	66
Moisture Content (%)	20.5		24.1	Effluent	65
Dry Unit Weight (pcf)	95.5		99.4		
Void Ratio	0.739		0.670		
Degree of Saturation (%)	73.7		95.6		
Trimmings MC (%)	21.4				

Applied Head Difference (psi) 1
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 6
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)
10-23-09	9:45	68.0	16.75	7.86	0	---	---	---	---
10-23-09	9:46	68.0	15.53	9.14	6.00E+01	8.7E-07	8.7E-05	8.7E-07	8.7E-05
10-23-09	9:47	68.0	14.44	10.23	6.00E+01	8.4E-07	8.4E-05	8.4E-07	8.4E-05
10-23-09	9:48	68.0	13.45	11.23	6.00E+01	8.3E-07	8.3E-05	8.3E-07	8.3E-05
10-23-09	9:49	68.0	12.56	12.08	6.00E+01	8.0E-07	8.0E-05	8.0E-07	8.0E-05



A gradient of approximately 99.9 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 8.34E-07 cm/s 8.34E-05
Average Hydraulic Conductivity @ 20° C (last run) m/s 8.34E-07 cm/s 8.34E-05

Reviewed by:

Stantec

Hydraulic Conductivity of Saturated Porous Materials
Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Allen Fossil Plant East Ash Pond

Project No. 172679016

Source HA-9, 3.0'-4.0', 5.0'-6.0'

Test ID 97

Visual Classification Poorly Graded Sand with Silt (SP-SM), brown

Prepared By KDG

Compacted 0 In. spacer

Specific Gravity 2.66 ASTM D854-A

Date 10-22-09

Maximum Dry Density (pcf) 99.1

Percent of Maximum 98.5

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.)	1.3890	1.3525	1.3527
Diameter (In.)	2.8020		2.7642
Moisture Content (%)	16.8		22.7
Dry Unit Weight (pcf)	97.7		103.0
Void Ratio	0.701		0.612
Degree of Saturation (%)	63.8		98.8
Trimmings MC (%)	17.4		

Final Pressures (psi)	
Chamber	71
Influent	66
Effluent	65

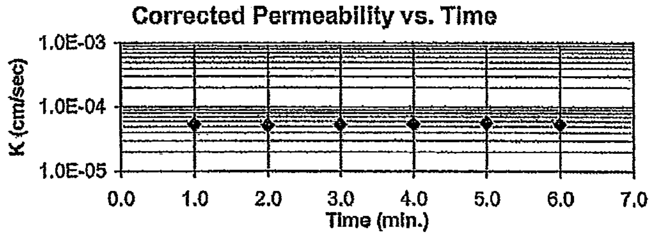
Applied Head Difference (psi) 1

Back Pressure Saturated to (psi) 65

Maximum Effective Consolidation Stress (psi) 6

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)
10-23-09	13:10	70.0	20.63	4.96	0	---	---	---	---
10-23-09	13:11	70.0	19.84	5.73	6.00E+01	5.4E-07	5.4E-05	5.3E-07	5.3E-05
10-23-09	13:12	70.0	19.13	6.46	6.00E+01	5.3E-07	5.3E-05	5.2E-07	5.2E-05
10-23-09	13:13	70.0	18.43	7.16	6.00E+01	5.4E-07	5.4E-05	5.3E-07	5.3E-05
10-23-09	13:14	70.0	17.78	7.84	6.00E+01	5.5E-07	5.5E-05	5.3E-07	5.3E-05
10-23-09	13:15	70.0	17.10	8:47	6.00E+01	5.7E-07	5.7E-05	5.6E-07	5.6E-05
10-23-09	13:16	70.0	16.51	9.05	6.00E+01	5.4E-07	5.4E-05	5.3E-07	5.3E-05



A gradient of approximately 99.4 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 5.38E-07 cm/s 5.38E-05

Average Hydraulic Conductivity @ 20° C (last run) m/s 5.33E-07 cm/s 5.33E-05

Reviewed by: KDG

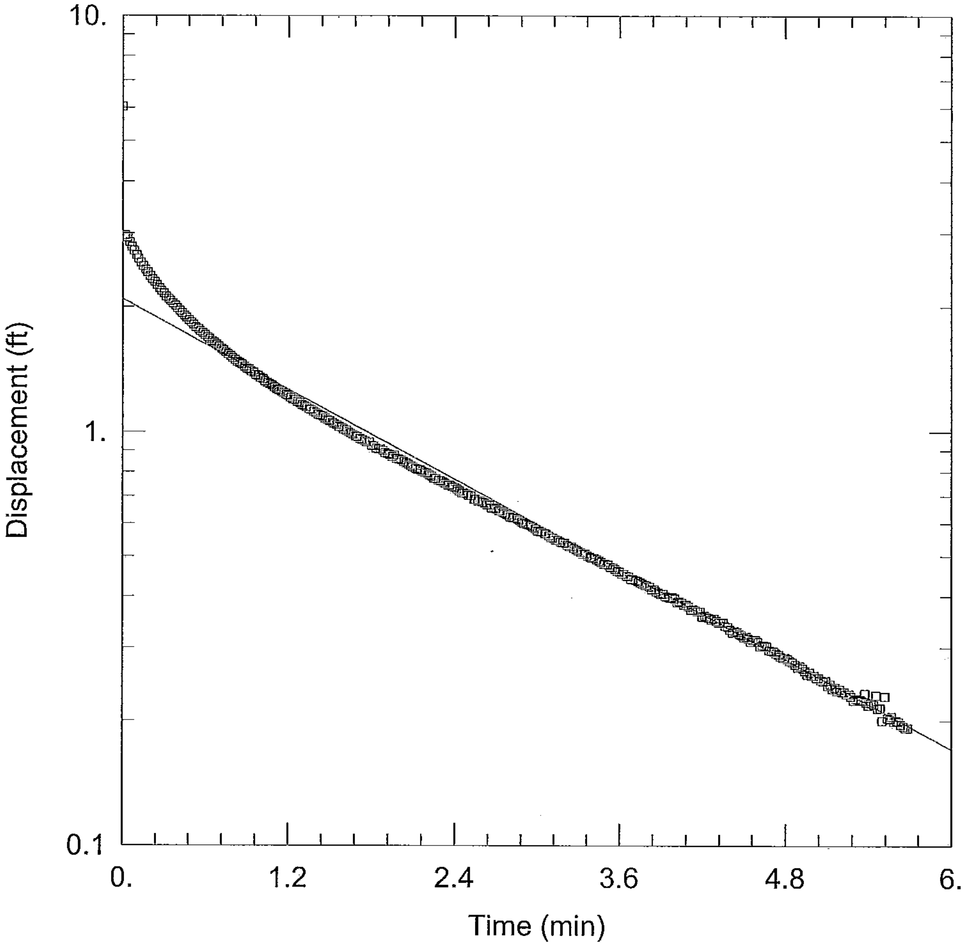
File: 172679016_jhp_97 Sheet: Report
Preparation Date 2-20-98
Revision Date 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By:JW
Approved By: TLK

Appendix E

Slug Test Data



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-1.aqt
Date: 11/18/09
Time: 14:58:47

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-1
Test Date: 11/11/09

AQUIFER DATA

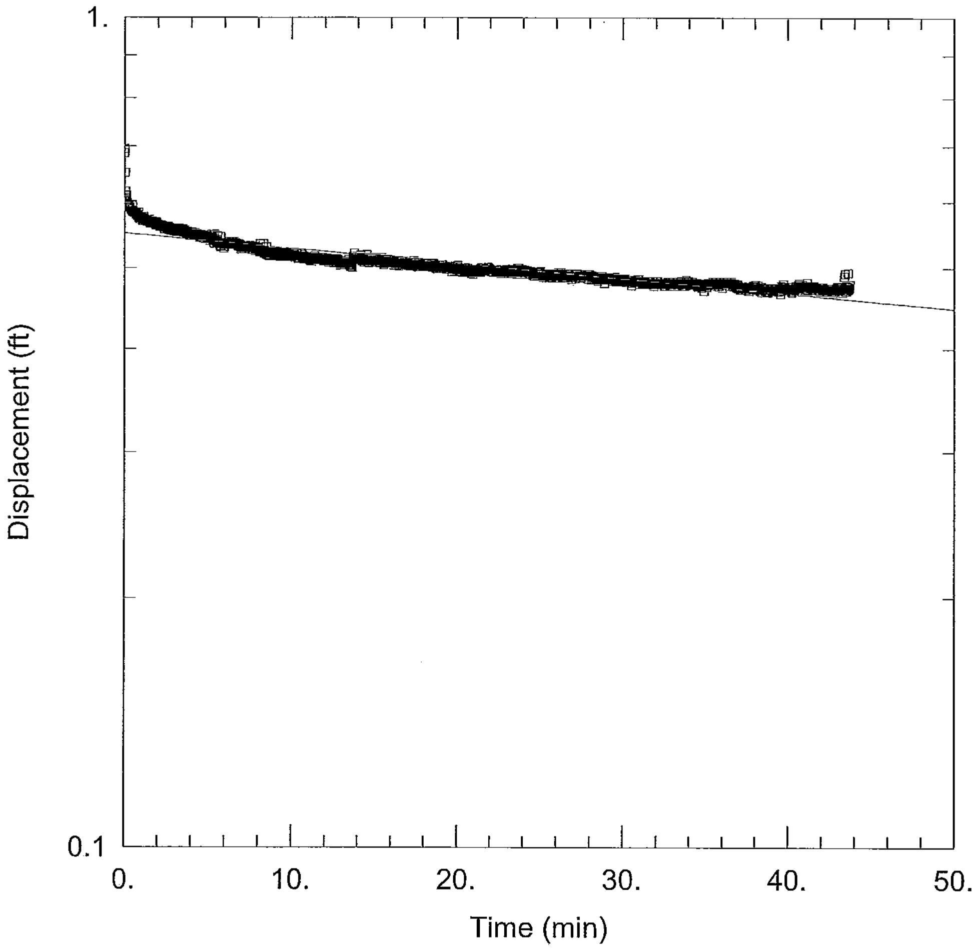
Saturated Thickness: 26.02 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-1)

Initial Displacement: 6.041 ft
Total Well Penetration Depth: 22.32 ft
Casing Radius: 0.0417 ft
Static Water Column Height: 22.32 ft
Screen Length: 5. ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0001399 cm/sec
y0 = 2.089 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-2.aqt
Date: 11/18/09 Time: 14:57:47

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-2
Test Date: 11/11/09

AQUIFER DATA

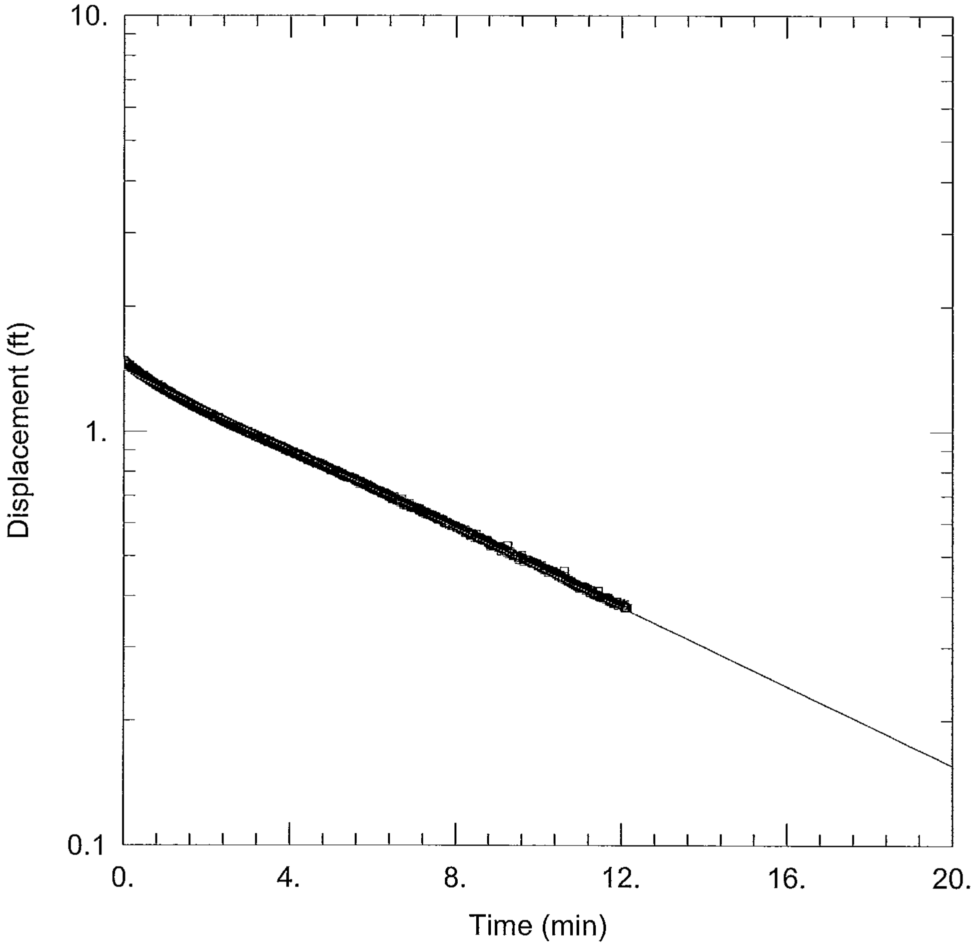
Saturated Thickness: 16.74 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-2)

Initial Displacement: 0.602 ft
Total Well Penetration Depth: 5. ft
Casing Radius: 0.0417 ft
Static Water Column Height: 3.54 ft
Screen Length: 5. ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.116E-6 cm/sec
y0 = 0.5507 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-3.aqt
Date: 11/18/09 Time: 14:56:51

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-3
Test Date: 11/11/09

AQUIFER DATA

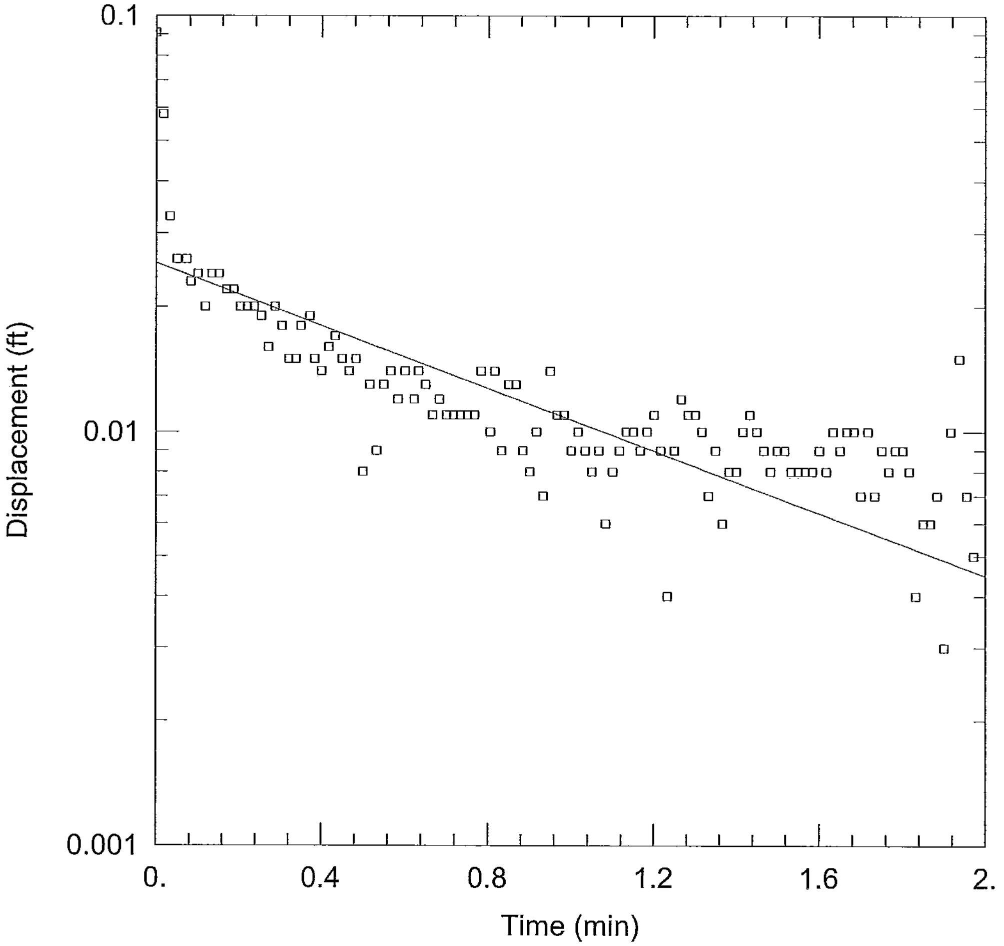
Saturated Thickness: 5.42 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-3)

Initial Displacement: 1.482 ft
Total Well Penetration Depth: 17.1 ft
Casing Radius: 0.0417 ft
Static Water Column Height: 5.42 ft
Screen Length: 5. ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.048E-5 cm/sec
y0 = 1.405 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-4.aqt
Date: 11/18/09 Time: 15:00:12

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-4
Test Date: 11/11/09

AQUIFER DATA

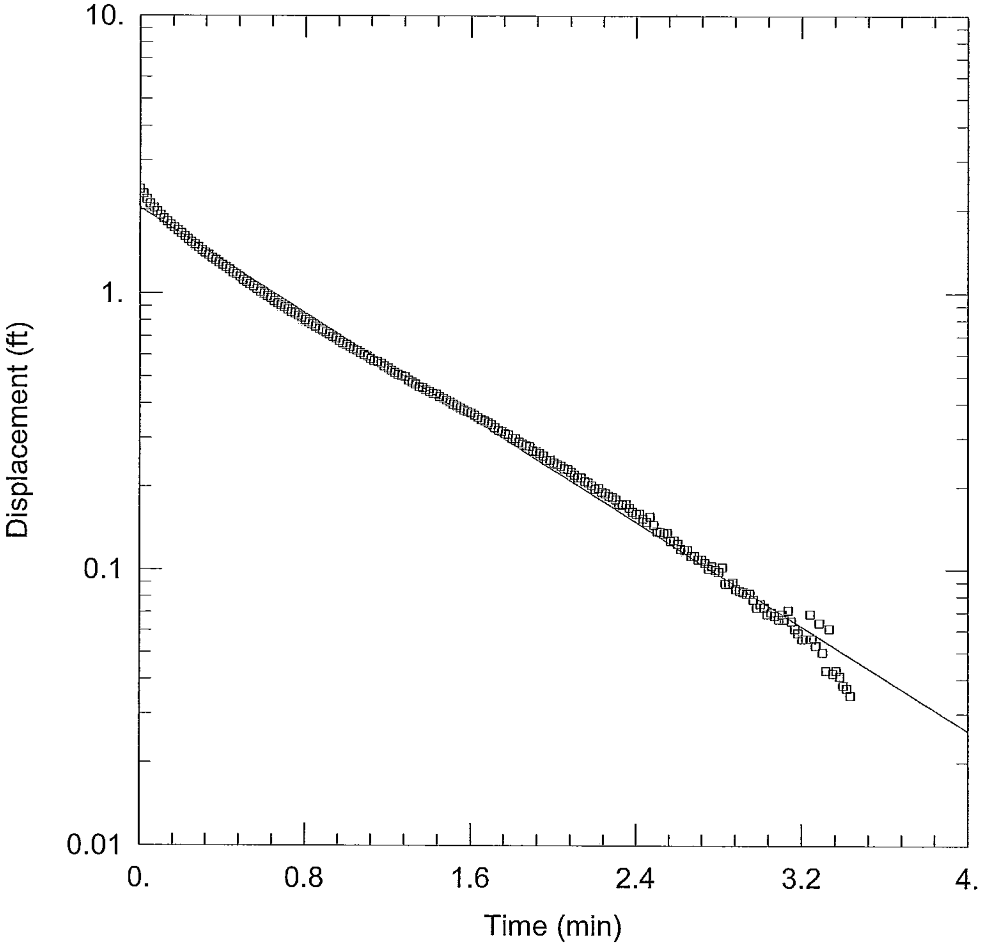
Saturated Thickness: 3.97 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-4)

Initial Displacement: 0.091 ft
Total Well Penetration Depth: 5. ft
Casing Radius: 0.0417 ft
Static Water Column Height: 3.37 ft
Screen Length: 5. ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0003297 cm/sec
y0 = 0.02549 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-5.aqt
Date: 11/18/09 Time: 14:55:40

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-5
Test Date: 11/11/09

AQUIFER DATA

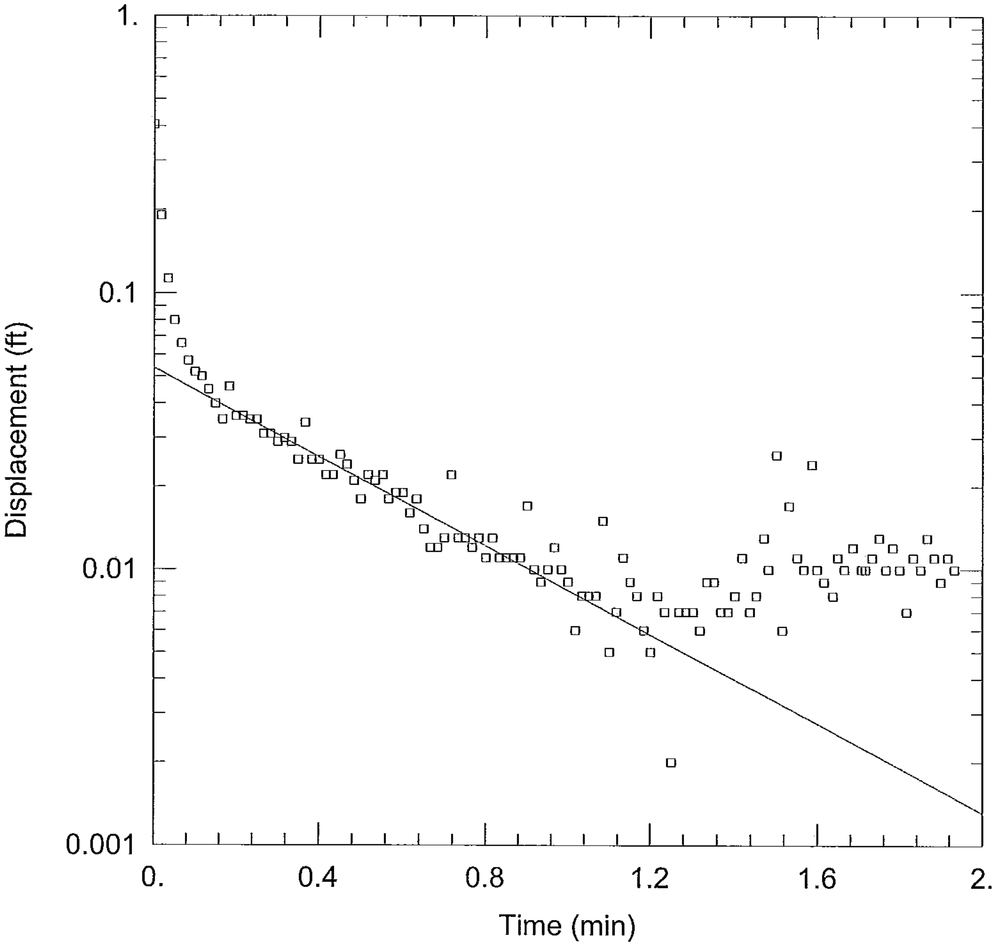
Saturated Thickness: 24.62 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-5)

Initial Displacement: 2.369 ft
Total Well Penetration Depth: 20.62 ft
Casing Radius: 0.0417 ft
Static Water Column Height: 20.62 ft
Screen Length: 5. ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0003618 cm/sec
y0 = 2.035 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-6.aqt
Date: 11/18/09 Time: 14:54:34

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-6
Test Date: 11/11/09

AQUIFER DATA

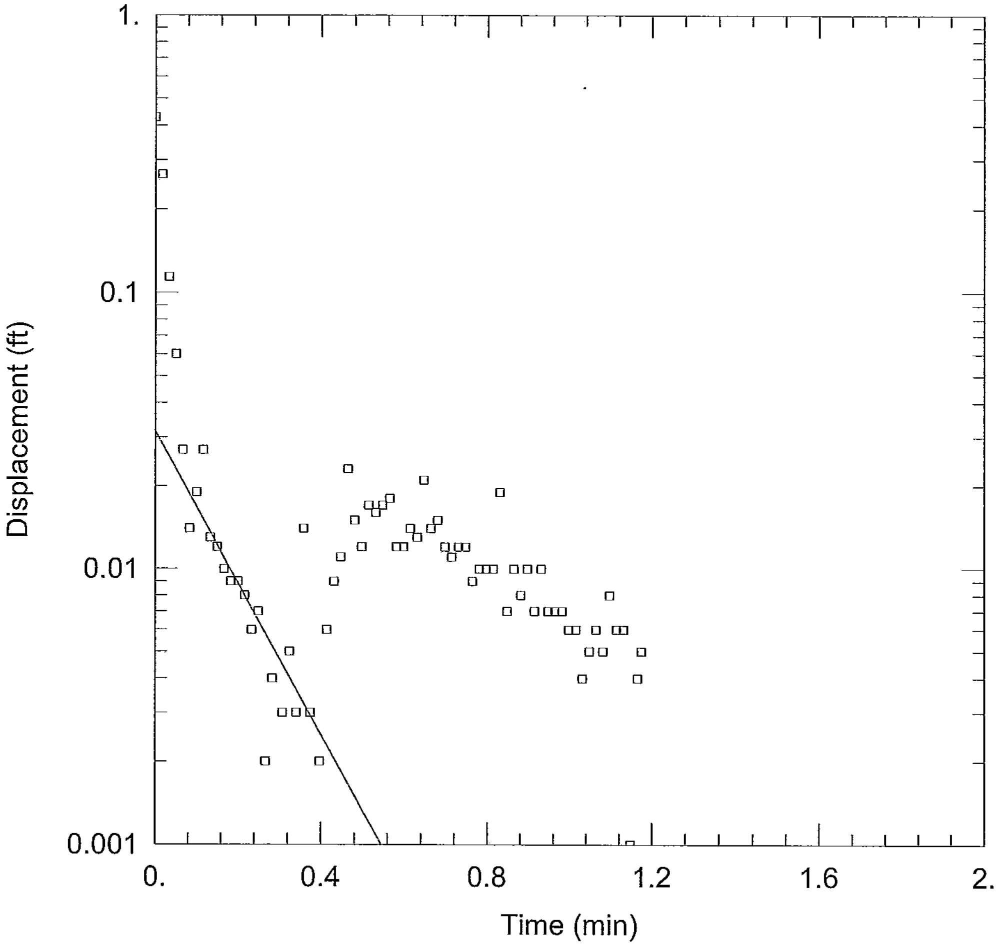
Saturated Thickness: 0.4 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-6)

Initial Displacement: 0.405 ft
Static Water Column Height: 0.4 ft
Total Well Penetration Depth: 5. ft
Screen Length: 5. ft
Casing Radius: 0.0417 ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.005303 cm/sec
y0 = 0.05384 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-7.aqt
Date: 11/18/09 Time: 14:02:39

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-7
Test Date: 11/11/09

AQUIFER DATA

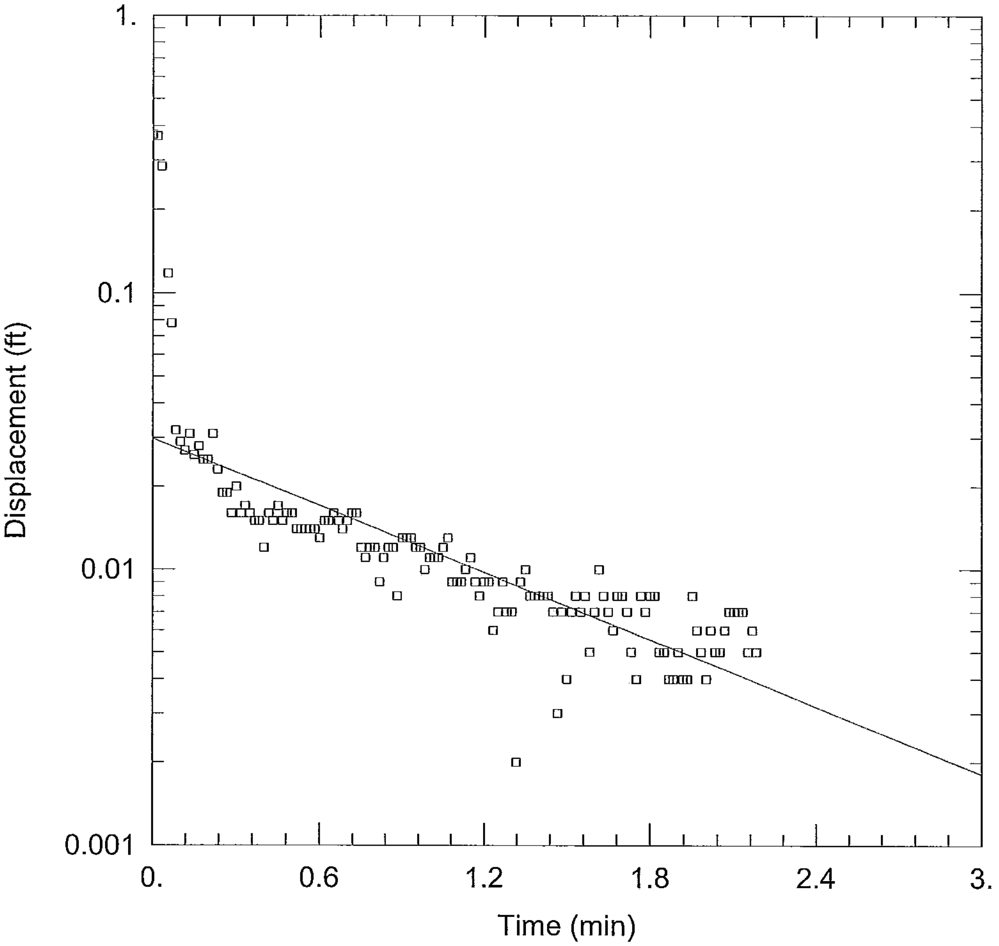
Saturated Thickness: 0.1 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-7)

Initial Displacement: 0.428 ft
Total Well Penetration Depth: 5. ft
Casing Radius: 0.0417 ft
Static Water Column Height: 0. ft
Screen Length: 5. ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.05384 cm/sec
y0 = 0.03159 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-8.aqt
Date: 11/18/09 Time: 14:09:36

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-8
Test Date: 11/11/09

AQUIFER DATA

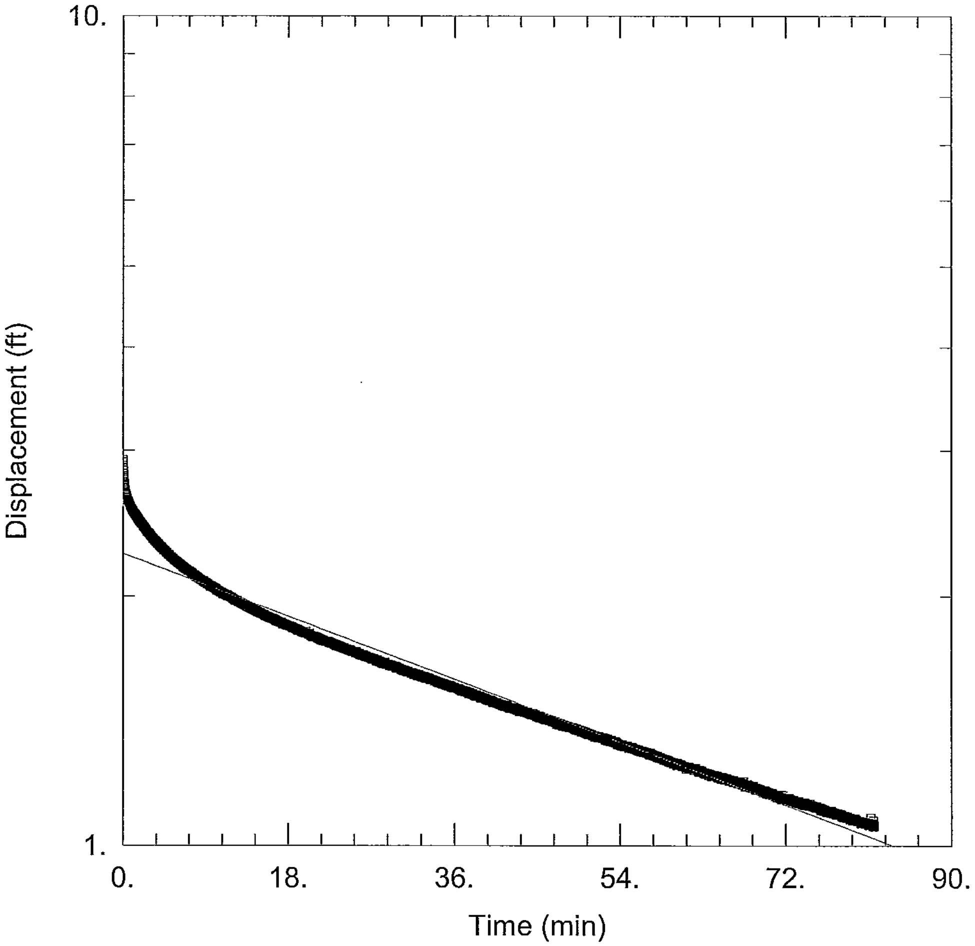
Saturated Thickness: 11.56 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-8)

Initial Displacement: 0.372 ft
Total Well Penetration Depth: 5. ft
Casing Radius: 0.0417 ft
Static Water Column Height: 0.4 ft
Screen Length: 5. ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0002531 cm/sec
y0 = 0.02985 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-9.aqt
Date: 11/18/09 Time: 14:15:58

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-9
Test Date: 11/11/09

AQUIFER DATA

Saturated Thickness: 19.2 ft
Anisotropy Ratio (Kz/Kr): 1.

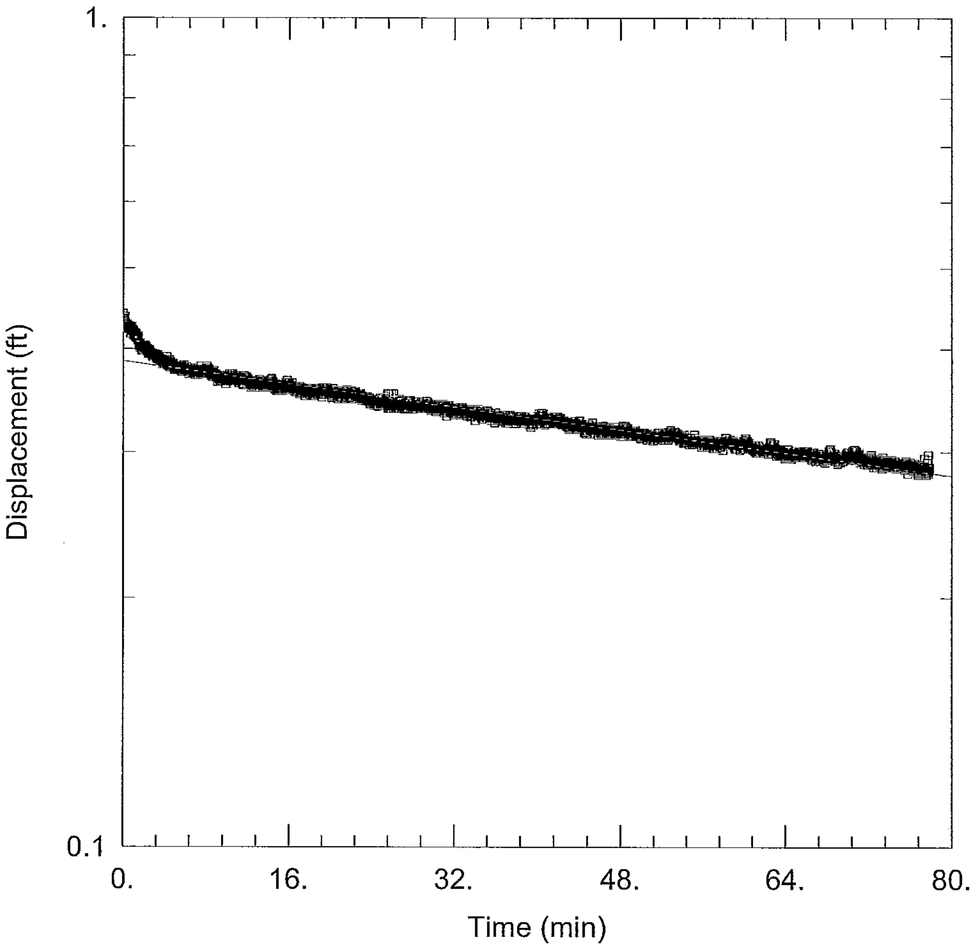
WELL DATA (STN-9)

Initial Displacement: 2.924 ft
Total Well Penetration Depth: 19.2 ft
Casing Radius: 0.0417 ft
Static Water Column Height: 19.2 ft
Screen Length: 5. ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 3.63E-6 cm/sec
y0 = 2.252 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-10.aqt
Date: 11/18/09 Time: 14:20:23

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-10
Test Date: 11/11/09

AQUIFER DATA

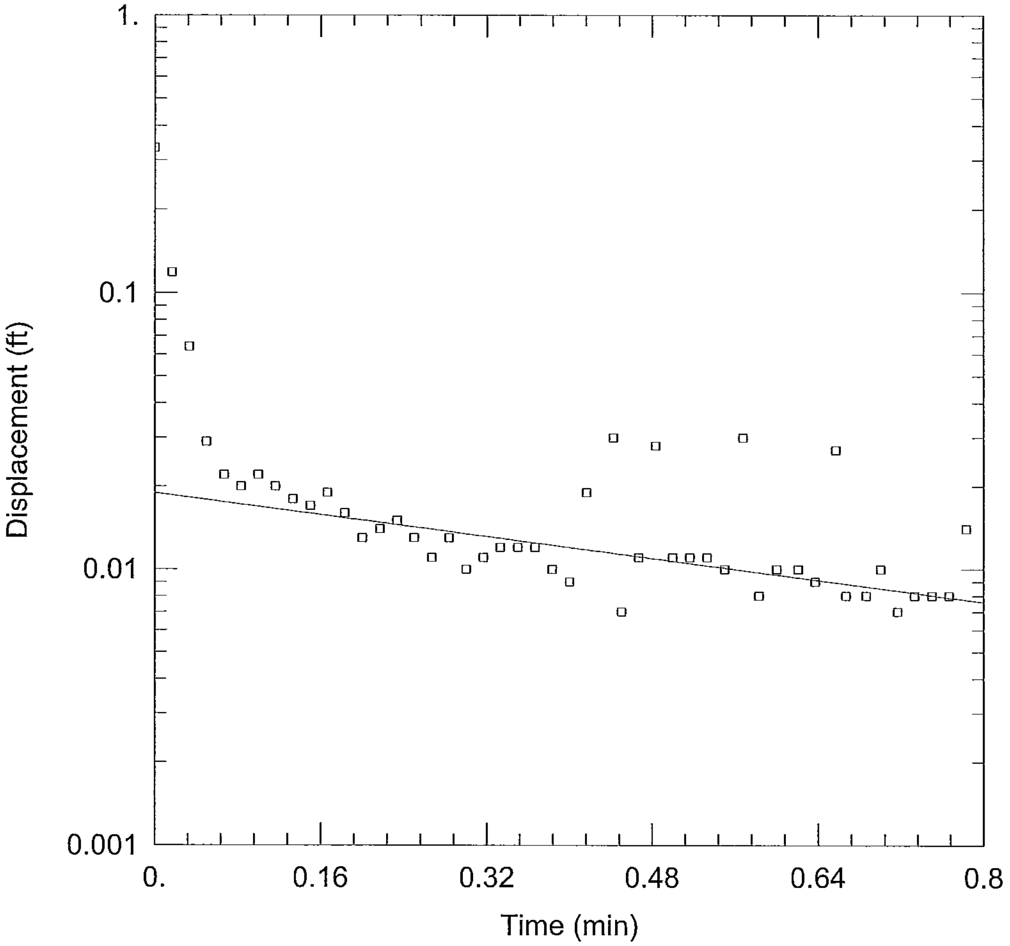
Saturated Thickness: 11.68 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-10)

Initial Displacement: 0.441 ft
Total Well Penetration Depth: 5. ft
Casing Radius: 0.0417 ft
Static Water Column Height: 12.8 ft
Screen Length: 5. ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.08E-6 cm/sec
y0 = 0.3867 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-11.aqt
Date: 11/18/09 Time: 14:26:28

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-11
Test Date: 11/11/09

AQUIFER DATA

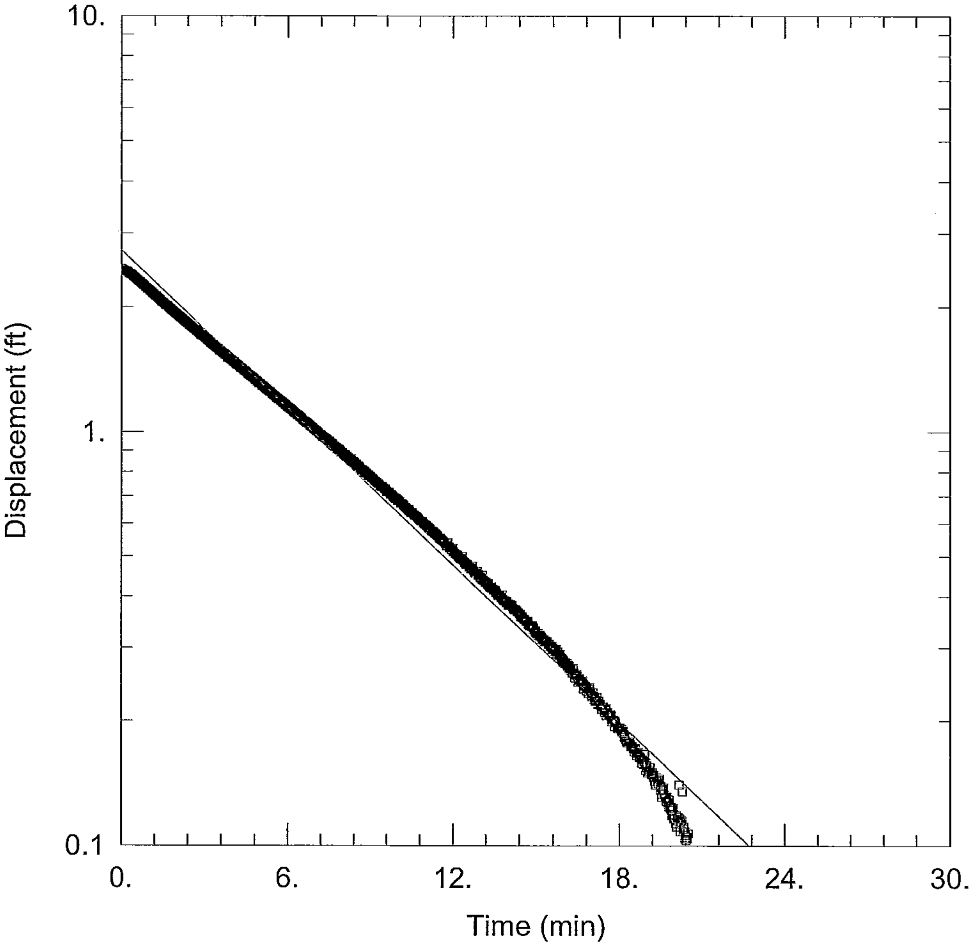
Saturated Thickness: 14.3 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-11)

Initial Displacement: 0.332 ft
Static Water Column Height: 0.42 ft
Total Well Penetration Depth: 5. ft
Screen Length: 5. ft
Casing Radius: 0.0417 ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0003075 cm/sec
y0 = 0.01892 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-12.aqt
Date: 11/18/09 Time: 14:31:19

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-12
Test Date: 11/11/09

AQUIFER DATA

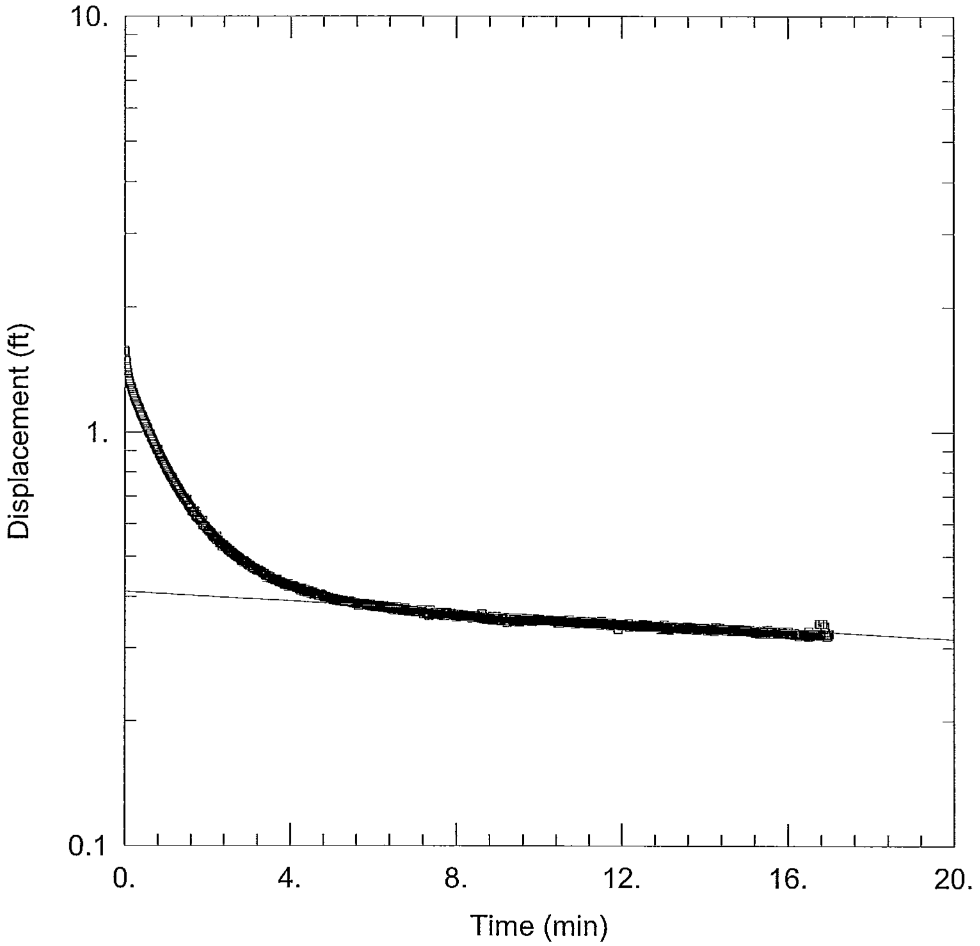
Saturated Thickness: 18.6 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-12)

Initial Displacement: 2.473 ft
Static Water Column Height: 17.8 ft
Total Well Penetration Depth: 17.8 ft
Screen Length: 5. ft
Casing Radius: 0.0417 ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.965E-5 cm/sec
y0 = 2.736 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-13.aqt
Date: 11/18/09 Time: 14:36:11

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-13
Test Date: 11/11/09

AQUIFER DATA

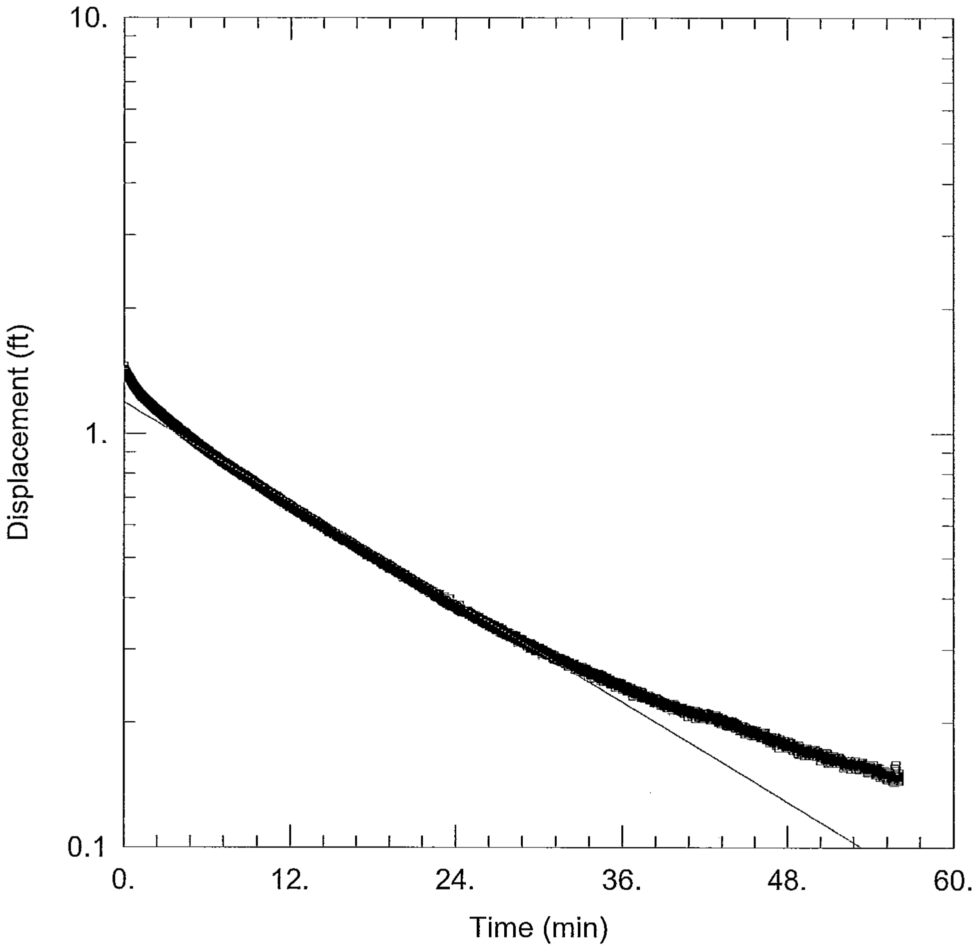
Saturated Thickness: 17.99 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-13)

Initial Displacement: 1.573 ft Static Water Column Height: 6.59 ft
Total Well Penetration Depth: 6.59 ft Screen Length: 5. ft
Casing Radius: 0.0417 ft Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 3.717E-6 cm/sec y0 = 0.4112 ft



ALLEN FOSSIL PLANT

Data Set: Z:\172679016\Slug Test\AQTESOLV files\STN-14.aqt
Date: 11/18/09 Time: 14:52:19

PROJECT INFORMATION

Company: Stantec
Client: TVA
Project: 172679016
Location: Allen
Test Well: STN-14
Test Date: 11/11/09

AQUIFER DATA

Saturated Thickness: 11.81 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (STN-14)

Initial Displacement: 1.45 ft
Total Well Penetration Depth: 11.81 ft
Casing Radius: 0.0417 ft
Static Water Column Height: 11.81 ft
Screen Length: 5. ft
Well Radius: 0.0417 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0001377 cm/sec
y0 = 1.191 ft

Appendix F

Results of Engineering Analyses

- Cross-Section C-C’
- Cross-Section D-D’
- Cross-Section E-E’

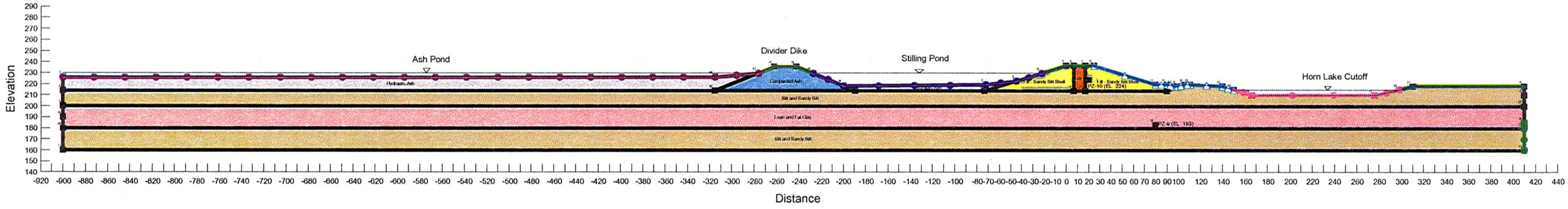
Cross-Section C-C’

Steady-State Seepage at Section C-C'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Boundary Conditions:
Stilling Pond Water Elevation - 230 ft
Ash Pond Water Elevation - 230 ft
Horn Lake Water Elevation - 215
Potential Seepage Face Total Flux - 0 cu.ft/sec
Bottom ML/SM Strata -
Downstream Total Head - 185 ft

Material Type	Kh,sat (ft/sec)	Kv/Kh ratio	Wsat
Fill - Sandy Silt Shell	1.31e-007	0.25	0.4
Fill - Sandy Silt Core	1.18e-007	0.25	0.39
Lean and Fat Clay	3.94e-008	0.05	0.47
Silt and Sandy Silt	1.64e-006	0.02	0.49
Hydraulic Ash	5e-005	0.02	0.46
Compacted Ash	2.5e-005	0.04	0.46



Subsurface Profile and Boundary Conditions

Steady-State Seepage at Section C-C'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Note:
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Bottom ML/SM Strata -
Downstream Total Head - 185 ft

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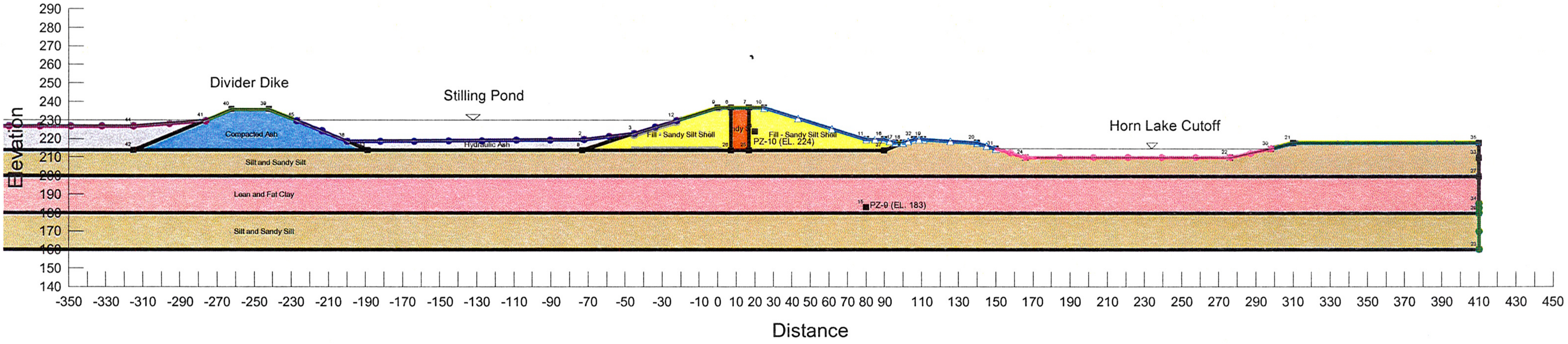
Hydraulic Ash	5e-005	0.02	0.46
Compacted Ash	2.5e-005	0.04	0.46



Finite Element Mesh, Flow Vectors and Phreatic Surface

Steady-State Seepage at Section C-C'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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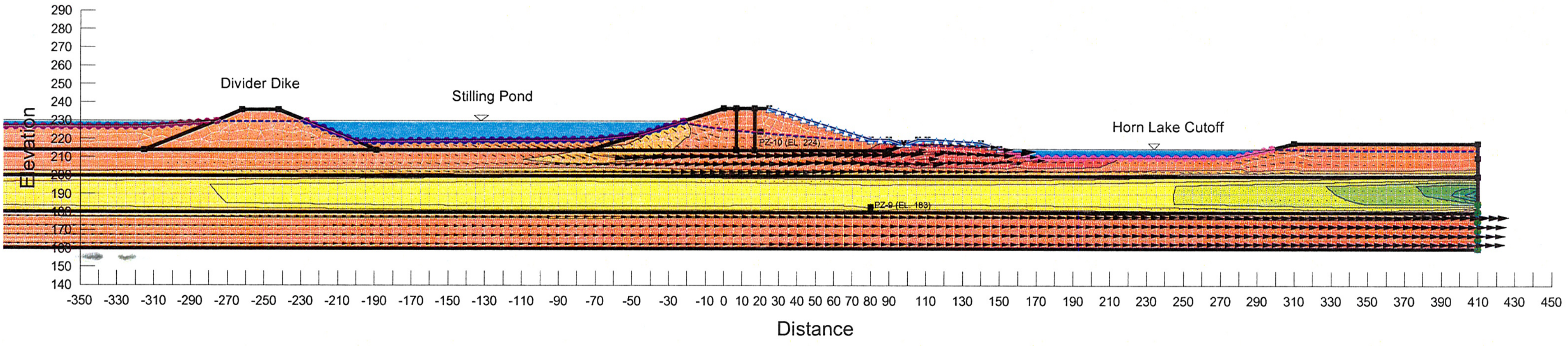
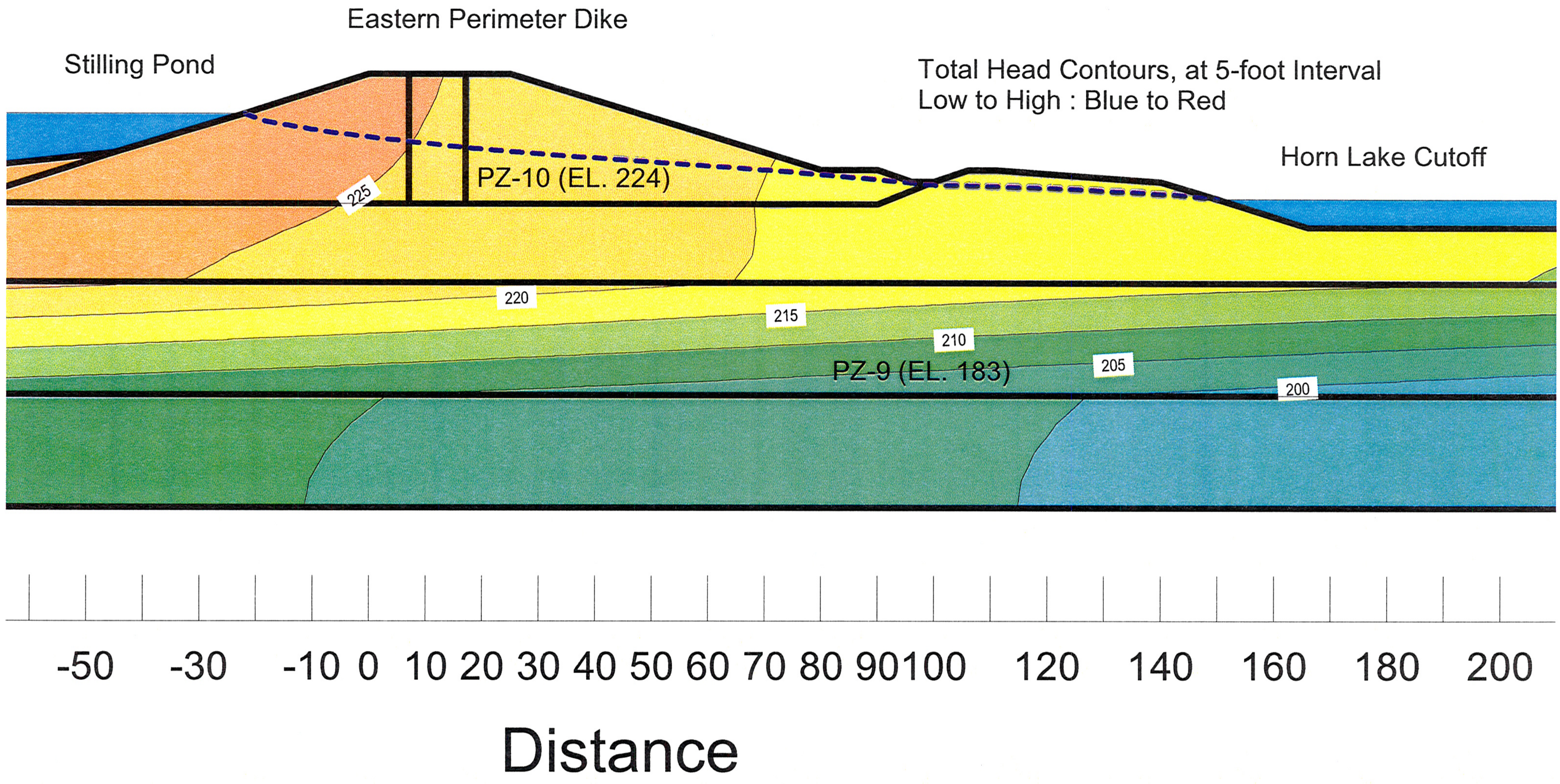
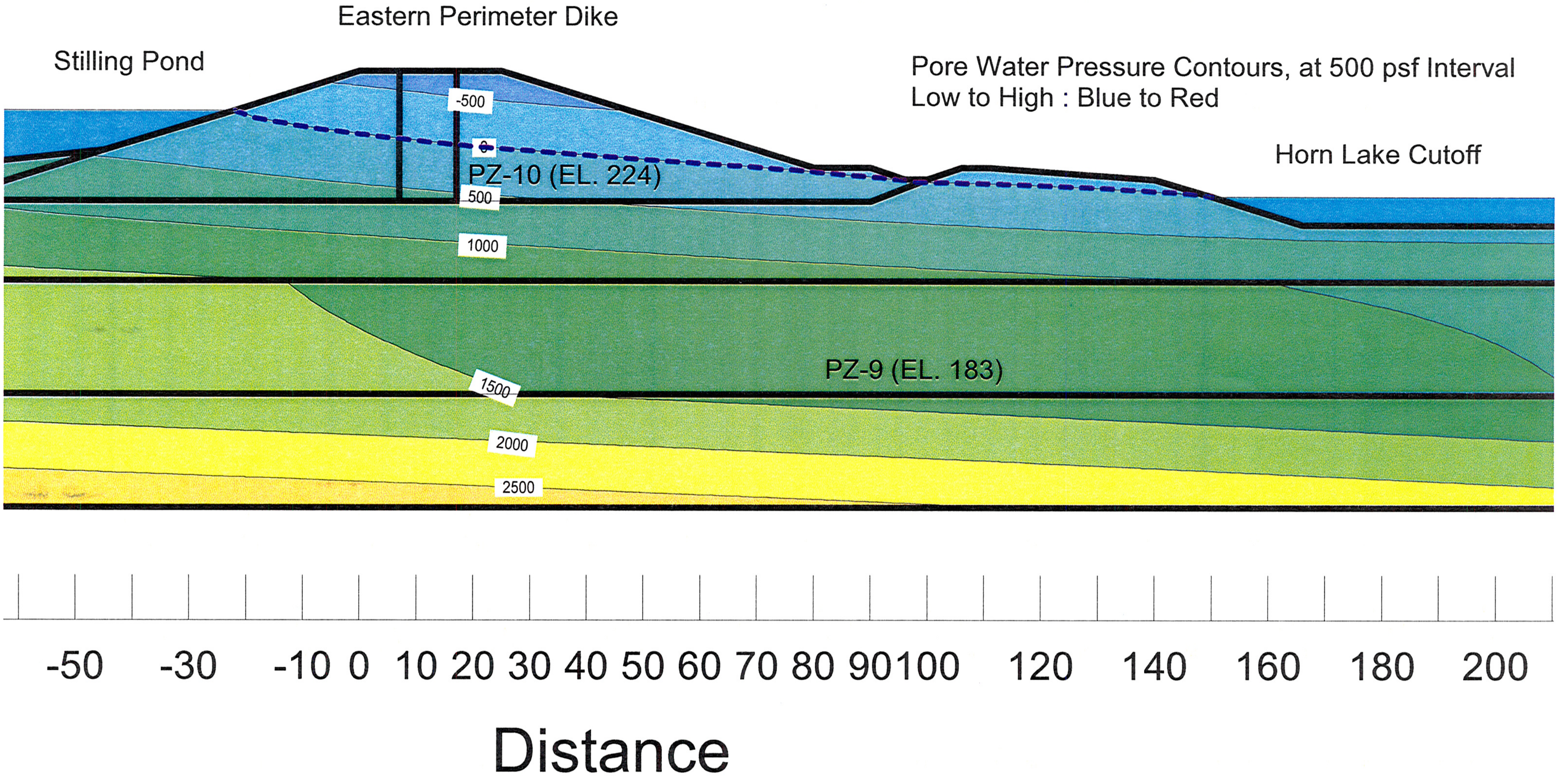


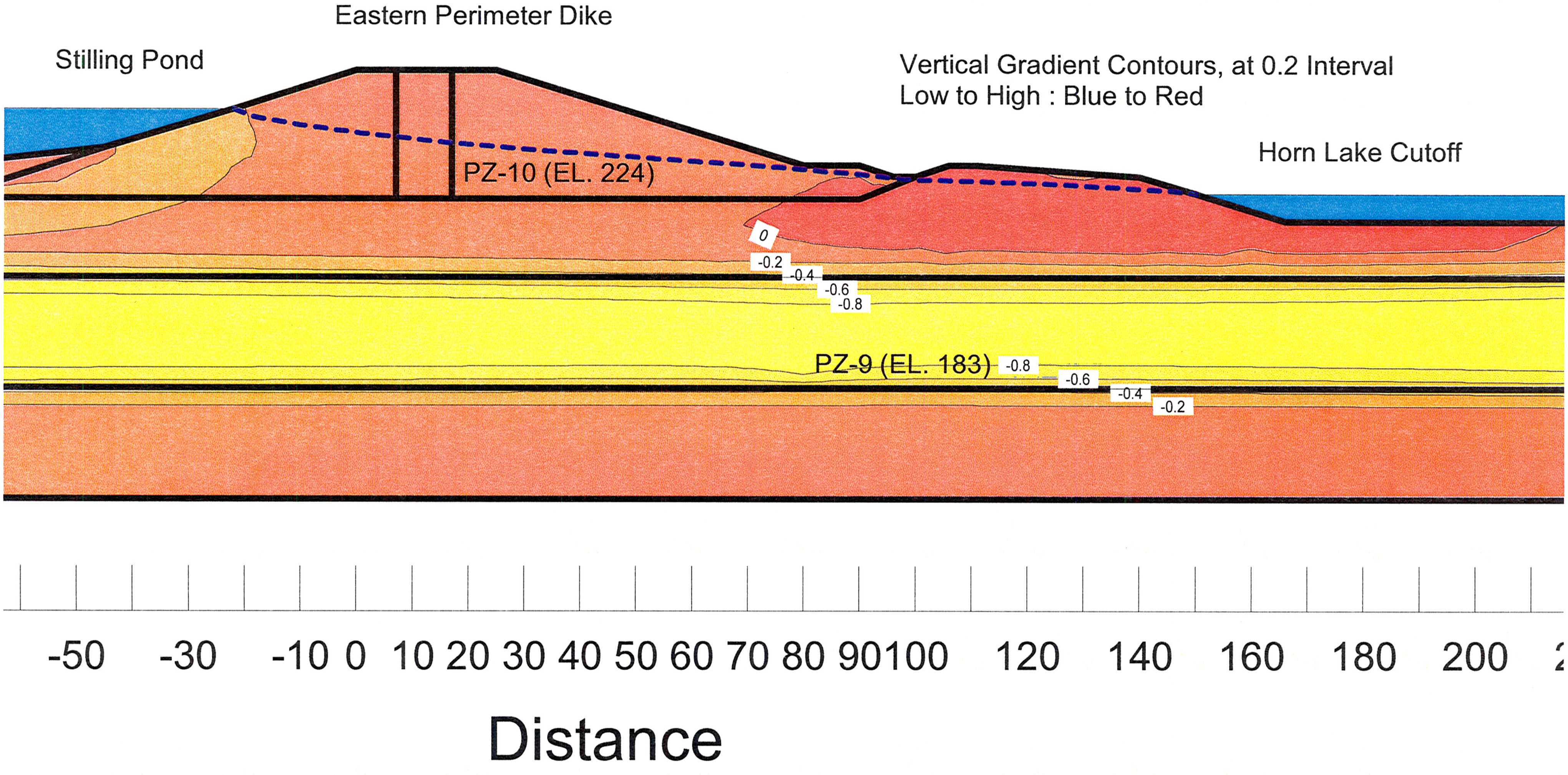
Steady-State Seepage at Cross-Section C-C’
Normal Pool Elevation



Steady-State Seepage at Cross-Section C-C’
Normal Pool Elevation



Steady-State Seepage at Cross-Section C-C'
Normal Pool Elevation

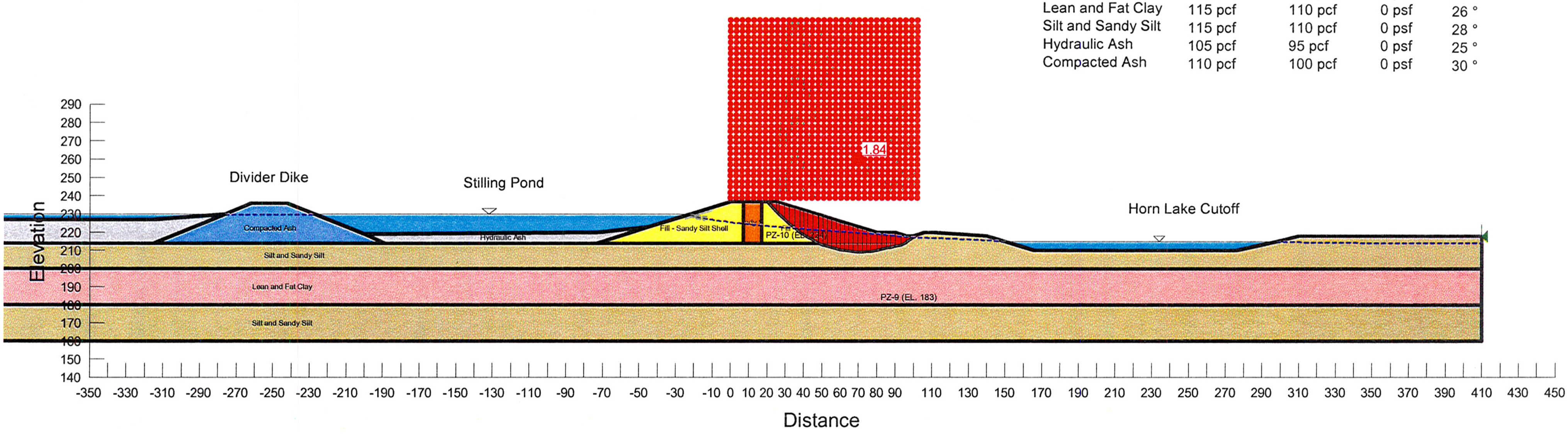


Downstream Deep Failure Circle

Slope Stability Analysis at Section C-C'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
Fill - Sandy Silt Shell	124 pcf	120 pcf	0 psf	31 °
Fill - Sandy Silt Core	125 pcf	125 pcf	0 psf	31 °
Lean and Fat Clay	115 pcf	110 pcf	0 psf	26 °
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °



Downstream Shallow Failure Circle

Slope Stability Analysis at Section C-C'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Note:
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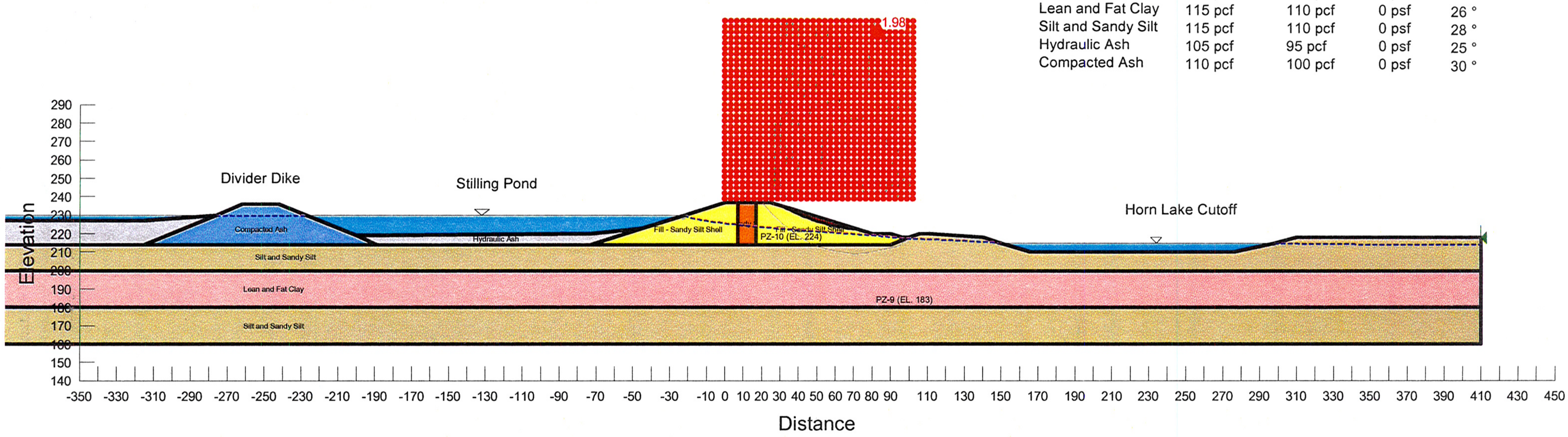
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °



Upstream Shallow Failure Circle

Slope Stability Analysis at Section C-C'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Note:
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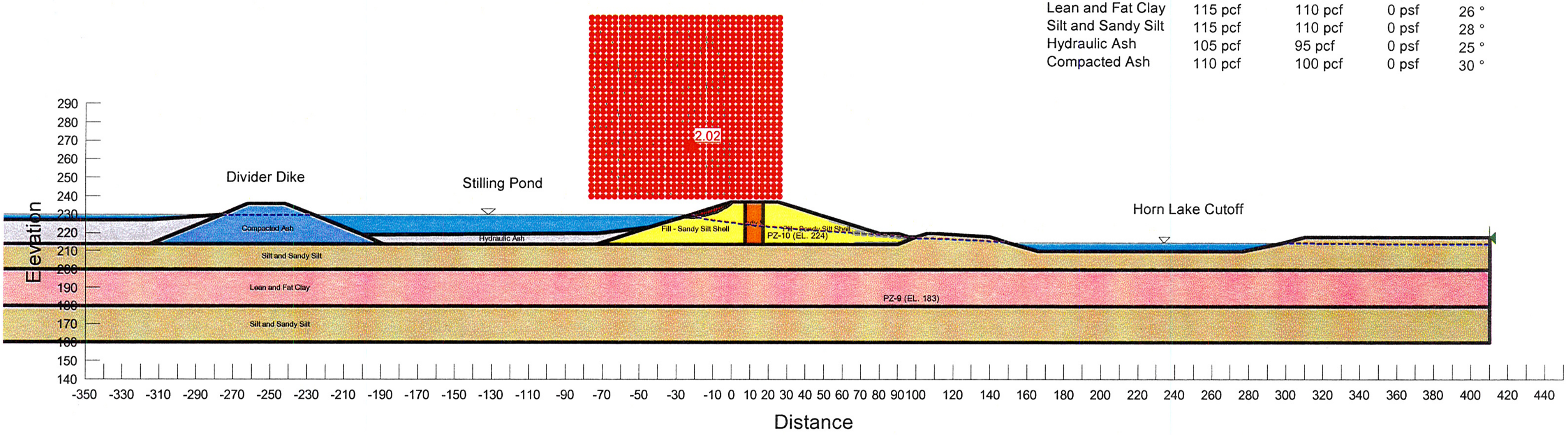
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °

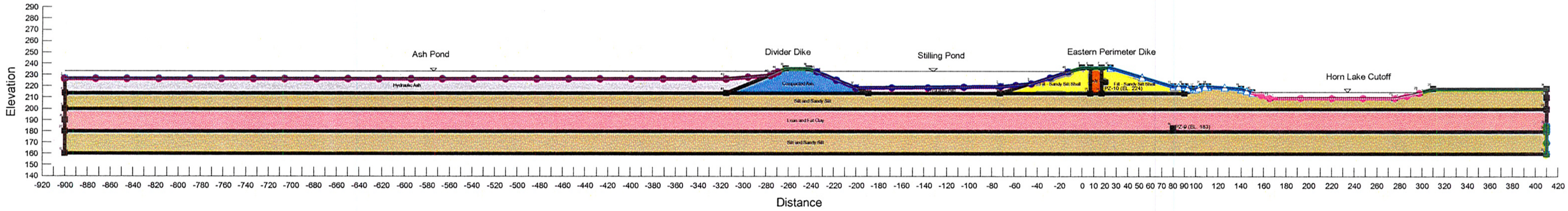


Steady State Seepage at Section C-C'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Boundary Conditions:
Stilling Pond Water Elevation - 233 ft
Ash Pond Water Elevation - 233 ft
Horn Lake Water Elevation - 215
Potential Seepage Face Total Flux - 0 cu.ft/sec
Bottom ML/SM Strata -
Downstream Total Head - 185 ft

Material Type	Kh,sat (ft/sec)	Kv/Kh ratio	Wsat
Fill - Sandy Silt Shell	1.31e-007	0.25	0.4
Fill - Sandy Silt Core	1.18e-007	0.25	0.39
Lean and Fat Clay	3.94e-008	0.05	0.47
Silt and Sandy Silt	1.64e-006	0.02	0.49
Hydraulic Ash	5e-005	0.02	0.46
Compacted Ash	2.5e-005	0.04	0.46



Subsurface Profile and Boundary Conditions

Steady State Seepage at Section C-C'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

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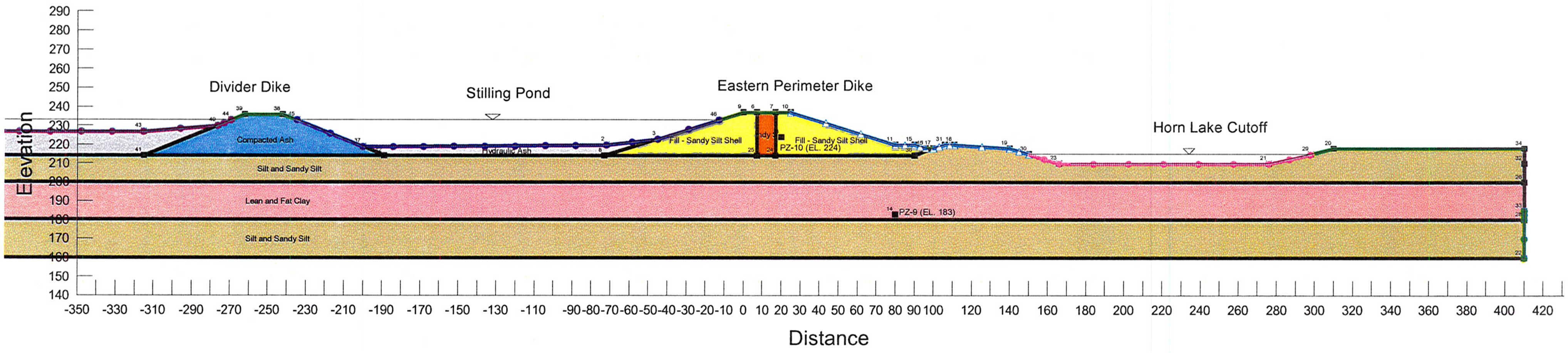
Compacted Ash	2.5e-005	0.04	0.46



Finite Element Mesh, Flow Vectors and Phreatic Surface

Steady State Seepage at Section C-C'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

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Bottom ML/SM Strata -
Downstream Total Head - 185 ft

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Hydraulic Ash	5e-005	0.02	0.46
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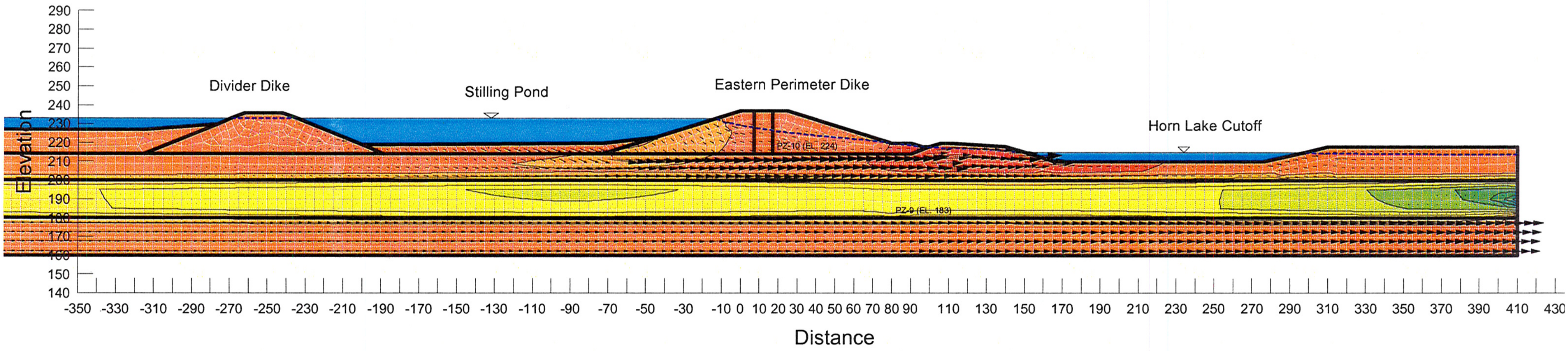
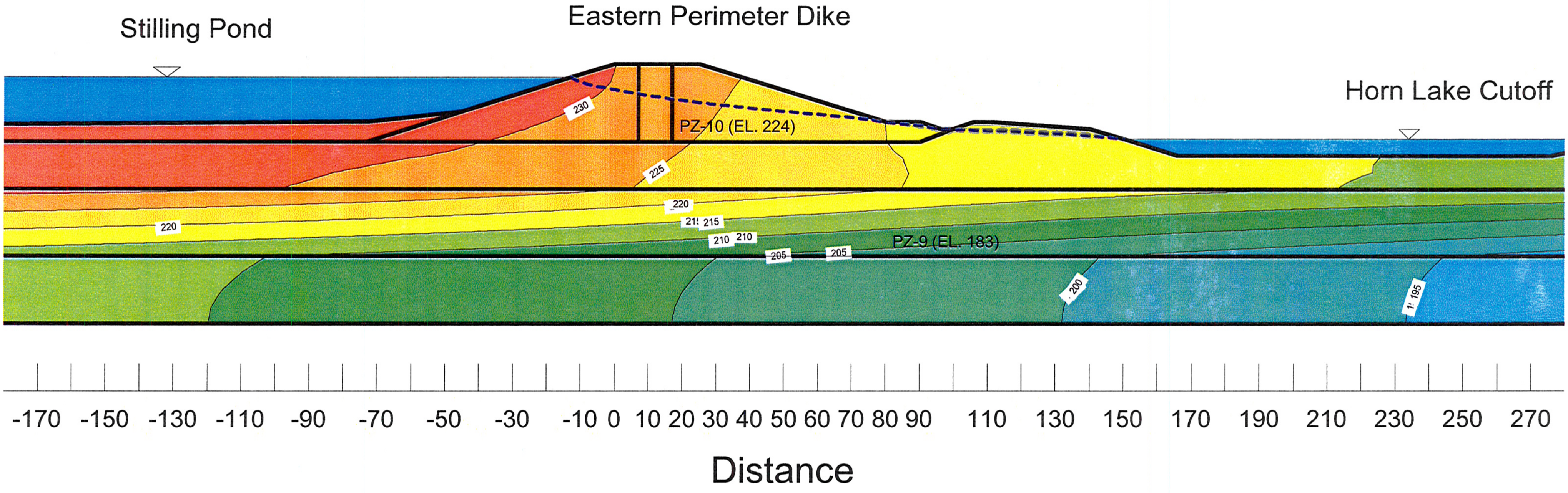


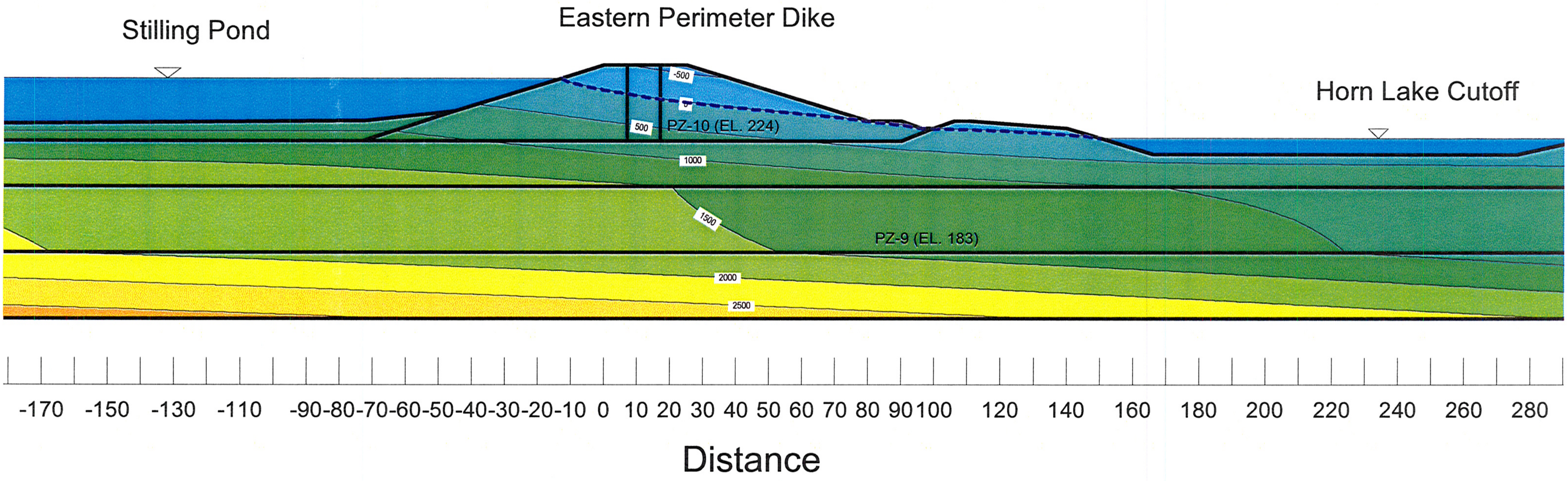
Steady State Seepage at Section C-C'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Total Head Contours, at 5-foot interval
Low to High : Blue to Red



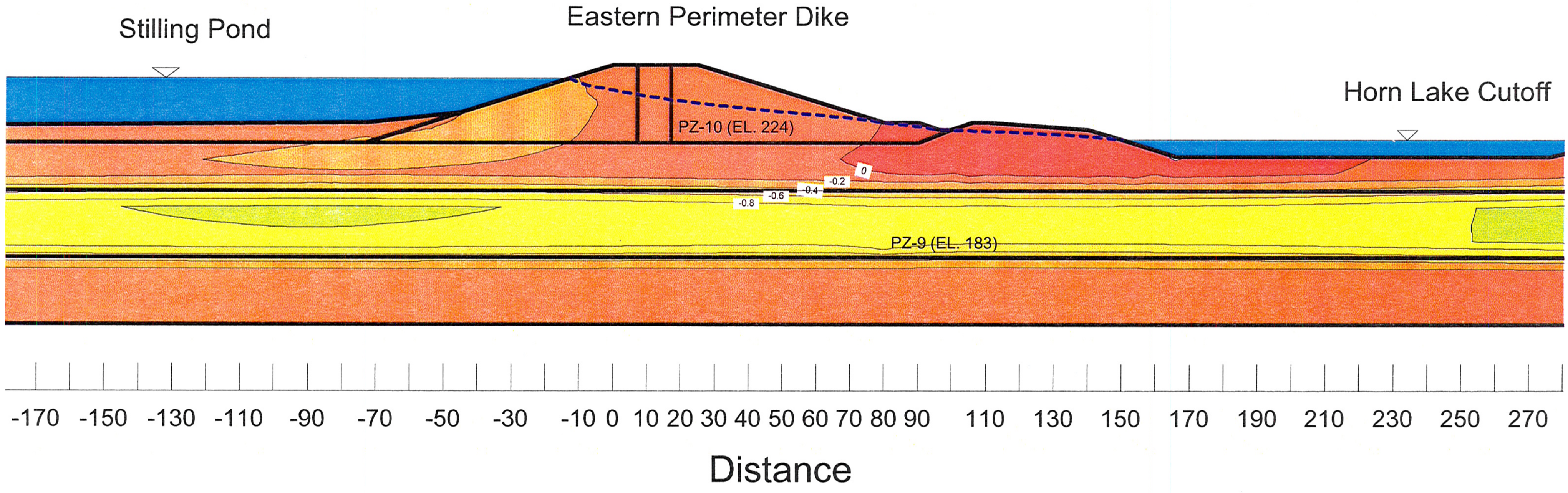
Steady State Seepage at Section C-C'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Pore Water Pressure Contours, at 500 psf interval
Low to High : Blue to Red



Steady State Seepage at Section C-C'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Vertical Gradient Contours, at 0.2 interval
Low to High : Blue to Red



Downstream Deep Failure Circle

Slope Stability Analysis at Section C-C'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Note:
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Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
Fill - Sandy Silt Shell	124 pcf	120 pcf	0 psf	31 °
Fill - Sandy Silt Core	125 pcf	125 pcf	0 psf	31 °
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Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
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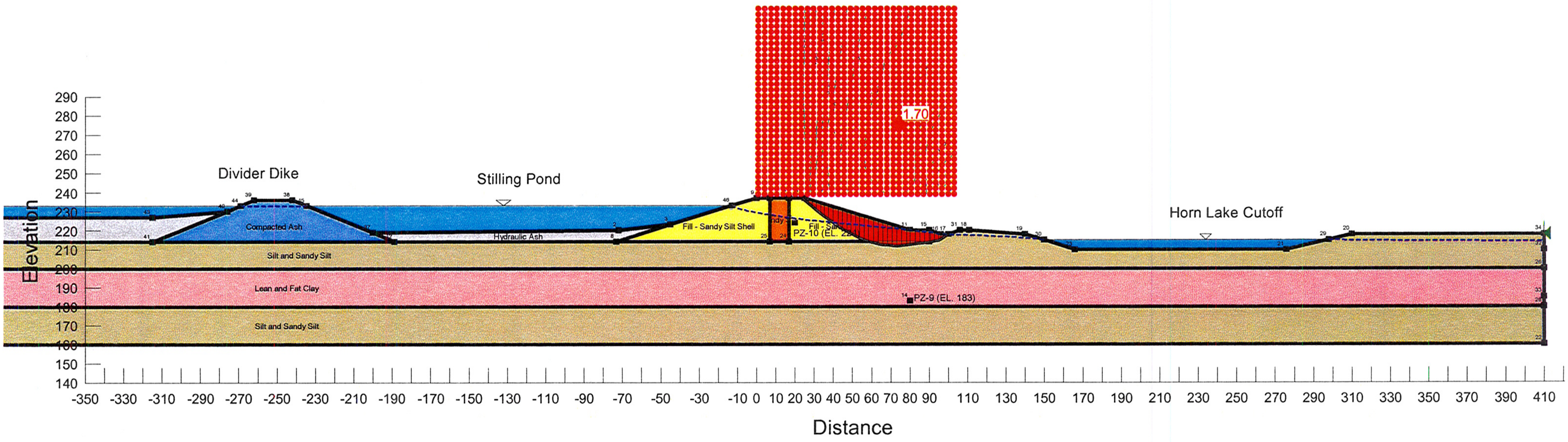

Downstream Shallow Failure Circle

Slope Stability Analysis at Section C-C'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Note:
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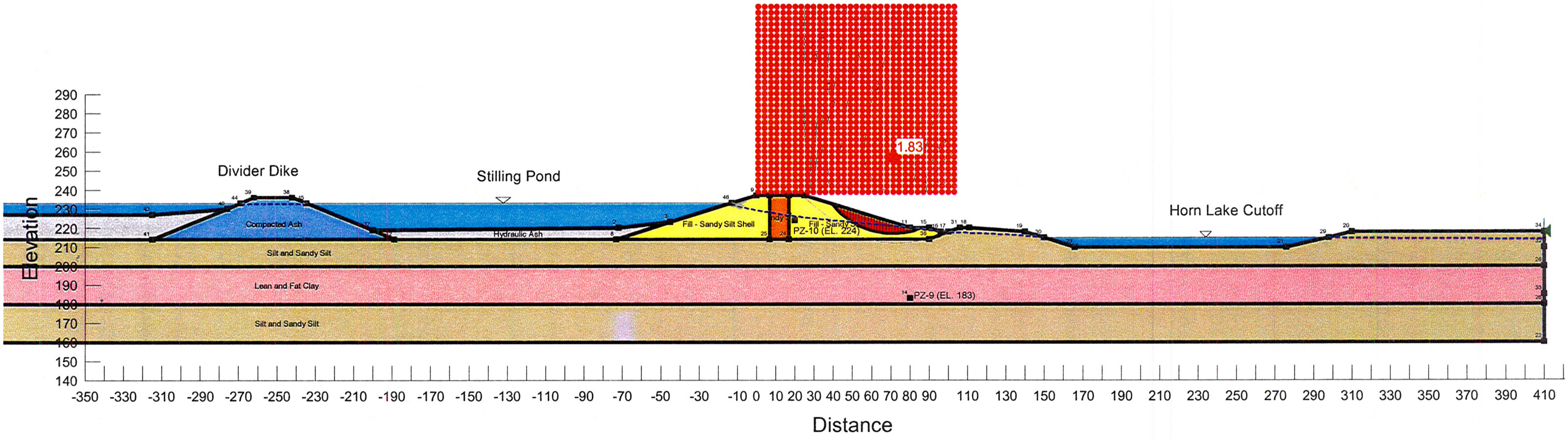

Upstream Shallow Failure Circle

Slope Stability Analysis at Section C-C'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Note:
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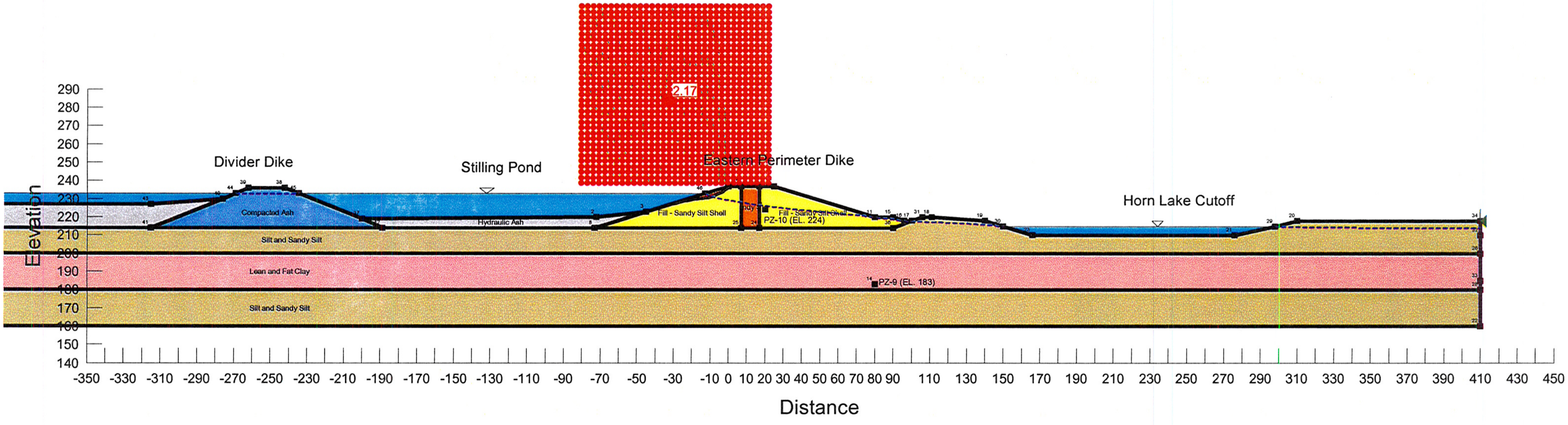

Cross-Section D-D’

Steady-State Seepage at Station D-D'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Note:
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Boundary Conditions:
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Ash Pond Water Elevation - 230 ft
Horn Lake Water Elevation - 215
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Bottom ML/SM Strata -
Downstream Total Head - 185 ft

Material Type	Kh,sat (ft/sec)	Kv/Kh ratio	Wsat
Fill - Sandy Silt Shell	1.31e-007	0.25	0.4
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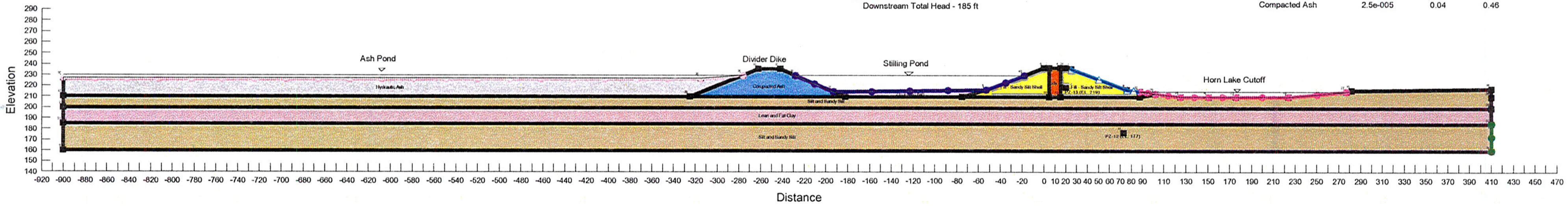

Subsurface Profile and Boundary Conditions

Steady-State Seepage at Station D-D'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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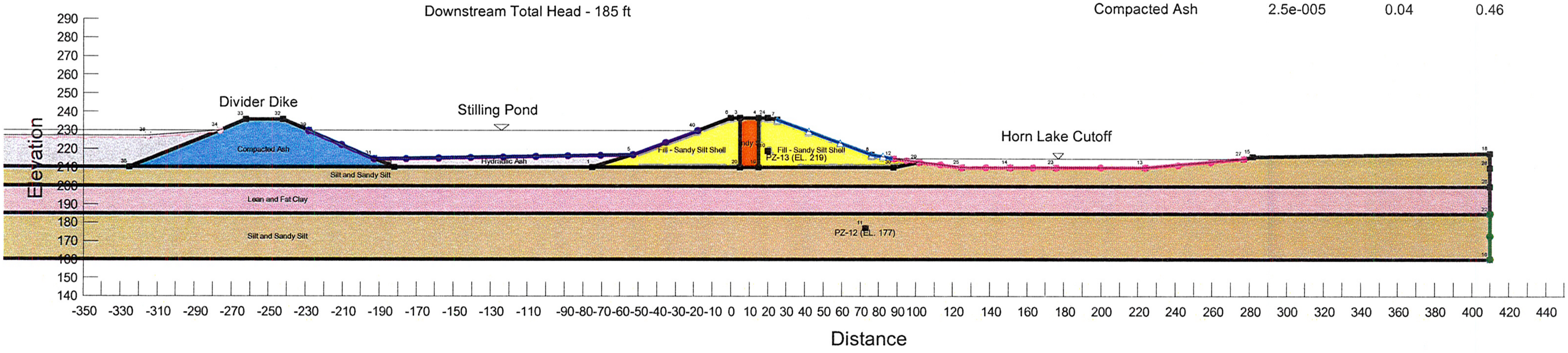

Finite Element Mesh, Flow Vectors and Phreatic Surface

Steady-State Seepage at Station D-D'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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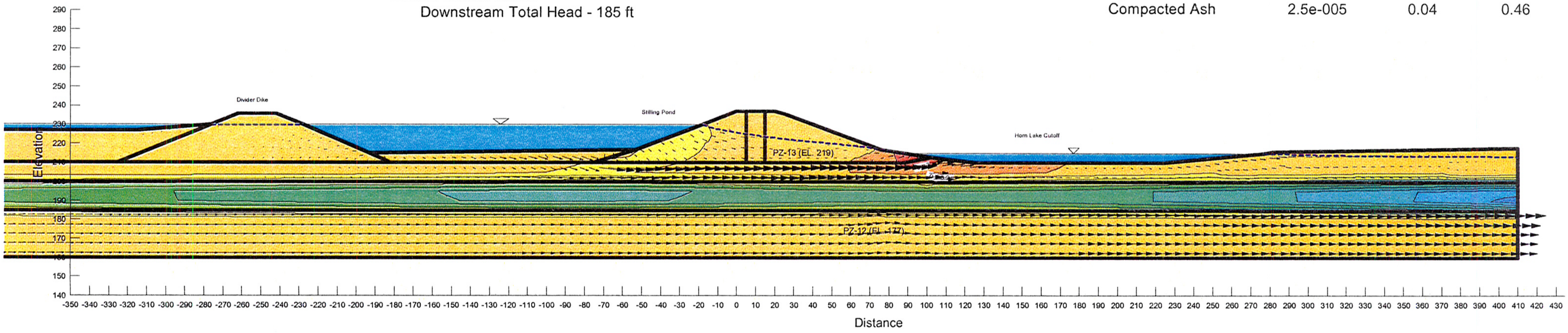
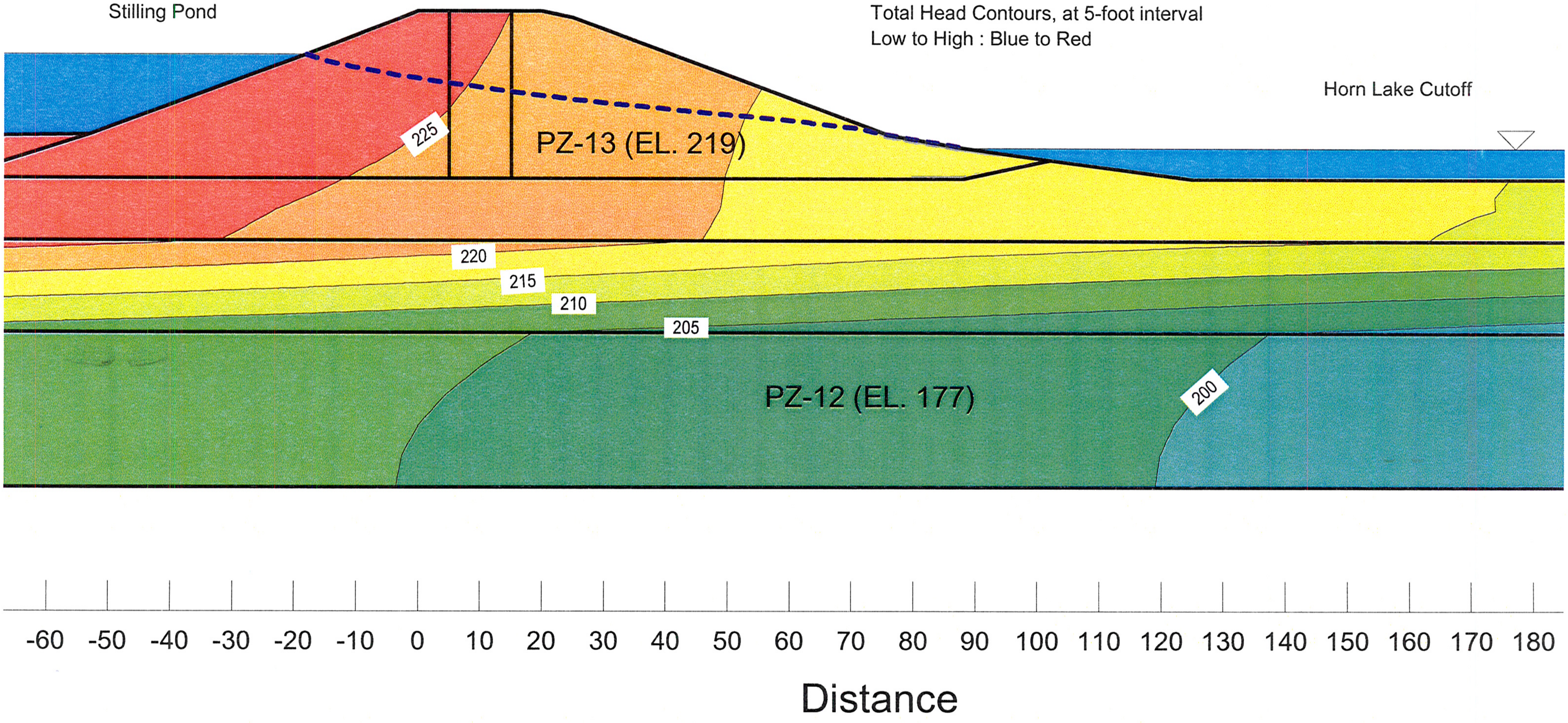
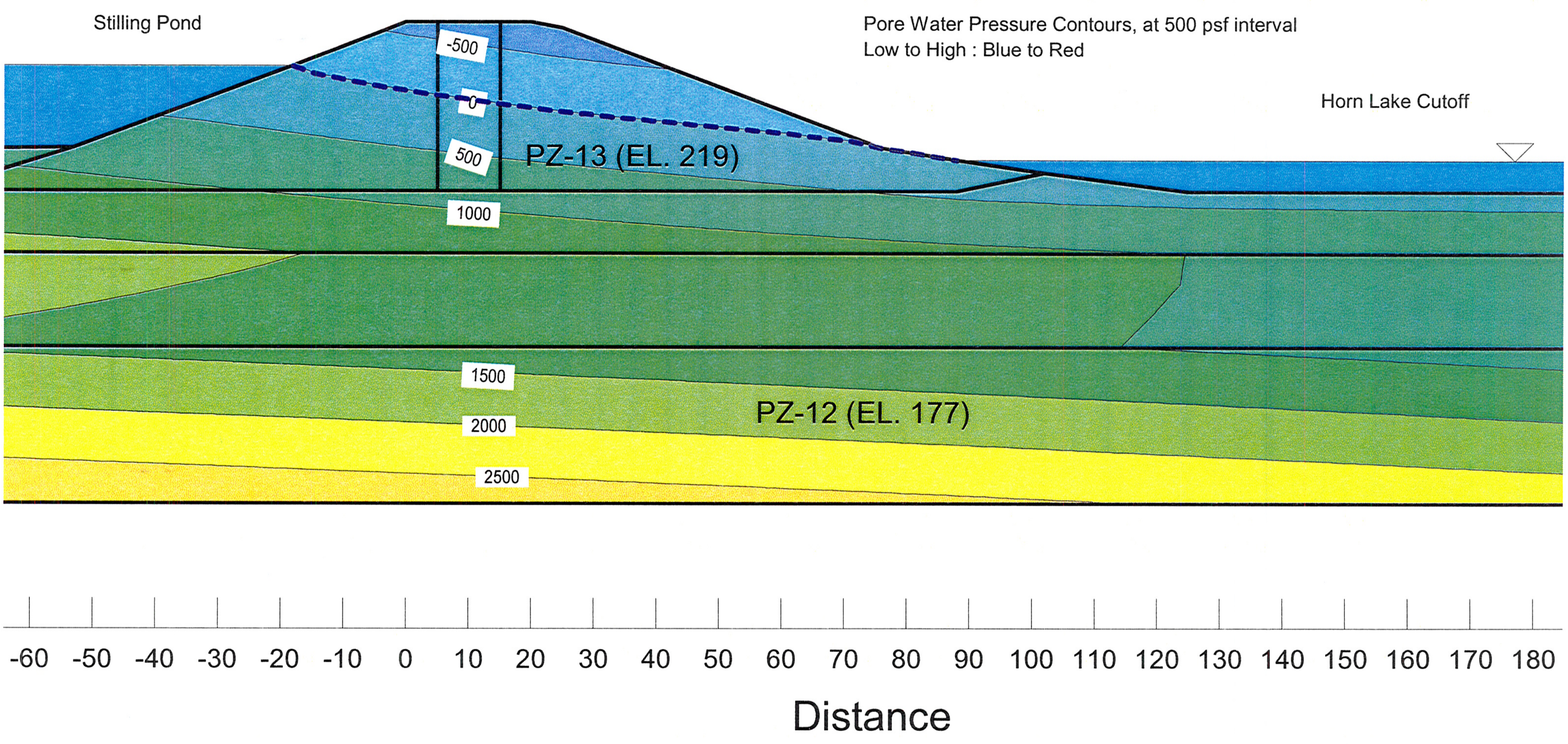


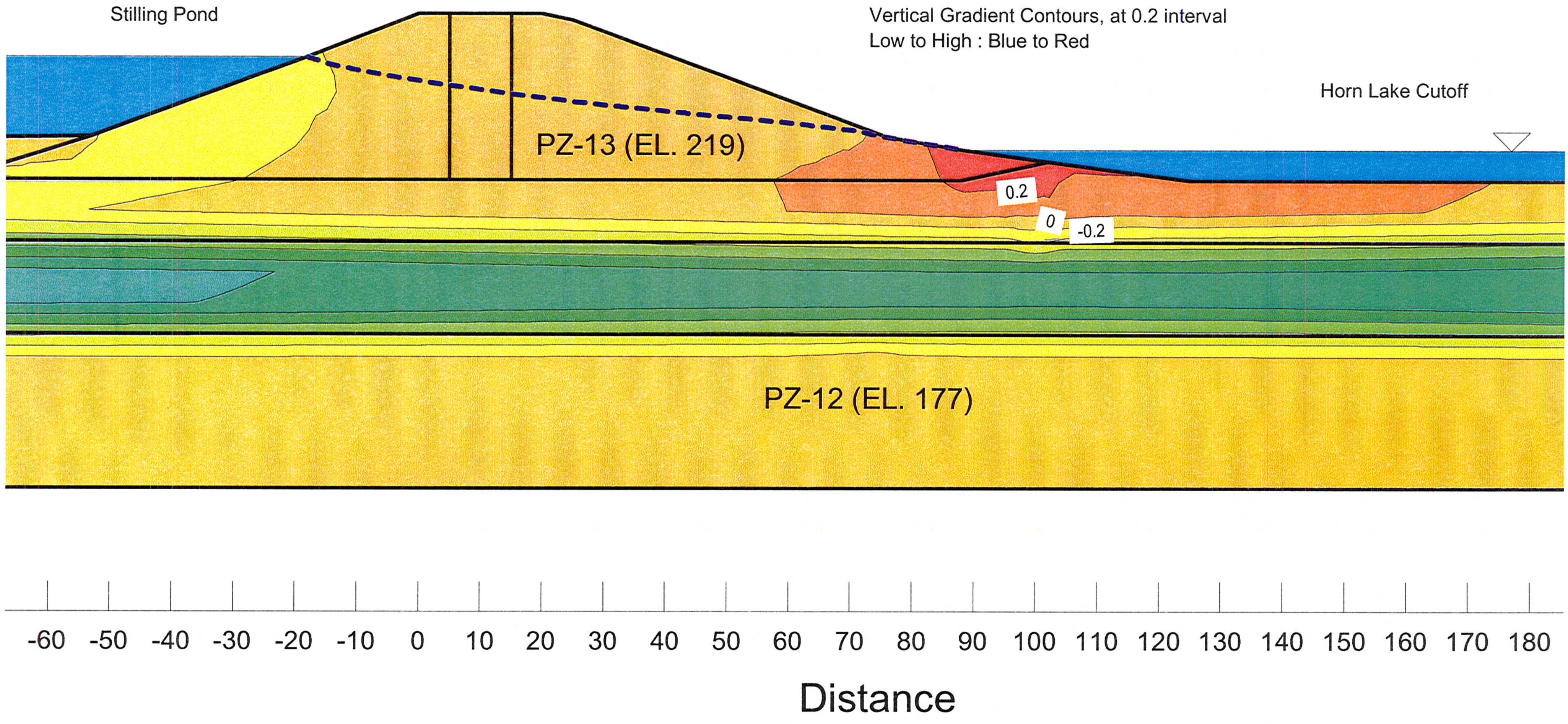
Steady-State Seepage at Cross-Section D-D'
Normal Pool Elevation



Steady-State Seepage at Cross-Section D-D'
Normal Pool Elevation



Steady-State Seepage at Cross-Section D-D’
Normal Pool Elevation

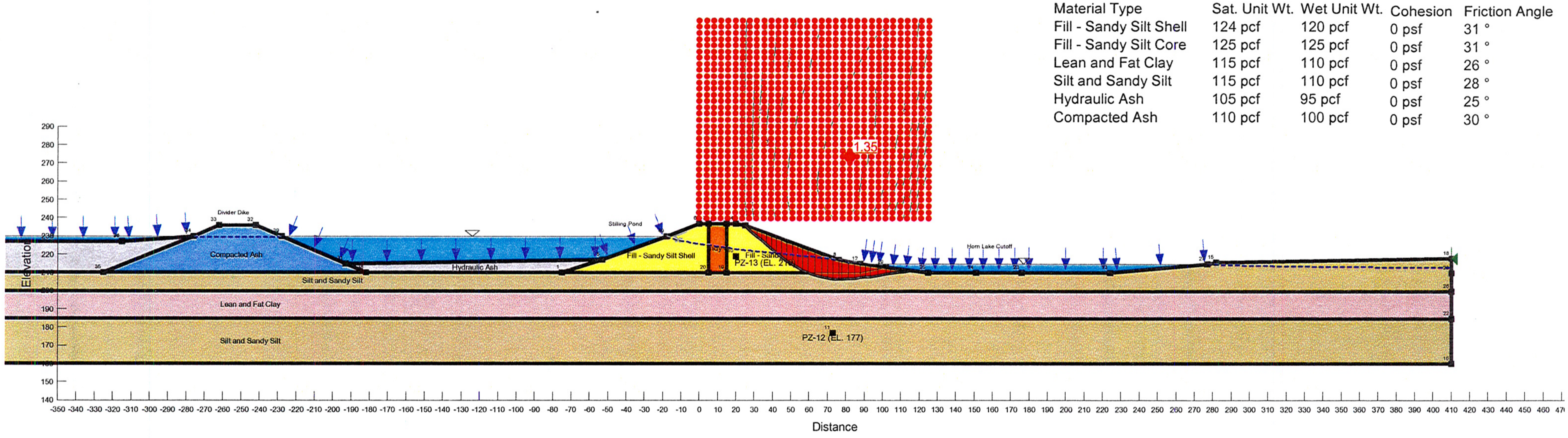


Downstream Deep Failure Circle

Slope Stability Analysis at Station D-D'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
Fill - Sandy Silt Shell	124 pcf	120 pcf	0 psf	31 °
Fill - Sandy Silt Core	125 pcf	125 pcf	0 psf	31 °
Lean and Fat Clay	115 pcf	110 pcf	0 psf	26 °
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °



Downstream Shallow Failure Circle

Slope Stability Analysis at Station D-D'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
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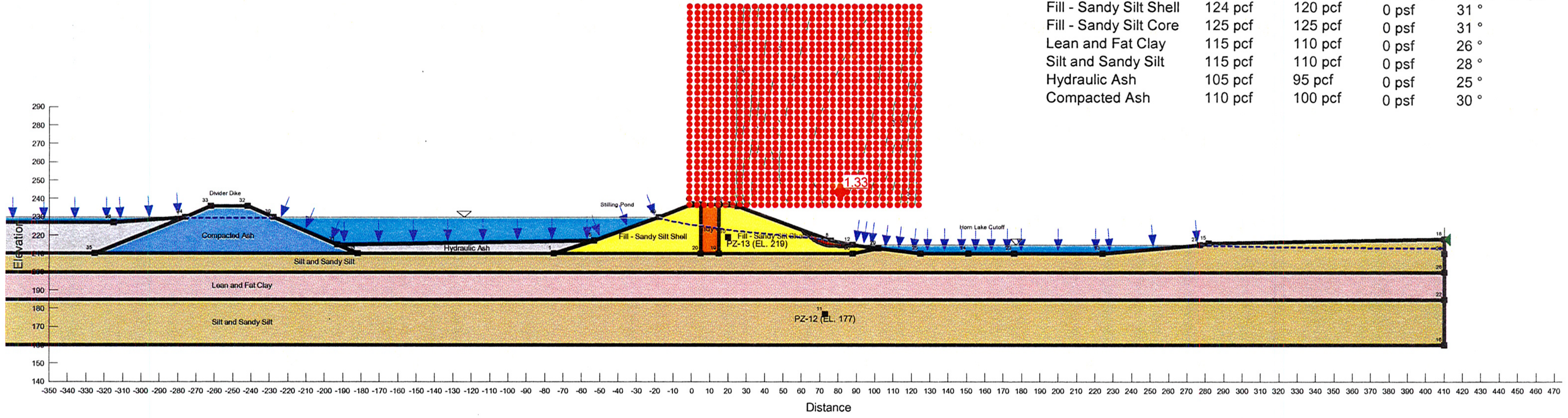
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °



Upstream Shallow Failure Circle

Slope Stability Analysis at Station D-D'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
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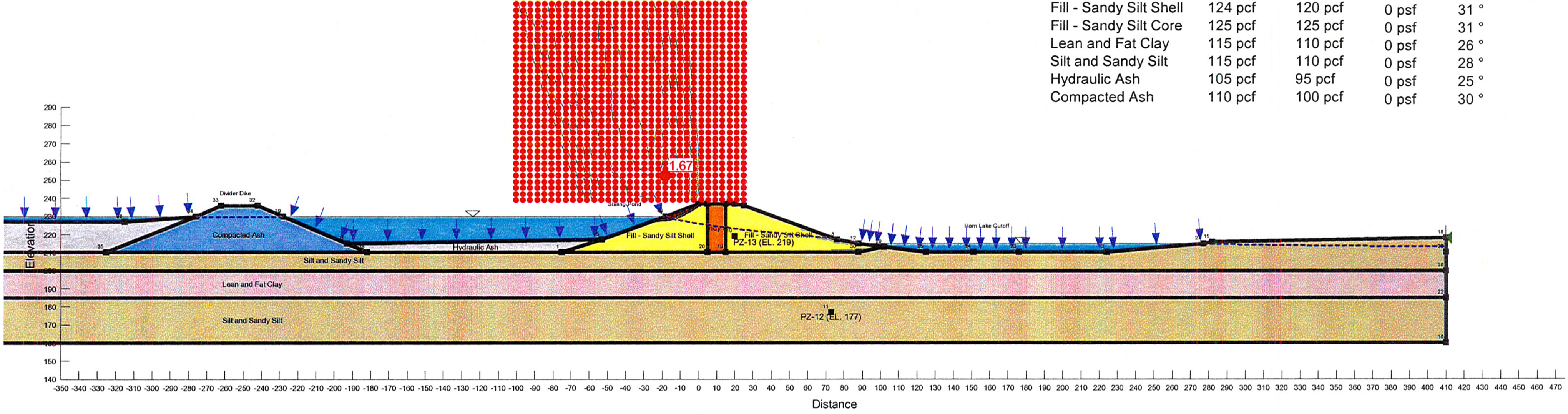
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °

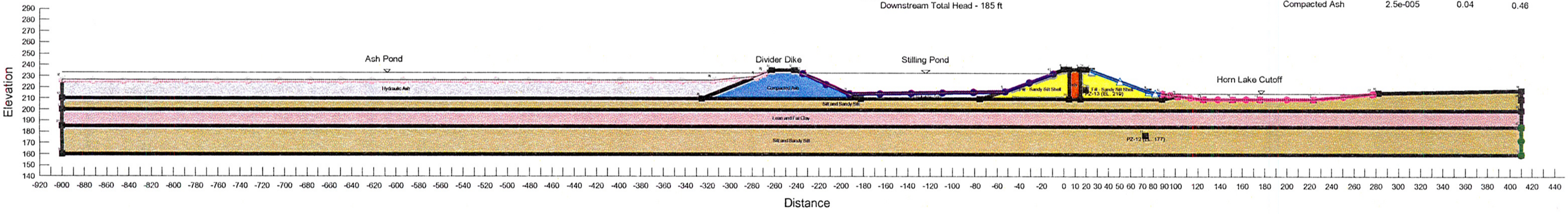


Steady-State Seepage at Station D-D'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Boundary Conditions:
Stilling Pond Water Elevation - 233 ft
Ash Pond Water Elevation - 233 ft
Horn Lake Water Elevation - 215
Potential Seepage Face Total Flux - 0 cu.ft/sec
Bottom ML/SM Strata -
Downstream Total Head - 185 ft

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

Material Type	Kh,sat (ft/sec)	Kv/Kh ratio	Wsat
Fill - Sandy Silt Shell	1.31e-007	0.25	0.4
Fill - Sandy Silt Core	1.17e-007	0.25	0.39
Lean and Fat Clay	3.94e-008	0.05	0.47
Silt and Sandy Silt	1.64e-006	0.02	0.49
Hydraulic Ash	5e-005	0.02	0.46
Compacted Ash	2.5e-005	0.04	0.46



Subsurface Profile and Boundary Conditions

Steady-State Seepage at Station D-D'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Boundary Conditions:
Stilling Pond Water Elevation - 233 ft
Ash Pond Water Elevation - 233 ft
Horn Lake Water Elevation - 215
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Bottom ML/SM Strata -
Downstream Total Head - 185 ft

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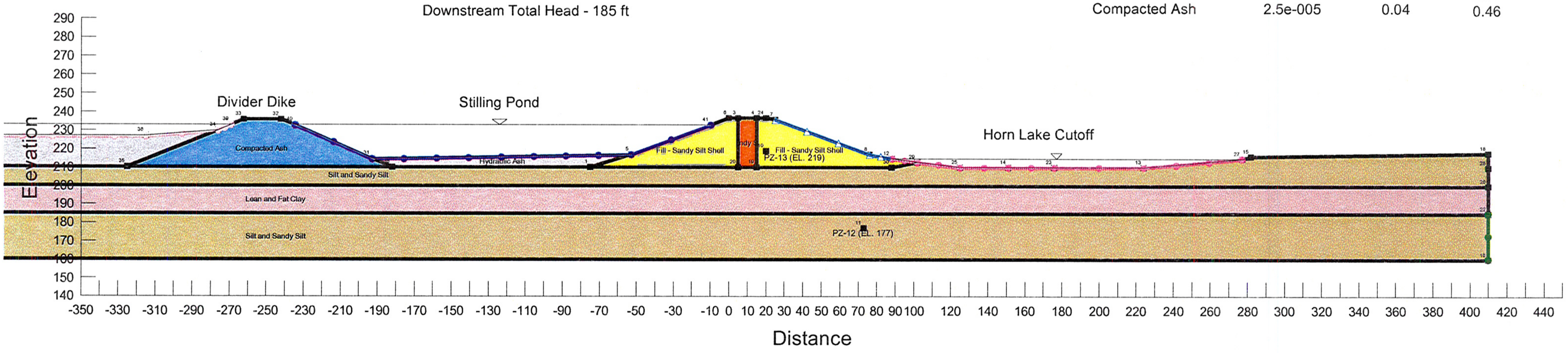


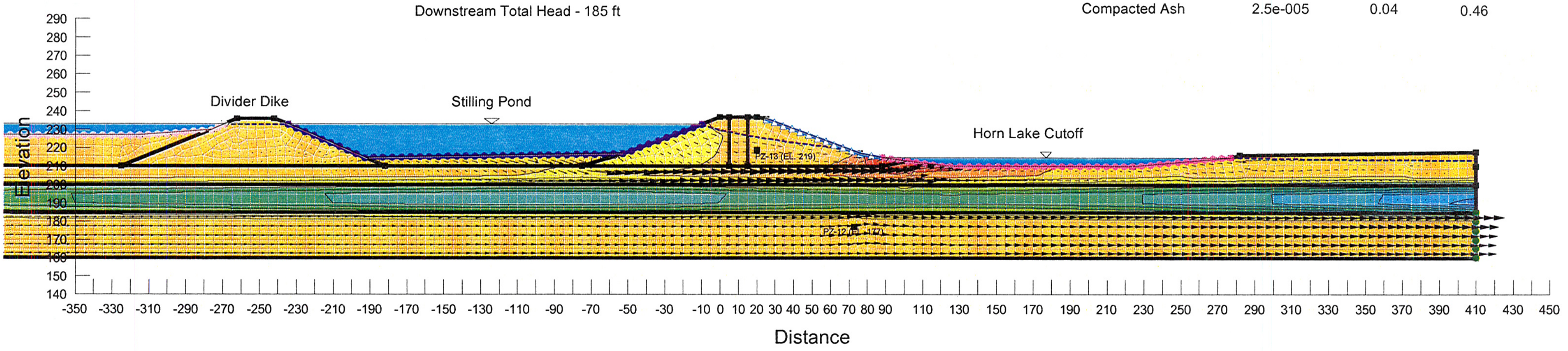
Finite Element Mesh, Flow Vectors and Phreatic Surface

Steady-State Seepage at Station D-D'
Maximum Pool Elevation
Eastern Perimeter Dike
Alien Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

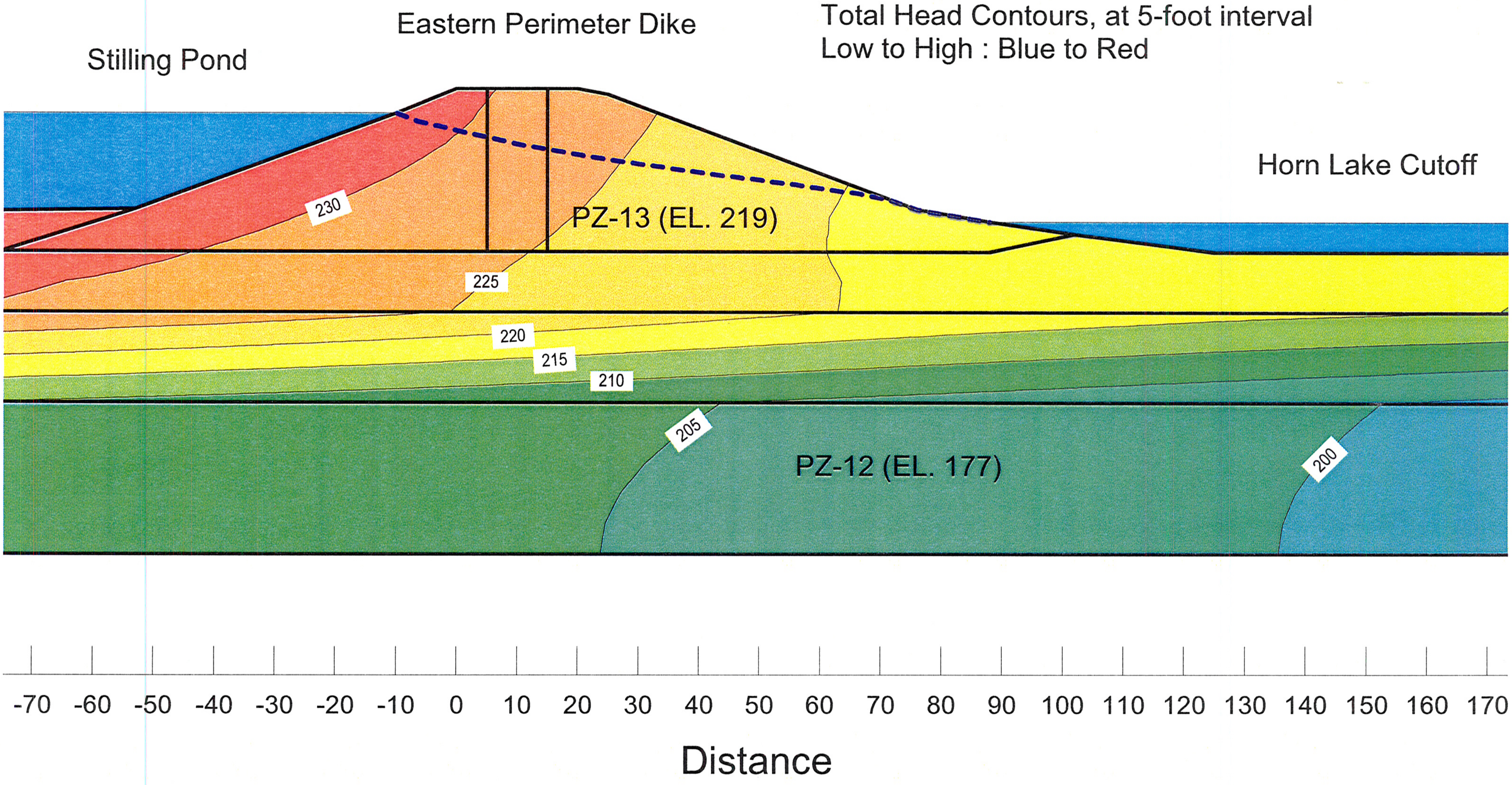
Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Boundary Conditions:
Stilling Pond Water Elevation - 233 ft
Ash Pond Water Elevation - 233 ft
Horn Lake Water Elevation - 215
Potential Seepage Face Total Flux - 0 cu.ft/sec
Bottom ML/SM Strata -
Downstream Total Head - 185 ft

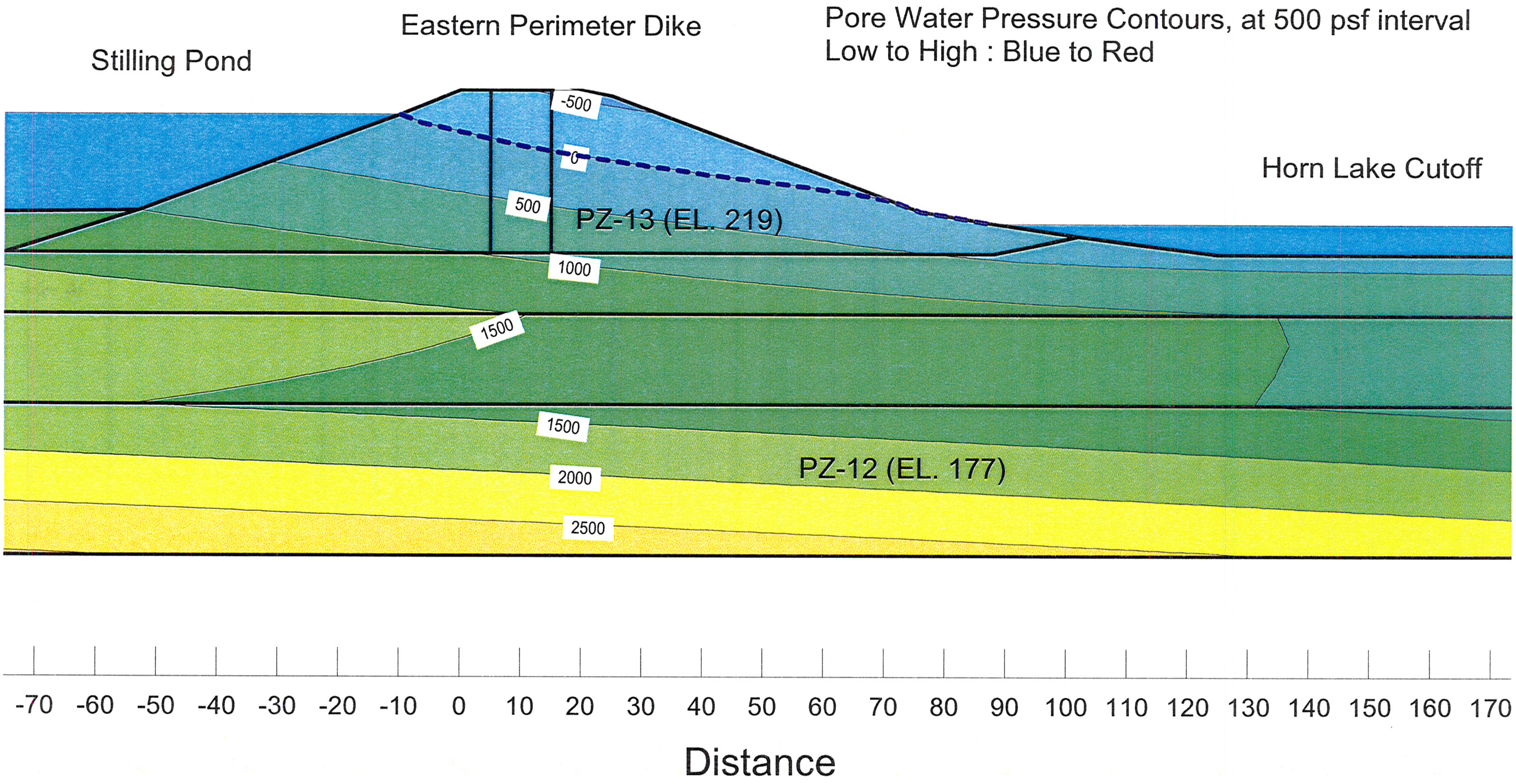
Material Type	Kh,sat (ft/sec)	Kv/Kh ratio	Wsat
Fill - Sandy Silt Shell	1.31e-007	0.25	0.4
Fill - Sandy Silt Core	1.17e-007	0.25	0.39
Lean and Fat Clay	3.94e-008	0.05	0.47
Silt and Sandy Silt	1.64e-006	0.02	0.49
Hydraulic Ash	5e-005	0.02	0.46
Compacted Ash	2.5e-005	0.04	0.46



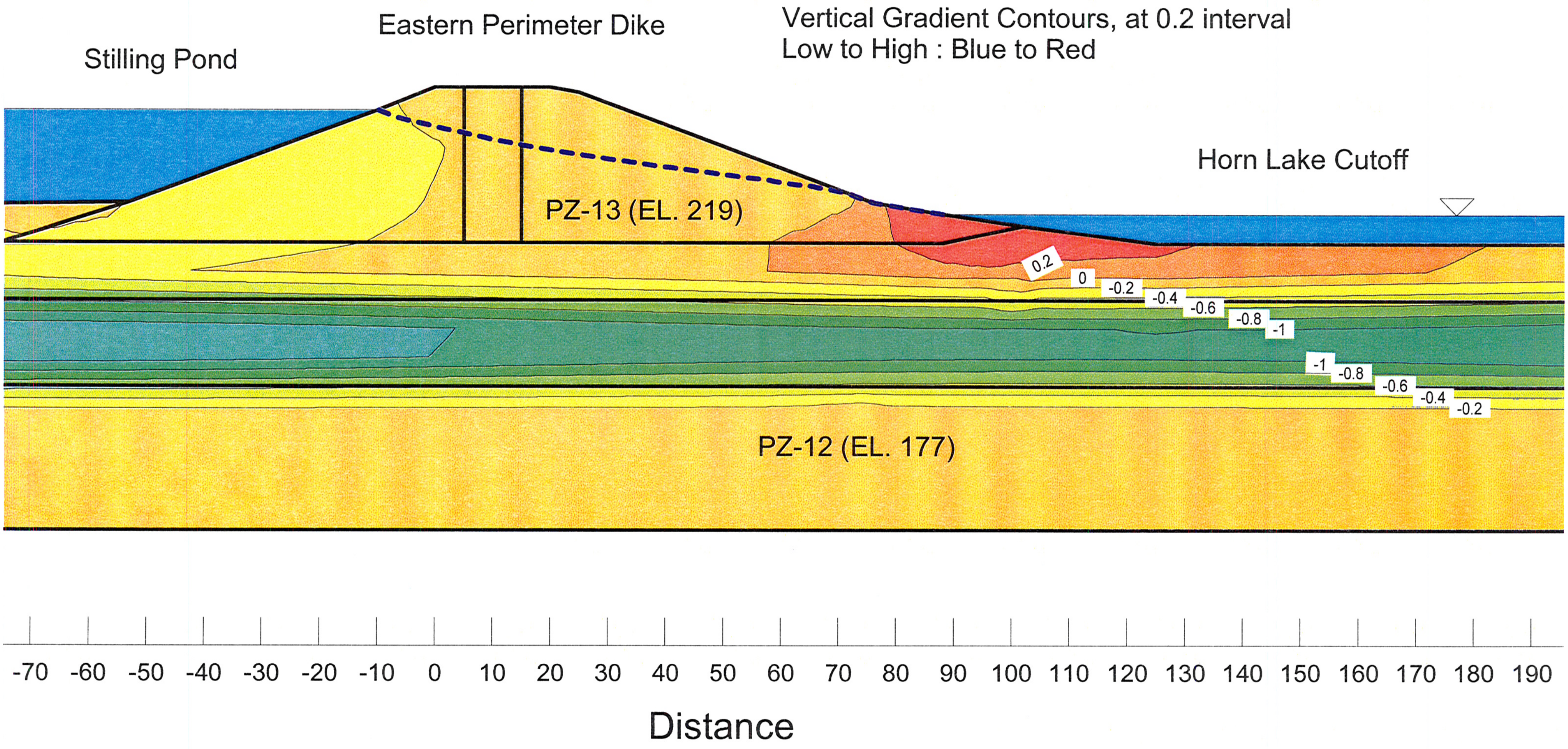
Steady-State Seepage at Cross-Section D-D'
Maximum Storage Pool Elevation



Steady-State Seepage at Cross-Section D-D’
Maximum Storage Pool Elevation



Steady-State Seepage at Cross-Section D-D'
Maximum Storage Pool Elevation

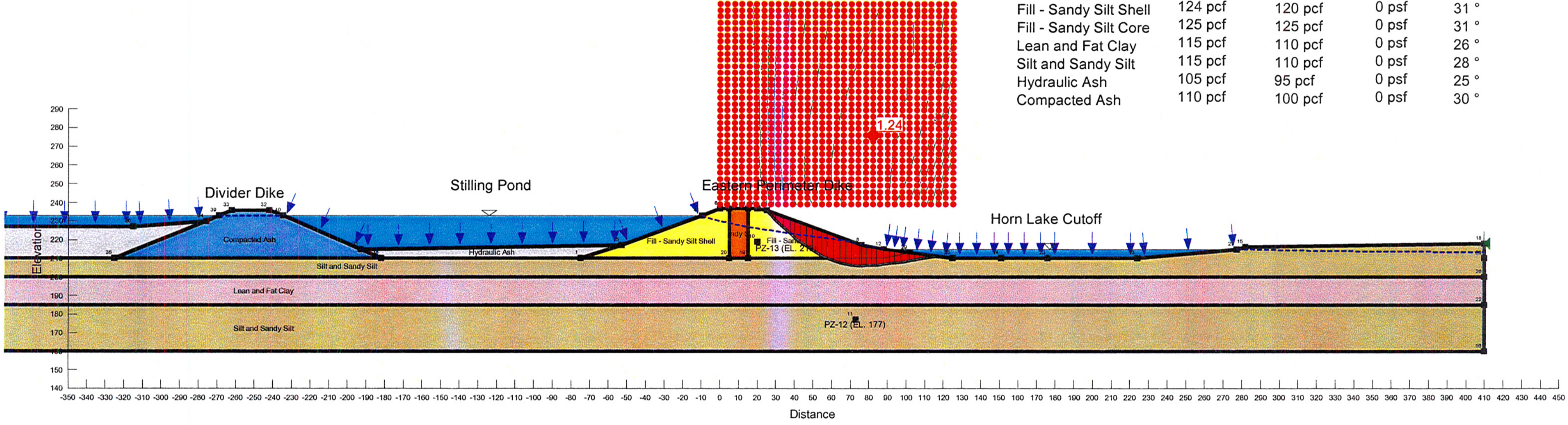


Downstream Deep Failure Circle

Slope Stability Analysis at Station D-D'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
Fill - Sandy Silt Shell	124 pcf	120 pcf	0 psf	31 °
Fill - Sandy Silt Core	125 pcf	125 pcf	0 psf	31 °
Lean and Fat Clay	115 pcf	110 pcf	0 psf	26 °
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °



Downstream Shallow Failure Circle

Slope Stability Analysis at Station D-D'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
Fill - Sandy Silt Shell	124 pcf	120 pcf	0 psf	31 °
Fill - Sandy Silt Core	125 pcf	125 pcf	0 psf	31 °
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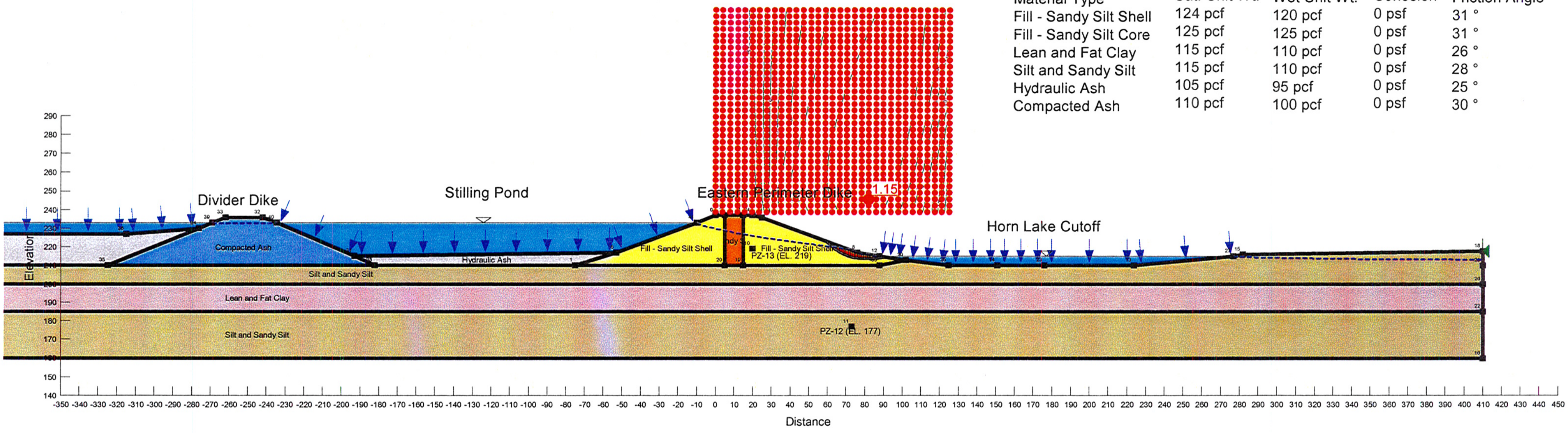

Upstream Shallow Failure Circle

Slope Stability Analysis at Station D-D'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
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Fill - Sandy Silt Core	125 pcf	125 pcf	0 psf	31 °
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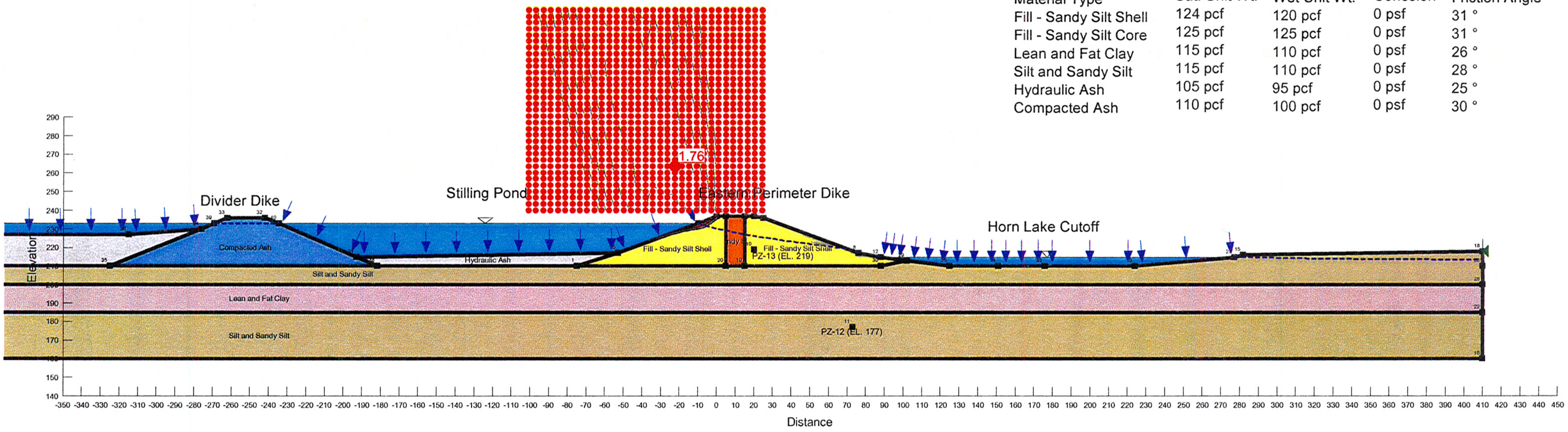
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °



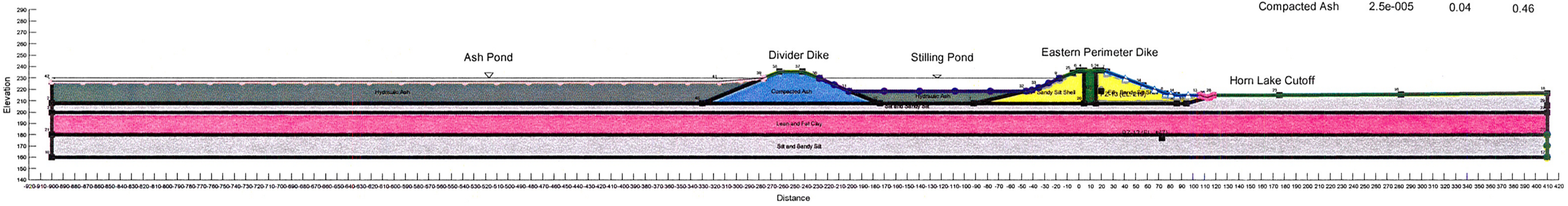
Cross-Section E-E’

Steady-State Seepage at Station E-E'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Boundary Conditions:
Stilling Pond Water Elevation - 230 ft
Ash Pond Water Elevation - 230 ft
Potential Seepage Face Total Flux - 0 cu.ft/sec
Bottom ML/SM Strata -
Downstream Total Head - 185 ft

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

Material Type	Kh,sat (ft/sec)	Kv/Kh ratio	Wsat
Fill - Sandy Silt Shell	1.31e-007	0.25	0.4
Fill - Sandy Silt Core	1.18e-007	0.25	0.39
Lean and Fat Clay	3.94e-008	0.05	0.47
Silt and Sandy Silt	1.64e-006	0.02	0.49
Hydraulic Ash	5e-005	0.02	0.46
Compacted Ash	2.5e-005	0.04	0.46



Subsurface Profile and Boundary Conditions

Steady-State Seepage at Station E-E'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Boundary Conditions:
Stilling Pond Water Elevation - 230 ft
Ash Pond Water Elevation - 230 ft
Potential Seepage Face Total Flux - 0 cu.ft/sec
Bottom ML/SM Strata -
Downstream Total Head - 185 ft

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

Material Type	Kh,sat (ft/sec)	Kv/Kh ratio	Wsat
Fill - Sandy Silt Shell	1.31e-007	0.25	0.4
Fill - Sandy Silt Core	1.18e-007	0.25	0.39
Lean and Fat Clay	3.94e-008	0.05	0.47
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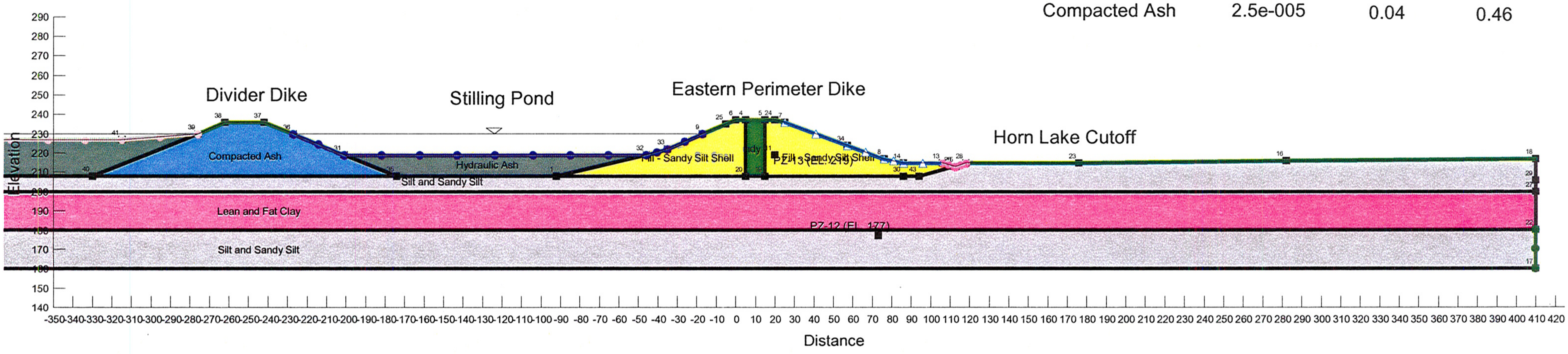
Hydraulic Ash	5e-005	0.02	0.46
Compacted Ash	2.5e-005	0.04	0.46



Finite Element Mesh, Flow Vectors and Phreatic Surface

Steady-State Seepage at Station E-E'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Boundary Conditions:
Stilling Pond Water Elevation - 230 ft
Ash Pond Water Elevation - 230 ft
Potential Seepage Face Total Flux - 0 cu.ft/sec
Bottom ML/SM Strata -
Downstream Total Head - 185 ft

Note:
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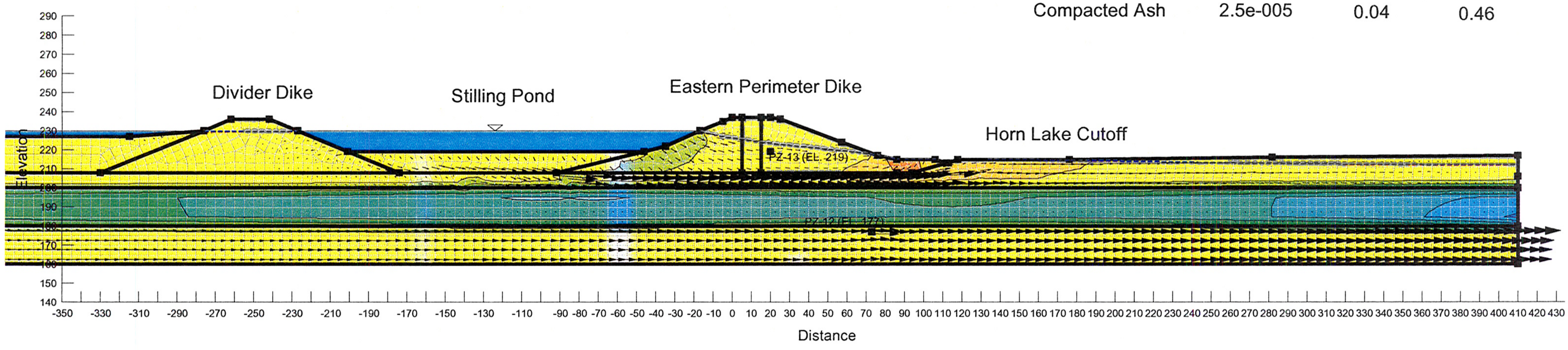
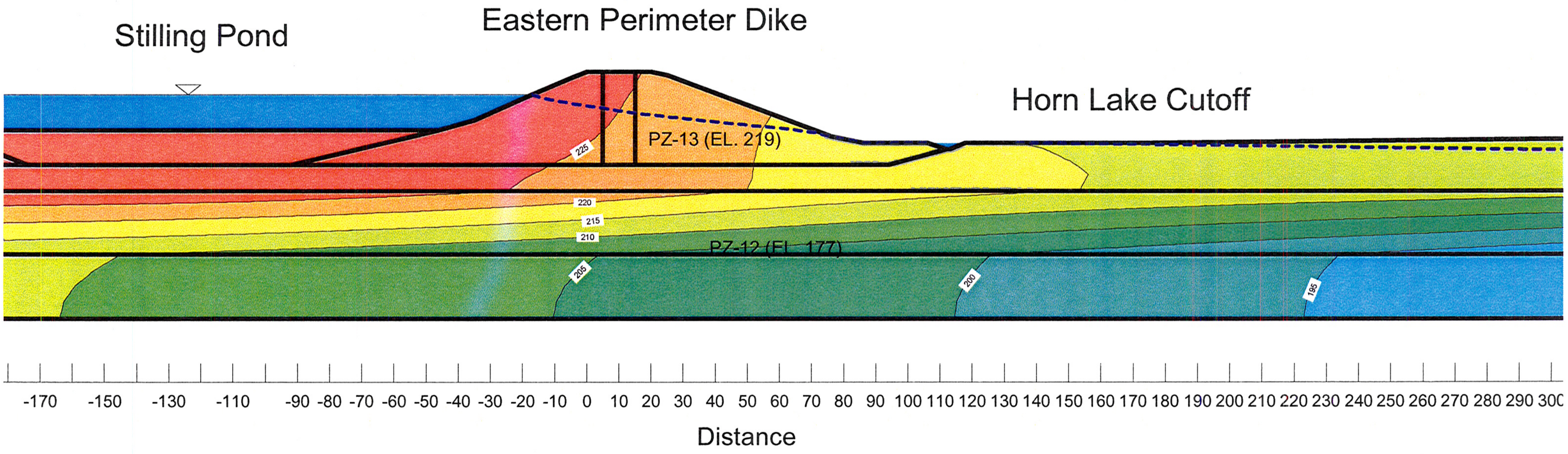


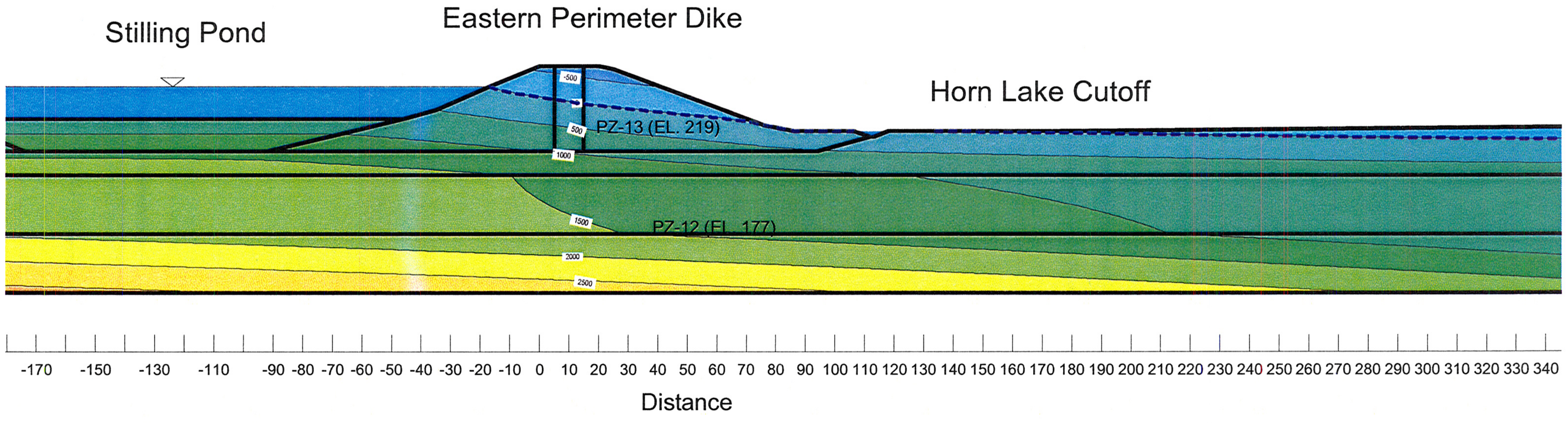
Steady-State Seepage at Station E-E'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Total Head Contours, at 5-foot interval
Low to High : Blue to Red



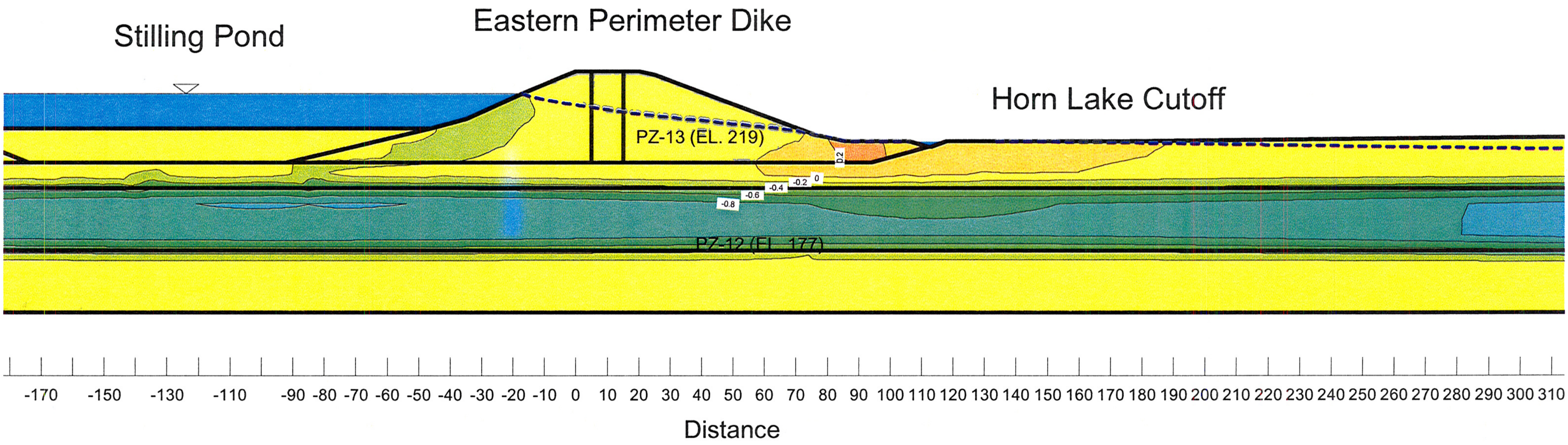
Steady-State Seepage at Station E-E'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Pore Water Pressure Contours, at 500 psf interval
Low to High : Blue to Red



Steady-State Seepage at Station E-E'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Vertical Gradient Contours, at 0.2 interval
Low to High : Blue to Red

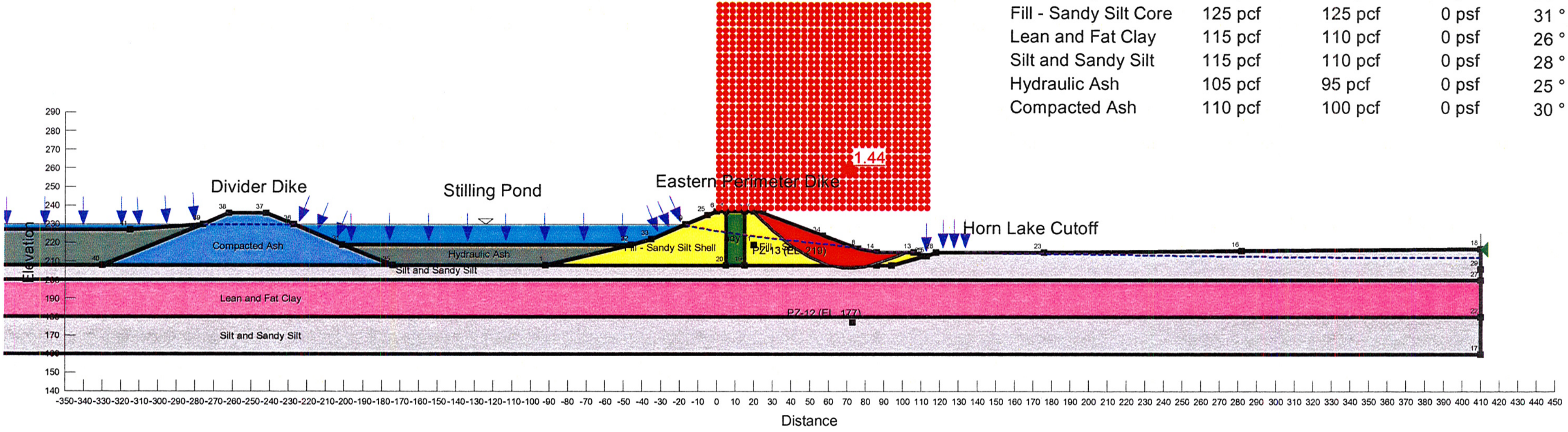


Downstream Deep Failure Circle

Slope Stability Analysis at Station E-E'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
Fill - Sandy Silt Shell	124 pcf	120 pcf	0 psf	31 °
Fill - Sandy Silt Core	125 pcf	125 pcf	0 psf	31 °
Lean and Fat Clay	115 pcf	110 pcf	0 psf	26 °
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °



Downstream Shallow Failure Circle

Slope Stability Analysis at Station E-E'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Note:
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Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
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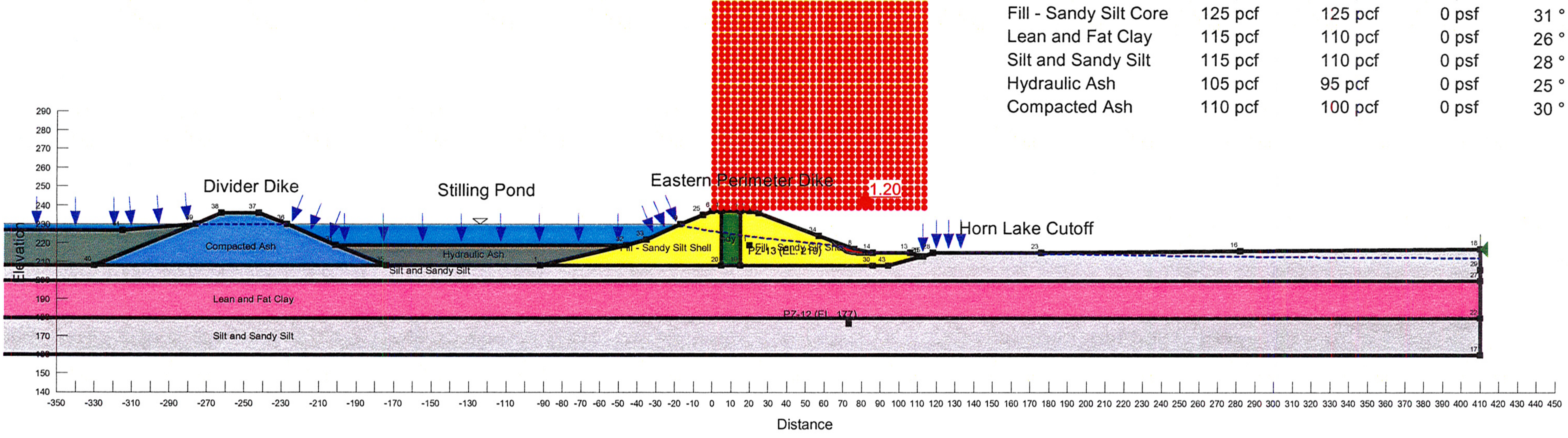

Upstream Shallow Failure Circle

Slope Stability Analysis at Station E-E'
Normal Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Note:
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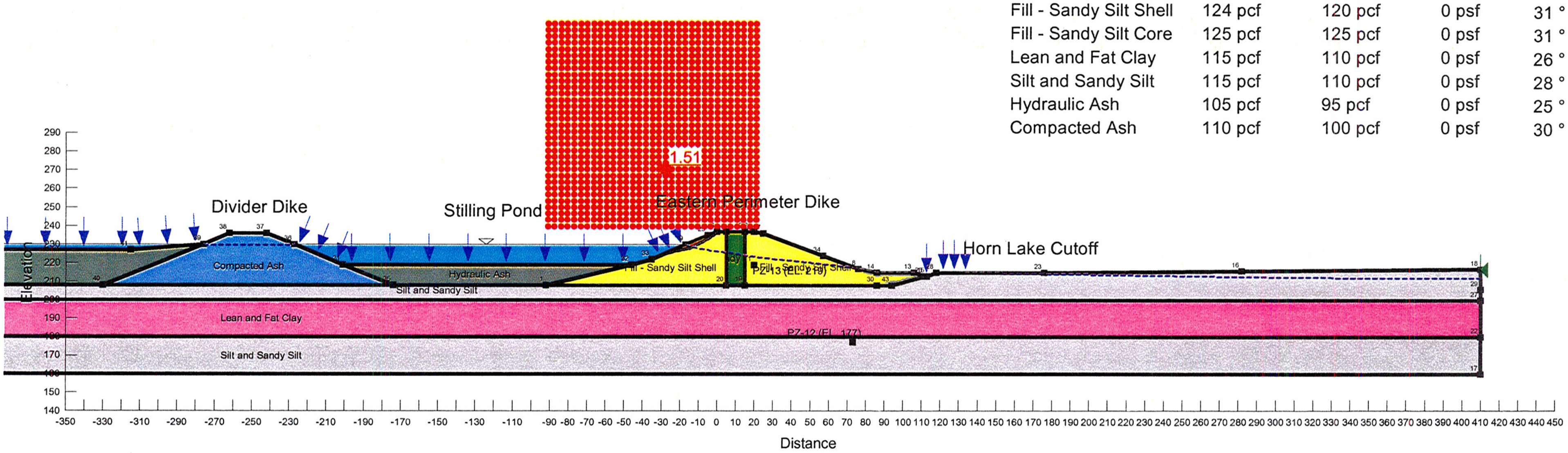
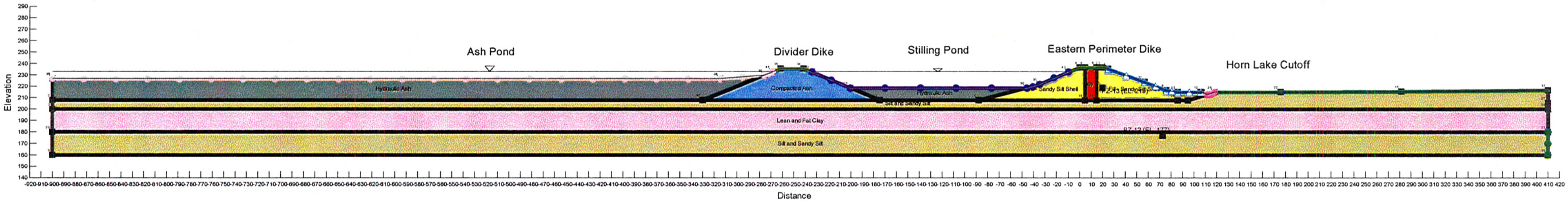


Steady-State Seepage at Section E-E'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Boundary Conditions:
Stilling Pond Water Elevation - 233 ft
Ash Pond Water Elevation - 233 ft
Potential Seepage Face Total Flux - 0 cu.ft/sec
Horn Lake Water Elevation - 215
Bottom ML/SM Strata -
Downstream Total Head - 185 ft

Material Type	Kh,sat (ft/sec)	Kv/Kh ratio	Wsat
Fill - Sandy Silt Shell	1.31e-007	0.25	0.4
Fill - Sandy Silt Core	1.18e-007	0.25	0.39
Lean and Fat Clay	3.94e-008	0.05	0.47
Silt and Sandy Silt	1.64e-006	0.02	0.49
Hydraulic Ash	5e-005	0.02	0.46
Compacted Ash	2.5e-005	0.04	0.46



Subsurface Profile and Boundary Conditions

Steady-State Seepage at Section E-E'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Boundary Conditions:
Stilling Pond Water Elevation - 233 ft
Ash Pond Water Elevation - 233 ft
Potential Seepage Face Total Flux - 0 cu.ft/sec
Horn Lake Water Elevation - 215
Bottom ML/SM Strata -
Downstream Total Head - 185 ft

Note:
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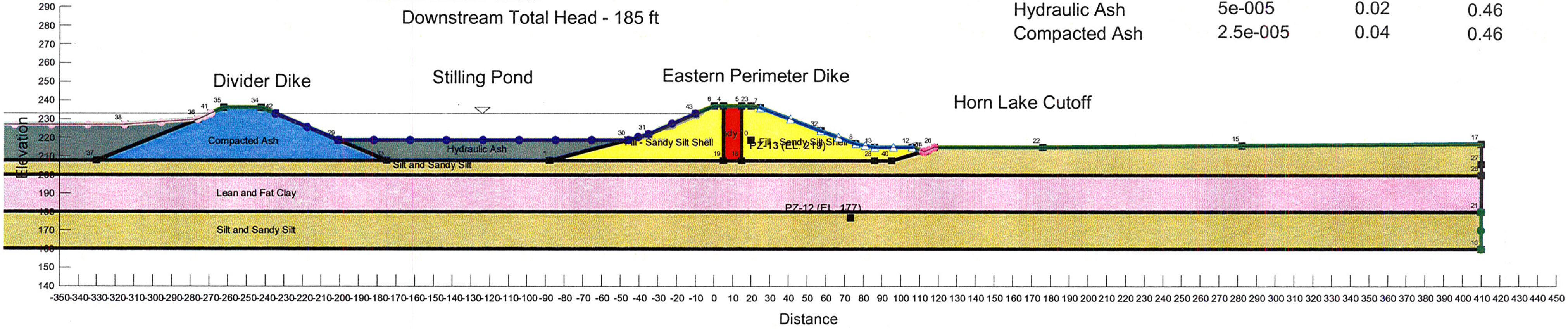

Finite Element Mesh, Flow Vectors and Phreatic Surface

Steady-State Seepage at Section E-E'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Boundary Conditions:
Stilling Pond Water Elevation - 233 ft
Ash Pond Water Elevation - 233 ft
Potential Seepage Face Total Flux - 0 cu.ft/sec
Horn Lake Water Elevation - 215
Bottom ML/SM Strata -
Downstream Total Head - 185 ft

Material Type	Kh,sat (ft/sec)	Kv/Kh ratio	Wsat
Fill - Sandy Silt Shell	1.31e-007	0.25	0.4
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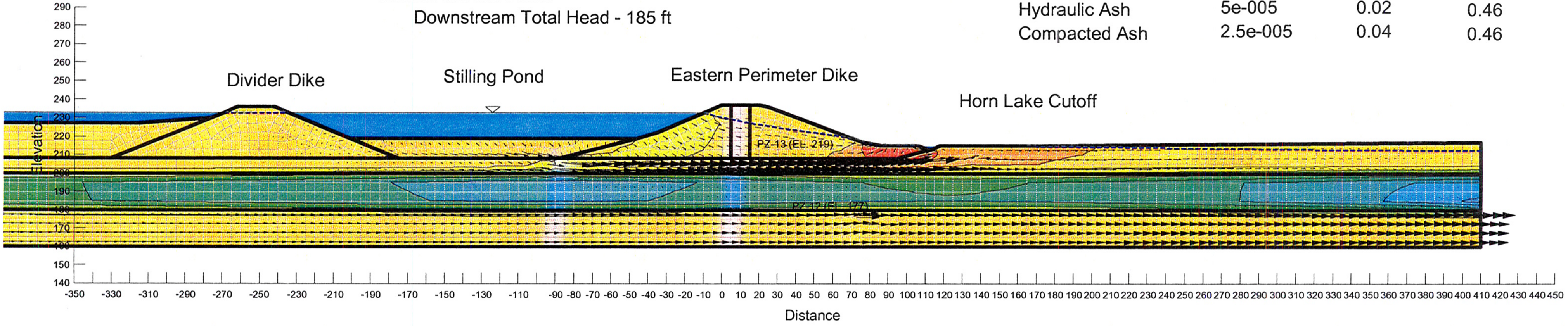
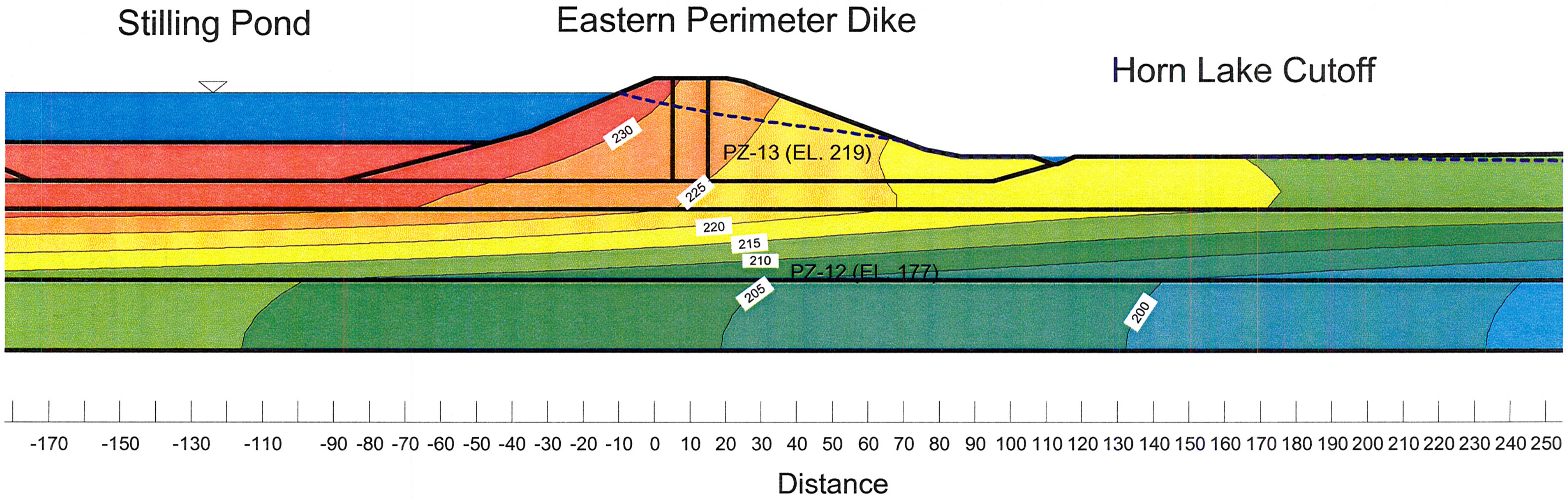
Hydraulic Ash	5e-005	0.02	0.46
Compacted Ash	2.5e-005	0.04	0.46



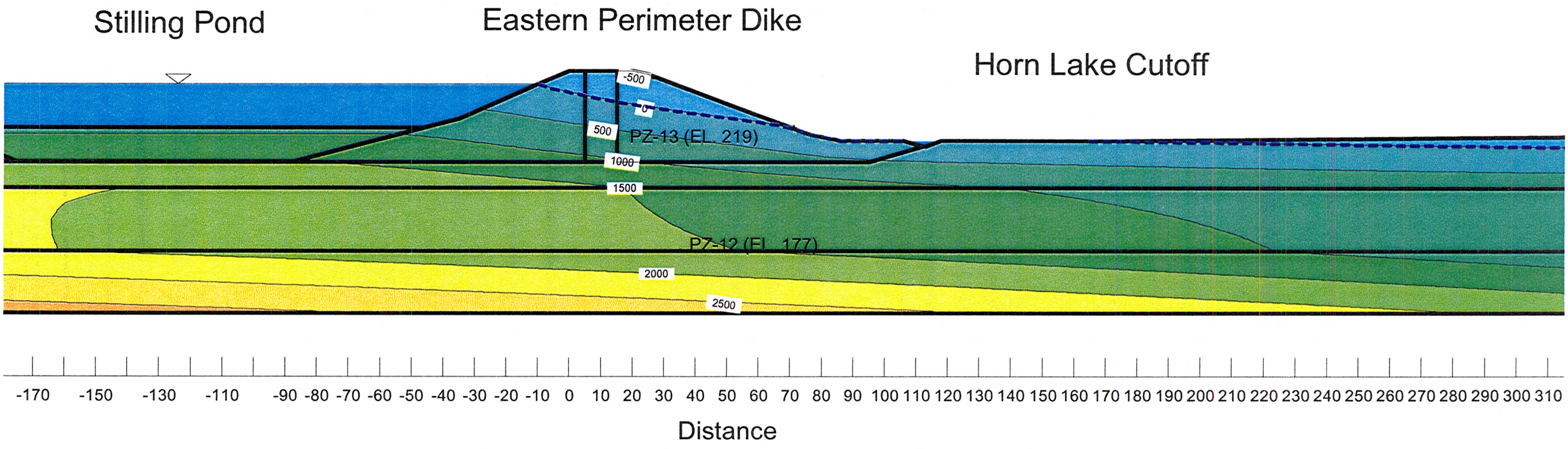
Steady-State Seepage at Section E-E'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Total Head Contours, at 5-foot interval
Low to High : Blue to Red



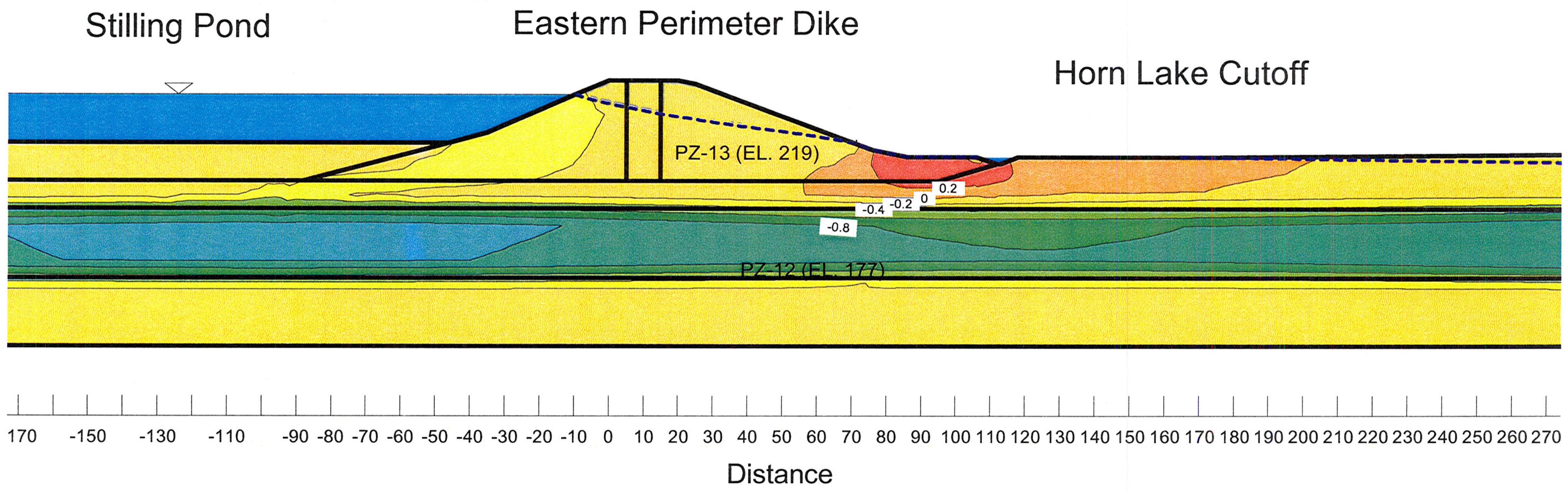
Steady-State Seepage at Section E-E'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Pore Water Pressure Contours, at 500 psf interval
Low to High : Blue to Red



Steady-State Seepage at Section E-E'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

Vertical Gradient Contours, at 0.2 interval
Low to High : Blue to Red

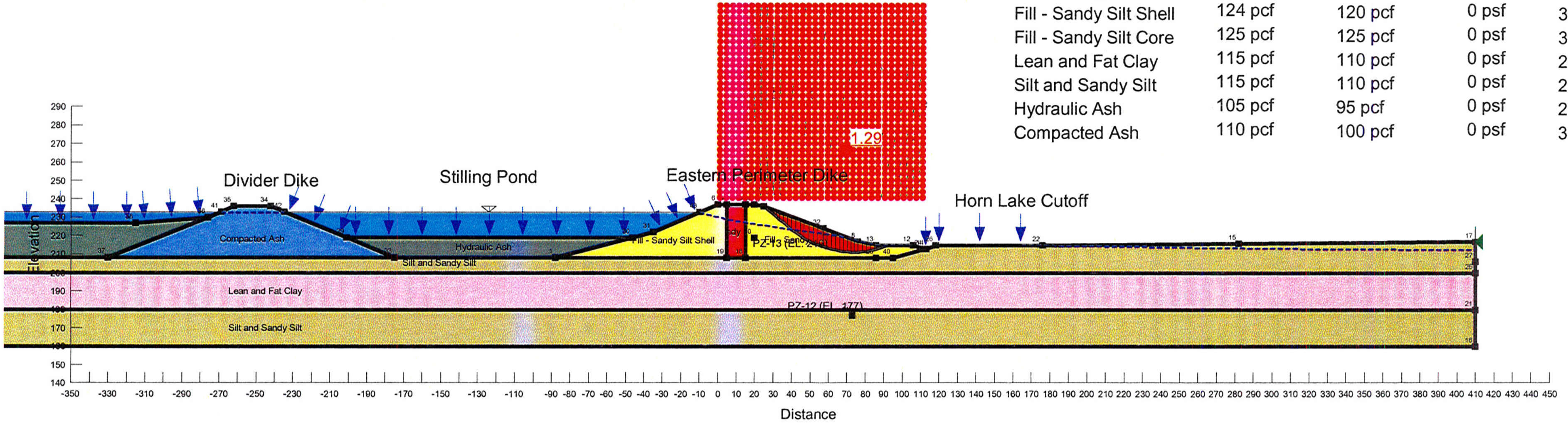


Downstream Deep Failure Circle

Slope Stability Analysis at Section E-E'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
Fill - Sandy Silt Shell	124 pcf	120 pcf	0 psf	31 °
Fill - Sandy Silt Core	125 pcf	125 pcf	0 psf	31 °
Lean and Fat Clay	115 pcf	110 pcf	0 psf	26 °
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °

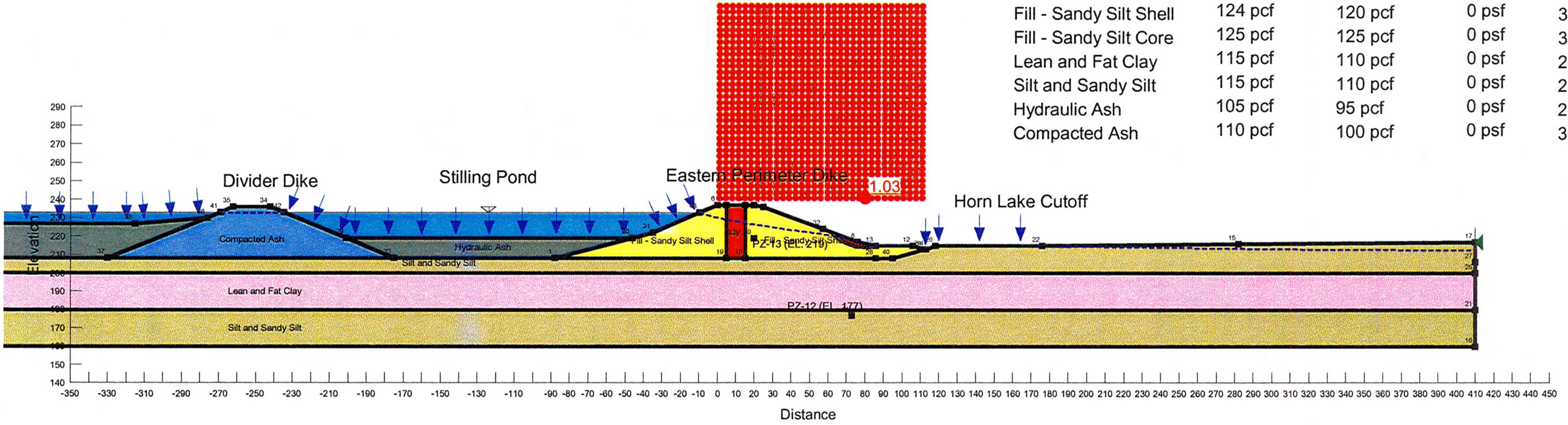


Downstream Shallow Failure Circle

Slope Stability Analysis at Section E-E'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
Fill - Sandy Silt Shell	124 pcf	120 pcf	0 psf	31 °
Fill - Sandy Silt Core	125 pcf	125 pcf	0 psf	31 °
Lean and Fat Clay	115 pcf	110 pcf	0 psf	26 °
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °

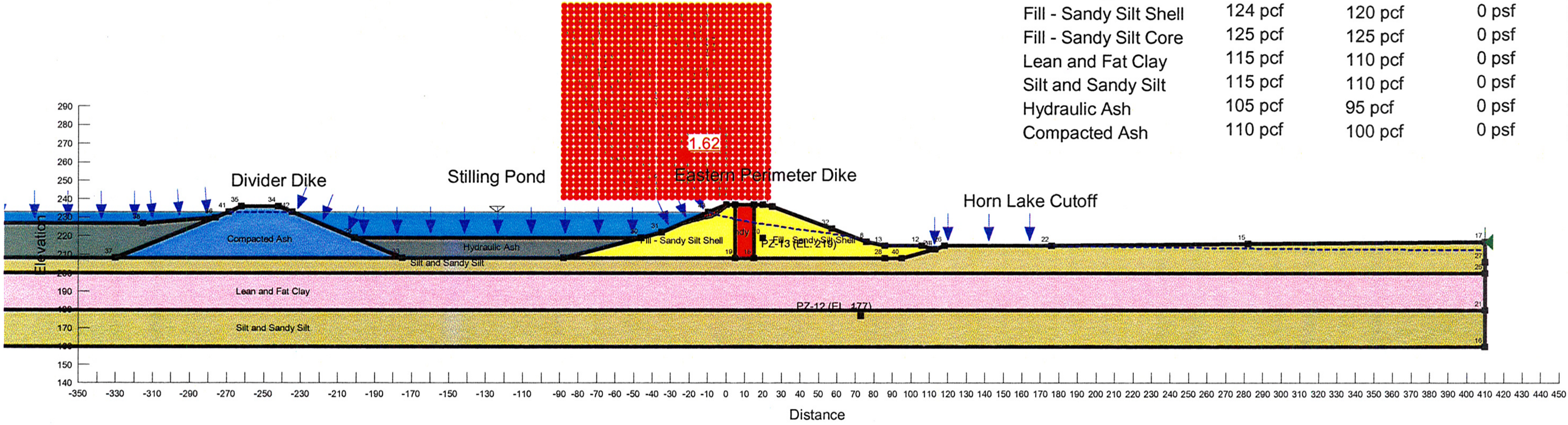


Upstream Shallow Failure Circle

Slope Stability Analysis at Section E-E'
Maximum Pool Elevation
Eastern Perimeter Dike
Allen Fossil Plant
Memphis, Tennessee
Tennessee Valley Authority

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

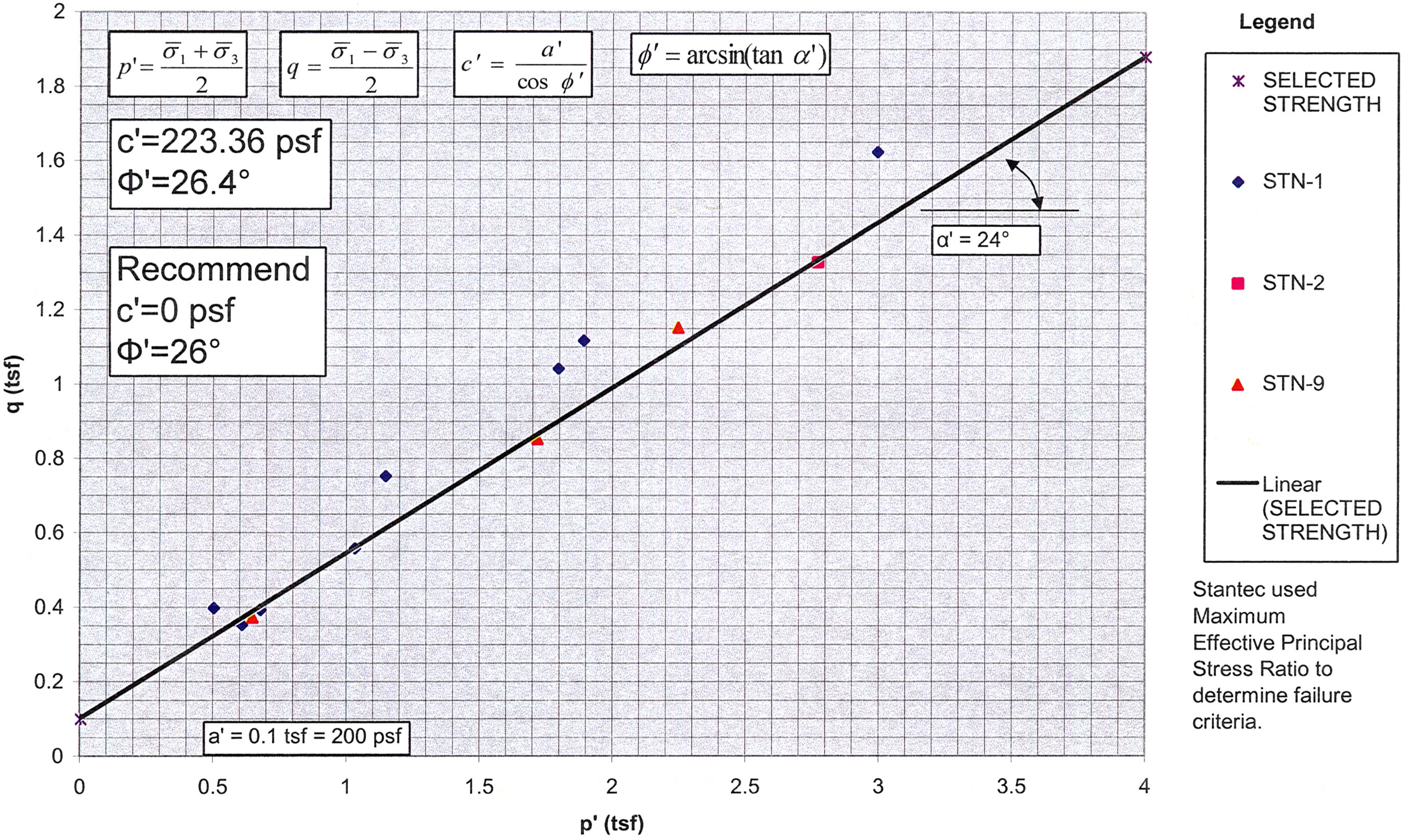
Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
Fill - Sandy Silt Shell	124 pcf	120 pcf	0 psf	31 °
Fill - Sandy Silt Core	125 pcf	125 pcf	0 psf	31 °
Lean and Fat Clay	115 pcf	110 pcf	0 psf	26 °
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	110 pcf	100 pcf	0 psf	30 °



Appendix G

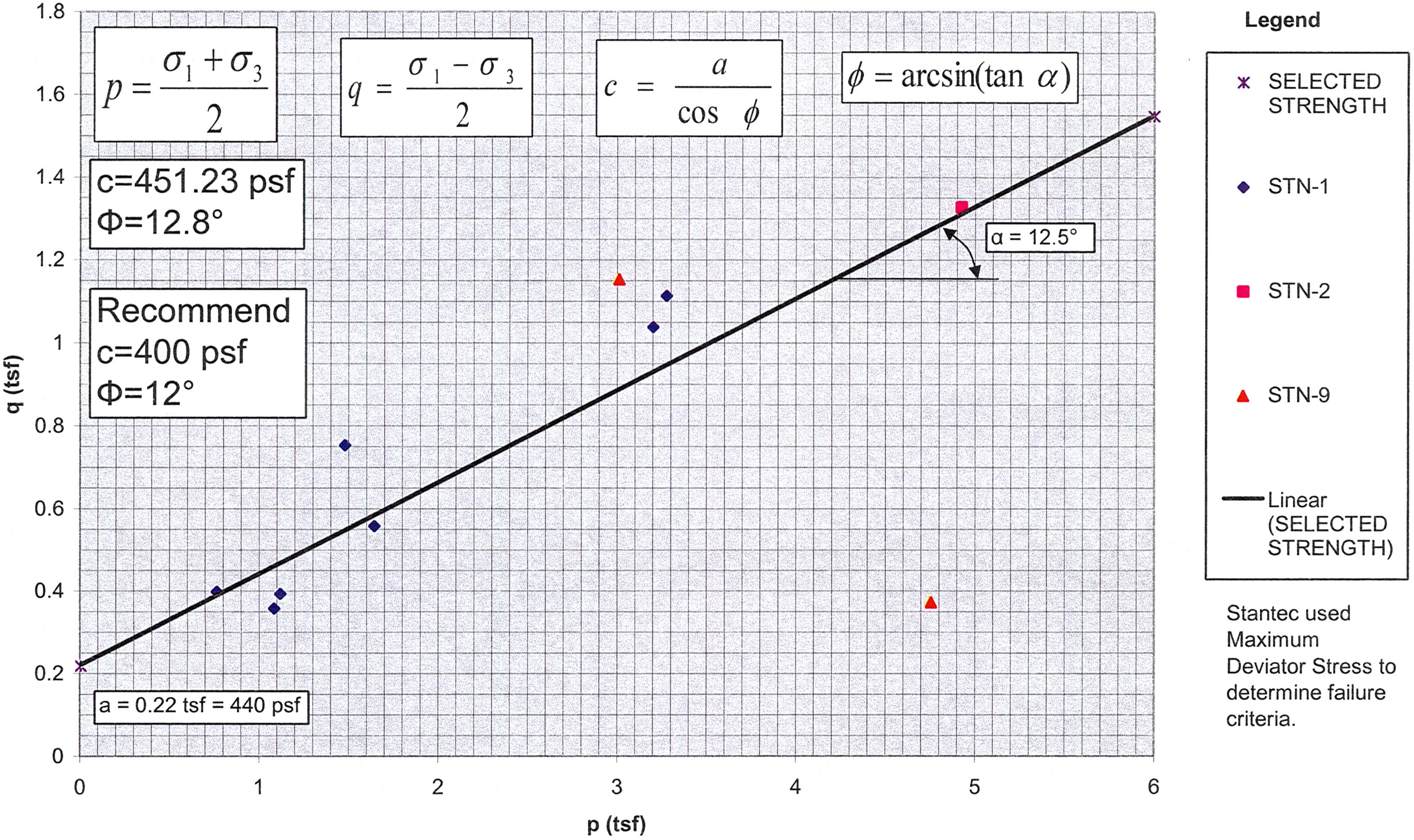
Strength Parameter Selection Charts

Foundation Alluvial Clay (Lean and Fat Clay)
Effective Stress Parameters from CU Triaxial Tests



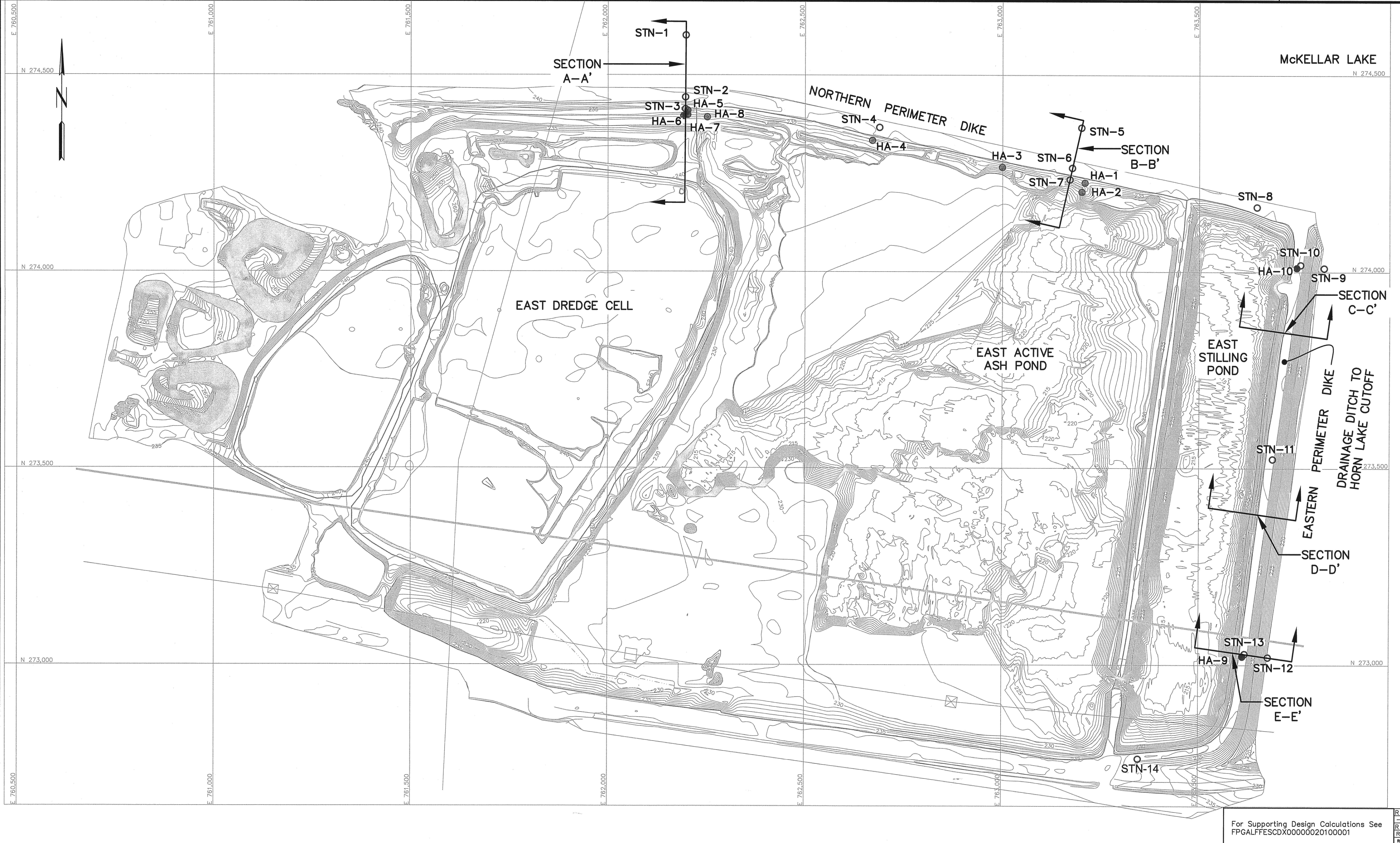
Stantec used Maximum Effective Principal Stress Ratio to determine failure criteria.

Foundation Alluvial Clay (Lean and Fat Clay)
Total Stress Parameters from CU Triaxial Tests



Stantec used Maximum Deviator Stress to determine failure criteria.

38 | C | 10W502-01



LEGEND

- ○ Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Location of Piezometers
- ● Hand Auger Boring

NOTES:

1. The topographic mapping presented on this drawing was provided to Stantec by TVA Surveying and Project Services. This plan view was prepared to support development of the geotechnical exploration program and should not be used for construction.
2. The geotechnical information and data furnished herein are not intended as representation or warranties but are furnished for information only. It shall be distinctly understood that the Owner or Engineer will not be responsible for any deduction, interpretation or conclusion drawn therefrom. The information is made available in order that the Contractor may have ready access to the same information available to the Owner and the Engineer and is not part of this contract.

BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEV. (FT.)
STN–1	274600.73	762196.97	215.3
STN–2	274443.30	762195.73	238.8
STN–3	274413.31	762195.54	234.6
STN–4	274366.97	762687.88	237.5
STN–5	274366.34	763200.60	217.5
STN–6	274264.03	763177.15	238.3
STN–7	274234.70	763171.06	235.6
STN–8	274165.16	763646.95	237.5
STN–9	274009.16	763820.47	221.2
STN–10	274018.24	763758.37	236.9
STN–11	273523.29	763688.16	237.8
STN–12	273018.83	763676.83	216.7
STN–13	273020.21	763618.05	236.9
STN–14	272761.34	763347.91	236.5

HAND AUGER BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEV. (FT.)
HA–1	274226.34	763209.32	235.7
HA–2	274202.98	763201.48	230.5
HA–3	274265.91	762999.17	234.2
HA–4	274333.93	762669.73	233.6
HA–5	274409.74	762201.44	233.7
HA–6	274395.67	762191.04	232.5
HA–7	274398.58	762201.29	232.4
HA–8	274392.70	762251.17	232.1
HA–9	273021.67	763612.37	237.0
HA–10	274010.59	763748.55	237.2

RECORD DRAWING

PLOT DATE: 02/04/2010 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679032\ENVIRONMENTAL\DRAWING\GEOTECH\REV0_RECORD\10W502–01–R0.DWG

50 0 100 200 FEET
GRAPHIC SCALE: 1" = 100'
CONTOUR INTERVAL = 1'

For Supporting Design Calculations See FPGALFFESCDX00000020100001

PATRICK V. KISER
No. 111395
2/4/2010

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Tel. 615.885.1144
Fax 615.885.1102
www.stantec.com

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R 0	02/04/10	PVK	PS	SF	HRA	HRA	PVK	TJ	–	–	–

RECORD DRAWING

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=100' EXCEPT AS NOTED

YARD
–

GEOTECHNICAL EXPLORATION
EASTERN PERIMETER DIKE
BORING LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 02/04/10 | 38 | C | 10W502–01 | R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
TJ

C.A.D. DRAWING
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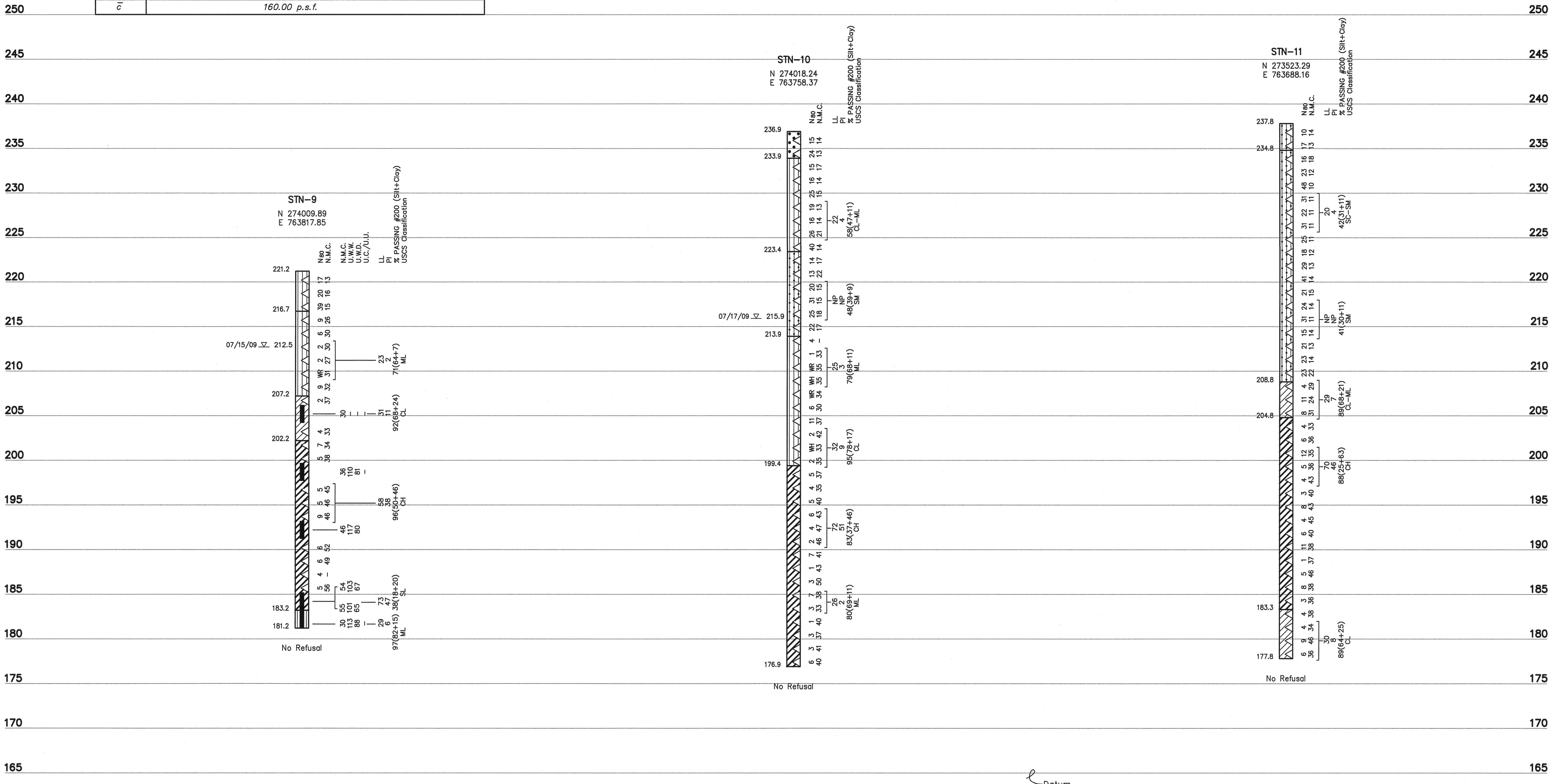
CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS			
Location	STN-9	STN-9	STN-9
Depth	28.0'-28.5'	36.0'-36.5'	36.5'-37.0'
$\bar{\phi}$	28.20°		
$\bar{c}$	160.00 p.s.f.		



LOGS OF BORINGS
SCALE: 1"=5' (VERTICAL ONLY)

LEGEND

☒	Overburden
▦	Topsoil
▨	Fat Clay, brown to grayish brown, moist to saturated
▤	Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
▩	Fly Ash, gray to dark gray, damp to wet
▧	Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
▨	Silty Clay, brown to grayish brown, moist to wet
▣	Gravel with Sand, gray to brown
▥	Silt to Sandy Silt, brown to gray, moist to saturated, occasional clay zones
▥	Sand to Silty Sand, brown to gray, moist to saturated
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
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.
NP	Non-Plastic

NOTES:
1. 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.
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SUMMARY OF OFFSET BORINGS				
BORING NO.	NORTHING	EASTING	SURFACE ELEV. (FT.)	BORING TYPE
PZ-10	274009.41	763758.03	237.39	PIEZOMETER
PZ-11	273517.12	763687.47	237.93	PIEZOMETER

RECORD DRAWING

For Supporting Design Calculations See FPGALFFESCDX00000020100001

PATRICK V. KISER
No. 111395
2/4/2010

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www.stantec.com

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R -	-	-	-	-	-	-	-	-	-	-	-
R 0	02/04/10	PVK	PS	SF	HRA	HRA	PVK	TJ	-	-	-
RECORD DRAWING											

DISCIPLINE INTERFACE
1
2
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4

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
-

EASTERN PERIMETER DIKE
EAST STILLING POND
LOGS OF BORINGS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

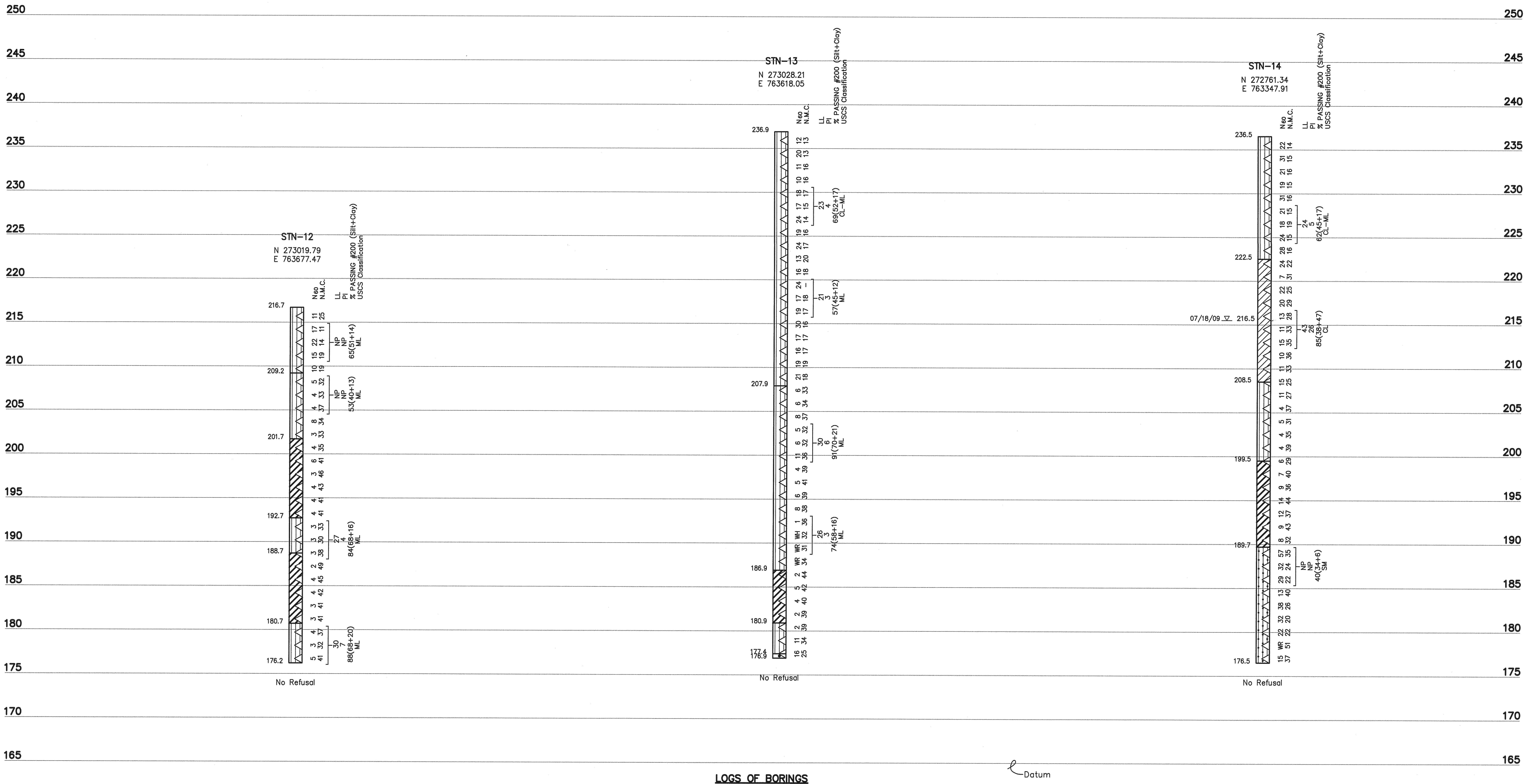
ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 02/04/10	38	C	10W502-02	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
TJ

C.A.D. DRAWING
DO NOT ALTER MANUALLY



LOGS OF BORINGS

SCALE: 1"=5' (VERTICAL ONLY)

LEGEND

☒	Overburden
▦	Topsoil
▨	Fat Clay, brown to grayish brown, moist to saturated
▤	Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
▒	Fly Ash, gray to dark gray, damp to wet
▨	Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
▩	Silty Clay, brown to grayish brown, moist to wet
▦	Gravel with Sand, gray to brown
▥	Silt to Sandy Silt, brown to gray, moist to saturated, occasional clay zones
▥	Sand to Silty Sand, brown to gray, moist to saturated
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
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.
NP	Non-Plastic

RECORD DRAWING

NOTES:

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SUMMARY OF OFFSET BORINGS

BORING NO.	NORTHING	EASTING	SURFACE ELEV. (FT.)	BORING TYPE
PZ-13	273020.94	763619.04	237.24	PIEZOMETER
PZ-14	272761.04	763351.79	236.64	PIEZOMETER

For Supporting Design Calculations See FPGALFFESCDX00000020100001

PATRICK V. KISER
No. 111395

2/4/2010

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R -	-	-	-	-	-	-	-	-	-	-	-
-											
R 0	02/04/10	PVK	PS	SF	HRA	HRA	PVK	TJ	-	-	-
RECORD DRAWING											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
-

EASTERN PERIMETER DIKE
EAST STILLING POND
LOGS OF BORINGS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

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ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 02/04/10 | 38 | C | 10W502-03 | R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
TJ

C.A.D. DRAWING
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PLOT DATE: 02/04/2010 USER: SILPACHARN, PRAYUTH (BILLY)
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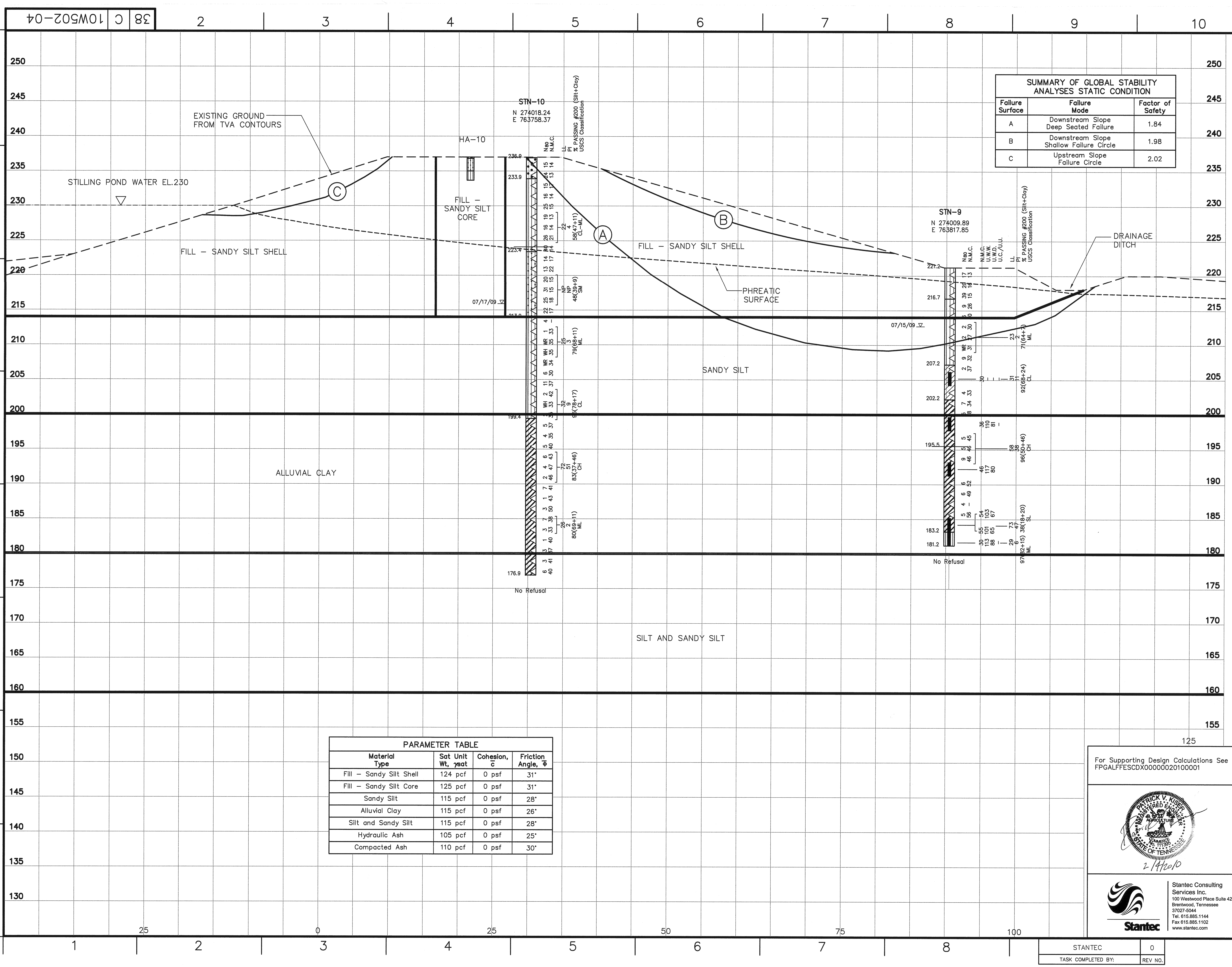

SUMMARY OF GLOBAL STABILITY ANALYSES STATIC CONDITION

Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	1.84
B	Downstream Slope Shallow Failure Circle	1.98
C	Upstream Slope Failure Circle	2.02

PARAMETER TABLE

Material Type	Sat Unit Wt, γsat	Cohesion, c	Friction Angle, Φ
Fill - Sandy Silt Shell	124 pcf	0 psf	31°
Fill - Sandy Silt Core	125 pcf	0 psf	31°
Sandy Silt	115 pcf	0 psf	28°
Alluvial Clay	115 pcf	0 psf	26°
Silt and Sandy Silt	115 pcf	0 psf	28°
Hydraulic Ash	105 pcf	0 psf	25°
Compacted Ash	110 pcf	0 psf	30°

LEGEND

⊠	Overburden
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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.)
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03/31/09 ▽	Water Level and Date Recorded
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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.
NP	Non-Plastic

RECORD DRAWING

PLOT DATE: 02/04/2010 USER: SILPACHARN, PRAYUTH (BILLY)
V:\1726\ACTIVE\172679032\ENVIRONMENTAL\DRAWING\GEOTECH\REV0_RECORD\10W502-04-R0.DWG

For Supporting Design Calculations See FPGALFFESCDX00000020100001

PATRICK V. KISER
REGISTERED ENGINEER
No. 111395
2/4/2010

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Tel. 615.885.1144
Fax 615.885.1102
www.stantec.com

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R 0	02/04/10	PVK	PS	SF	HRA	HRA	PVK	TJ	–	–	–

RECORD DRAWING

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=5' EXCEPT AS NOTED

YARD
–

GEOTECHNICAL EXPLORATION
EASTERN PERIMETER DIKE
CROSS-SECTION C-C'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

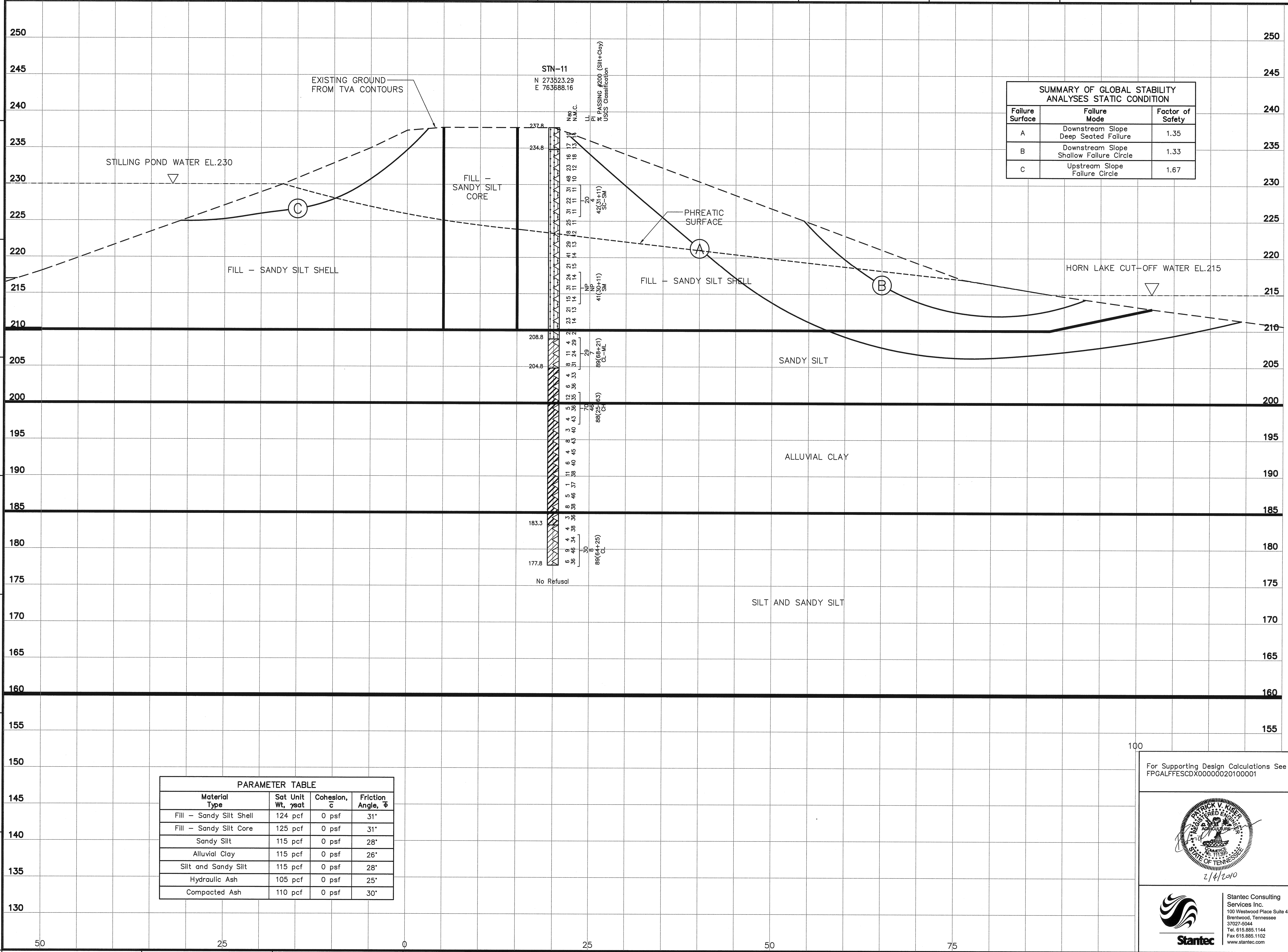
ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 02/04/10	38	C	10W502-04	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
TJ

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SUMMARY OF GLOBAL STABILITY ANALYSES STATIC CONDITION		
Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	1.35
B	Downstream Slope Shallow Failure Circle	1.33
C	Upstream Slope Failure Circle	1.67

PARAMETER TABLE			
Material Type	Sat Unit Wt, γsat	Cohesion, c	Friction Angle, Φ
Fill – Sandy Silt Shell	124 pcf	0 psf	31°
Fill – Sandy Silt Core	125 pcf	0 psf	31°
Sandy Silt	115 pcf	0 psf	28°
Alluvial Clay	115 pcf	0 psf	26°
Silt and Sandy Silt	115 pcf	0 psf	28°
Hydraulic Ash	105 pcf	0 psf	25°
Compacted Ash	110 pcf	0 psf	30°

LEGEND

⊠	Overburden
▦	Topsoil
▨	Fat Clay, brown to grayish brown, moist to saturated
▤	Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
▩	Fly Ash, gray to dark gray, damp to wet
▧	Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
▨	Silty Clay, brown to grayish brown, moist to wet
▩	Gravel with Sand, gray to brown
▥	Silt to Sandy Silt, brown to gray, moist to saturated, occasional clay zones
▥	Sand to Silty Sand, brown to gray, moist to saturated
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
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.
NP	Non–Plastic

RECORD DRAWING

For Supporting Design Calculations See FPGALFFESCDX00000020100001

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2/4/2010

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R –	–	–	–	–	–	–	–	–	–	–	–
–											
R 0	02/04/10	PVK	PS	SF	HRA	HRA	PVK	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"=5' EXCEPT AS NOTED

YARD
–

GEOTECHNICAL EXPLORATION
EASTERN PERIMETER DIKE
CROSS–SECTION D–D'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

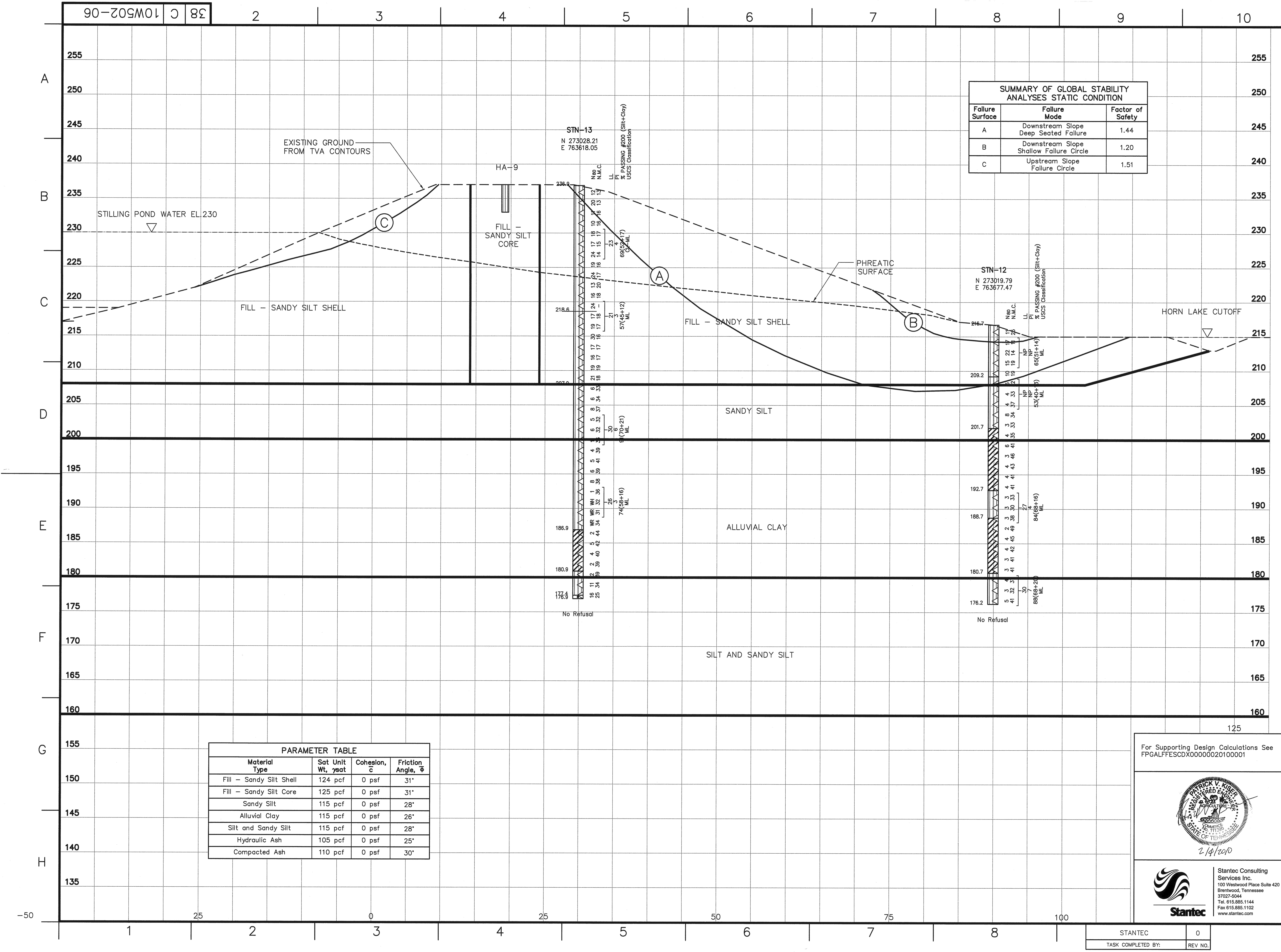
ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 02/04/10	38	C	10W502–05	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
TJ

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SUMMARY OF GLOBAL STABILITY ANALYSES STATIC CONDITION

Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	1.44
B	Downstream Slope Shallow Failure Circle	1.20
C	Upstream Slope Failure Circle	1.51

PARAMETER TABLE

Material Type	Sat Unit Wt, γ_{sat}	Cohesion, c	Friction Angle, Φ
Fill – Sandy Silt Shell	124 pcf	0 psf	31°
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No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586–99. Refer to typed boring log.
NP	Non–Plastic

RECORD DRAWING

PLOT DATE: 02/04/2010 USER: SILPACHARN, PRAYUTH (BILLY)
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For Supporting Design Calculations See FPGALFFESCDX00000020100001

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REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
–											
R 0	02/04/10	PVK	PS	SF	HRA	HRA	PVK	TJ	–	–	–
RECORD DRAWING											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=5' EXCEPT AS NOTED

YARD
–

GEOTECHNICAL EXPLORATION
EASTERN PERIMETER DIKE
CROSS–SECTION E–E'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

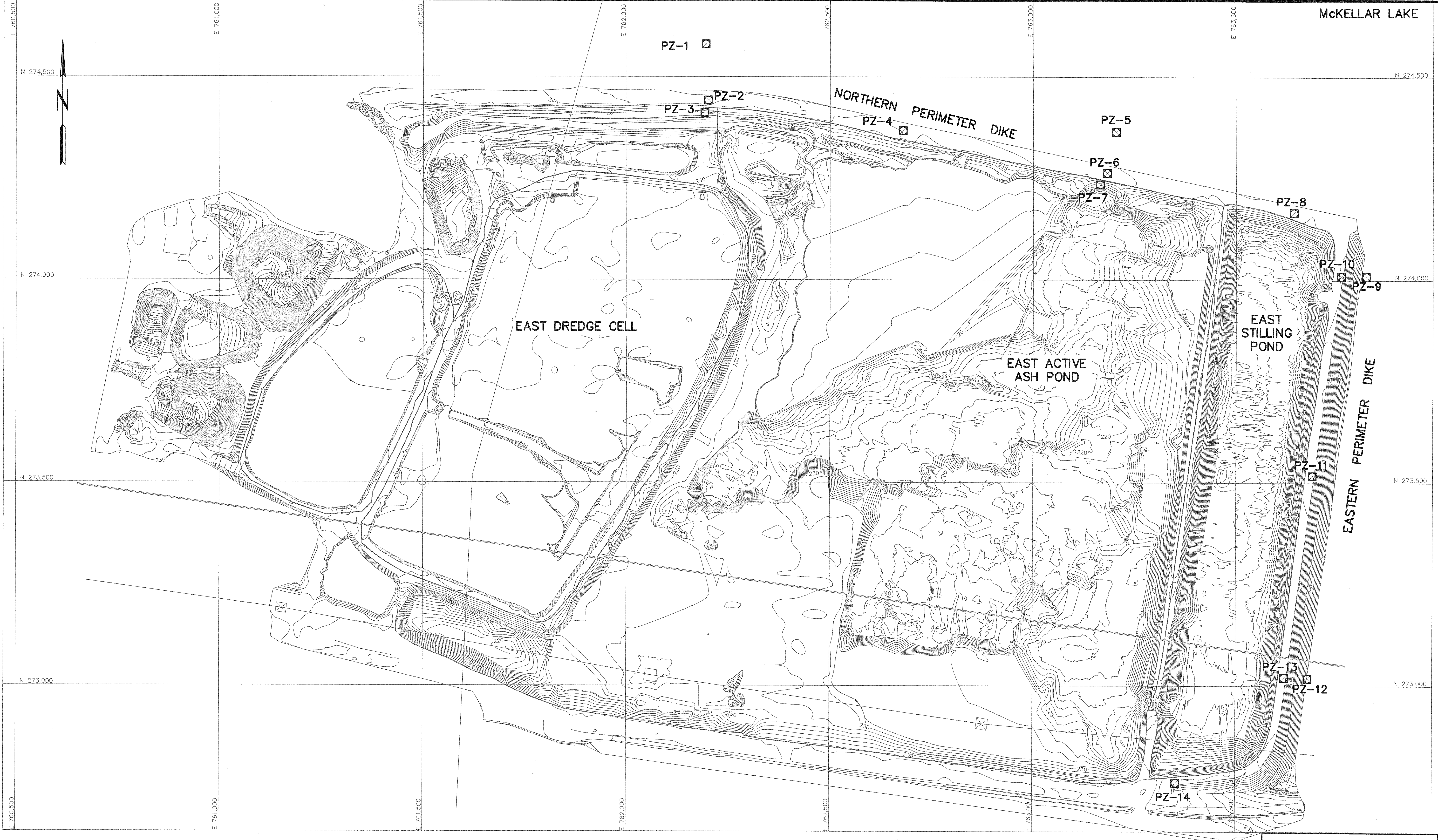
ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 02/04/10 | 38 | C | 10W502–06 | R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
TJ

C.A.D. DRAWING
DO NOT ALTER MANUALLY



LEGEND

PZ-14 ⊠ Piezometer (PZ)

NOTES:

1. The topographic mapping presented on this drawing was provided to Stantec by TVA Surveying and Project Services. This plan view was prepared to support development of the geotechnical exploration program and should not be used for construction.
2. The geotechnical information and data furnished herein are not intended as representation or warranties but are furnished for information only. It shall be distinctly understood that the Owner or Engineer will not be responsible for any deduction, interpretation or conclusion drawn therefrom. The information is made available in order that the Contractor may have ready access to the same information available to the Owner and the Engineer and is not part of this contract.

INSTRUMENTATION LOCATION TABLE

BORING	NORTHING	EASTING	TOP OF CASING ELEV. (FT.)	CONCRETE PAD ELEV. (FT.)
PZ-1	274580.31	762195.58	218.2	215.5
PZ-2	274441.99	762201.92	238.7	238.8
PZ-3	274411.16	762192.94	237.4	234.5
PZ-4	274367.46	762679.46	237.3	237.5
PZ-5	274364.82	763202.51	220.7	218.0
PZ-6	274263.61	763180.87	238.4	238.5
PZ-7	274235.39	763163.82	235.4	235.5
PZ-8	274166.09	763641.32	237.7	237.8
PZ-9	274009.16	763820.47	224.2	221.2
PZ-10	274009.41	763758.03	237.1	237.4
PZ-11	273517.12	763687.47	237.8	237.9
PZ-12	273018.83	763676.83	220.1	217.2
PZ-13	273020.94	763619.04	237.0	237.2
PZ-14	272761.04	763351.79	236.4	236.6

RECORD DRAWING

50 0 100 200 FEET
GRAPHIC SCALE: 1" = 100'
CONTOUR INTERVAL = 1'

For Supporting Design Calculations See FPGALFFESCDX00000020100001

PATRICK V. KISER
No. 111395
2/4/2010

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R 0	02/04/10 RECORD DRAWING	PVK	PS	SF	HRA	HRA	PVK	TJ	–	–	–

DISCIPLINE INTERFACE
1
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3
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SCALE: 1"=100' EXCEPT AS NOTED

YARD
–

GEOTECHNICAL EXPLORATION PIEZOMETER LOCATION PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
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AUTOCAD R 2000 | DATE 02/04/10 | 38 | C | 10W502-07 | R 0

PLOT FACTOR:XX
TJ

C.A.D. DRAWING
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STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT DATE: 02/04/2010 USER: SILPACHARN, PRAYUTH (BILLY)
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38 | C | 10W502-07