Geosyntec consultants

COMPUTATION COVER SHEET

Client: TVA **Project:** Dredge Cells Recovery **Project/Proposal #:** GR4327 **Task #:** 105

TITLE OF COMPUTATIONS Seepage and Stability Study for East Dike and Raised Dike

COMPUTATIONS BY:
Signature ______________________ 30 June 2010 DATE
Printed Name and Title: Justin Wang, Project Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer)
Signature ______________________ 30 June 2010 DATE
Printed Name and Title: Jill F. Simons, Project Engineer

COMPUTATIONS CHECKED BY:
Signature ______________________ 30 June 2010 DATE
Printed Name and Title: Jill F. Simons, Project Engineer

COMPUTATIONS BACKCHECKED BY: (Originator)
Signature ______________________ 30 June 2010 DATE
Printed Name and Title: Justin Wang, Project Engineer

APPROVED BY: (PM or Designate)
Signature ______________________ 30 June 2010 DATE
Printed Name and Title: Robert C. Bachus, Principal

APPROVAL NOTES: ______________________

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

SEEPAGE AND STABILITY STUDY FOR EAST DIKE AND RAISED DIKE

PURPOSE

In March 2010, the Tennessee Valley Authority (TVA) requested that Geosyntec Consultants (Geosyntec) perform a seepage and stability study to evaluate the current stability of the East Dike that is located adjacent to the Intake Channel for the TVA Kingston Fossil Plant (KIF). As shown in Figure 1, the East Dike is located on a portion of reclaimed land that is adjacent to the existing Sluice Channel and the Ballfield Site (Site) at the KIF. In June 2010, TVA requested that Geosyntec also consider the effects of construction traffic that may traverse the Raised Dike haul road located between the Sluice Channel and the East Dike (see Figure 1) and potential improvements that may be needed at the toe of the East Dike adjacent to the Intake Channel. This calculation package was prepared to address these TVA requests.

The seepage and static stability analyses presented herein are used to evaluate potential shallow- and deep-seated failure modes along a typical cross section through the Sluice Channel, the Raised Dike, and the East Dike. In this calculation package, a conceptual rock blanket design is provided to address possible surface erosion and reduce the potential loss of fines along the downstream slope of the East Dike. Geosyntec understands that TVA requests that this conceptual design be provided to Stantec for preparation of detailed construction drawings that will be used for related ongoing dike stabilization activities adjacent to the Intake Channel.

BACKGROUND

The KIF is located on the Watts Bar Reservoir, at the confluence of the Emory River and Clinch River in Harriman, Tennessee approximately 35 miles southwest of Knoxville, Tennessee. The East Dike is on the far eastern edge of a portion of land bounded by the Sluice Channel and the Intake Channel as shown on the attached aerial plan included as Figure 1.

The top of the East Dike is a relatively narrow driveway used for inspection of the perimeter slopes of the KIF Site and is at approximate elevation 755 feet, which is approximately 18 feet above the winter pool elevation (i.e., 737 feet) of Watts Bar Lake. The Raised Dike is located approximately 120 feet west of the East Dike as shown in Figure 1. The top of the Raised Dike is used as a haul road and is at approximate elevation 767 feet. The outboard slope of the Raised Dike towards the east was originally constructed at a slope of approximately 3 horizontal to 1 vertical (3H:1V) and was covered with grass. In April 2010, a rock embankment was constructed on the eastern side of the Raised Dike to widen the haul road at the crest of the Raised Dike. The slope of the new rock embankment is approximately 2H:1V. The outboard slope of the East Dike near the Intake Channel is approximately 6H:1V and is covered with grass and numerous small trees.

A drainage ditch is located along the northern edge of the East Dike driveway and below the toe of the referenced rock embankment on the eastern side of the Raised Dike. The ditch collects seepage water (referenced as the Red Water Seeps) from the slope of the Raised Dike and directs the water towards an area (referenced as the Passive Treatment Area) to the northeast that was created as a wetland by TVA to treat the Red Water Seeps. After passing through the Passive Treatment Area, water collects in a detention pond where the collected water is then pumped to the Ash Pond for discharge through the permitted outfall.

In addition to the Red Water Seeps, TVA has historically reported seepage locations along the slope of the East Dike, below the inspection driveway and above the Intake Channel. In March 2010, Jacobs Engineering (Jacobs) performed a survey of the seep locations along the East Dike. A total of 20 seep locations were identified as shown in Figure 2. At the request of TVA and Jacobs, Geosyntec performed a site reconnaissance in March 2010. A summary of the findings of the site reconnaissance was submitted to TVA as a memorandum dated 22 March 2010. In the memorandum, Geosyntec proposed a Seepage and Stability Study to evaluate the static stability of the East Dike in recognition of the observed seepage. After commencing this study, TVA and Jacobs requested that Geosyntec also assess stability of the Raised Dike, given that this area is being used to route construction traffic. This document provides the results of the analyses performed by Geosyntec in response to the TVA and Jacobs requests.

GEOTECHNICAL INVESTIGATION PROGRAM

As a part of the Seepage and Stability Study conducted in April 2010, Geosyntec requested that MACTEC advance six Standard Penetration Testing (SPT) borings along two cross section locations (i.e., A-A and B-B) selected by Geosyntec. The cross sections were selected at the locations where most active seeps along the outboard slope of the East Dike were observed. Continuous split-spoon samples were obtained during drilling. The borings were advanced to auger refusal depths to investigate the general engineering characteristics and the subsurface conditions. After the completion of the borings, TVA personnel surveyed the boring locations and the local ground surface elevations adjacent to the borings. The boring location plan is presented in Figure 3 along with cross section locations. The boring logs prepared by MACTEC are included in Attachment 1. A summary of the location and depth of the borings is presented in Table 1.

MACTEC also installed standpipe piezometers near each of the six borings to monitor the water levels in the Lower Dike Fill (five piezometers) and the Upper Dike Fill (one piezometer). Piezometer construction consisted of two-inch diameter, five-foot long, Schedule 40 PVC well screen at the bottom of the standpipes. A sand filter pack was used to backfill to some distance above the screened section followed by a minimum two-foot thick bentonite seal. Piezometer locations and tip elevations are summarized in Table 2. Water levels at these six locations were obtained on a daily basis during the first two weeks, and three times per week subsequently. A summary of the water level readings through 14 June 2010 is shown in Figure 4.

MACTEC performed laboratory testing on selected split-spoon samples and undisturbed (i.e., Shelby) tube samples. The results of these tests are included in Attachment 2. Table 3 summarizes the consolidated-undrained triaxial shear testing results. Table 4 summarizes the results of the permeability testing.

SUBSURFACE STRATIGRAPHY & MATERIAL PROPERTIES

Based on Geosyntec's review of the results of the geotechnical investigation program, the subsurface materials along cross section B-B generally exhibit slightly higher blow counts than the subsurface materials along cross section A-A. Therefore, Geosyntec identified cross section A-A as a more critical cross section and subsequently used the stratigraphy along this cross section in the seepage and static stability analyses. The location of the cross section A-A is shown in Figure 3. The ground surface geometry and the interpreted subsurface stratigraphy are presented in Figure 6. Previous geotechnical borings B-36, B-39, and B-47 performed by MACTEC in early 2009 were also included in the preparation of the stratigraphy of cross section A-A. The boring locations are shown in Figure 6. The boring logs for these three previous borings are also included in Attachment 1.

Geosyntec relied on information provided in previous documents related to the KIF [i.e., Geosyntec 2009a, 2009b, 2009c] as well as the new subsurface and laboratory information provided by MACTEC in Attachment 2 to select material properties for the seepage and stability analyses. The material properties used in the seepage analyses are summarized in Table 6, and the properties used in the stability analyses are summarized in Table 7.

SEEPAGE ANALYSES

Methodology

Based on the interpreted subsurface stratigraphy, a seepage model for the entire cross section A-A was developed based on the interpreted subsurface stratigraphy. Calculations related to seepage were conducted using the computer program SLIDE (version 5.044). SLIDE is distributed by Rocscience of Toronto, Ontario, Canada and includes the capability of performing steady-state, saturated and unsaturated groundwater analysis using the finite element method. The program calculates pore-pressures, piezometric head, and discharge quantities using the site-specific geometry considered for the slope stability analysis. Calculated pore pressures at discrete points are integrated into the slope stability analysis.

Steady state seepage was assumed for these analyses, using static water levels in the rim ditch, the sluice channel, and the intake channel as boundary conditions. The water level in the rim ditch and sluice channel was assumed to be at elevation 765 feet based on recent topographic plan provided by Jacobs. On the downstream side, the water level in the intake channel was assumed to be at elevation 737 feet, corresponding to a normal winter pool of the adjacent Watts Bar Lake.

Additional relevant boundary conditions for the SLIDE analysis are assumed as follows. Along the vertical upstream edge of the model, the hydraulic head at each node is constant with depth and equal to the rim ditch/sluice channel water level elevation. Along the vertical downstream edge of the model, the hydraulic head at each node is equal to the intake channel water level elevation at the location of the node. Other nodes along the ground surface are treated as potential seepage exit locations. The base of the model is assumed to be located on top of the shale bedrock and is modeled as a seepage barrier, where flow is not allowed to cross these boundary nodes.

Input Parameters

For the analyzed cross section A-A, the representative profile was compiled based on boring logs and available record drawings. The hydraulic conductivity for vertical seepage through saturated materials (k_v) was estimated using available laboratory data. Typical values for similar soils were obtained by Geosyntec using various public sources in cases when laboratory data were not available. The ratio of horizontal hydraulic conductivity (k_h) to vertical hydraulic conductivity (k_v) was estimated based on placement condition of the materials. Given the hydraulic placement condition of the materials, a typical value of k_h/k_v=10 was assumed for the ash, the clay dike material, the clayey foundation materials, and the sandy foundation material.

Comparing Field Measurements and Piezometer Readings

The field measurements and the calculated water levels at the piezometer locations along the analyzed section A-A are graphically shown in Figure 4. The calculated phreatic surface is observed to intersect the ditch near the toe of the Raised Dike where the Red Water Seeps were observed. The phreatic surface is also observed to intersect the sloping ground surface above the Intake Channel elevation. The numerical model, did not, however, indicate conditions in which the phreatic surface was above the ground surface, a condition that was measured in the field in piezometer PZ-A3. To address this discrepancy, Geosyntec has studied the pressure head calculated by the seepage analysis. In Figure 5, Point A located at the center of the Upper East Dike Fill layer indicates that the calculated pressure head equals the hydrostatic pressure. This is explains why the calculated phreatic surface is at the ground surface. Point B located at the center screen location of piezometer PZ-A3 indicates that the calculated pressure head is approximately 0.25 feet higher than the hydrostatic pressure. This is consistent with the measured ground water level in piezometer PZ-A3 is higher than the ground surface, indicating that the Upper Dike Fill may be performing as a confining unit for the lower stratum. These site-specific water pressures in the two units were considered in the stability analyses.

In general, the calculated water levels at piezometers PZ-A1 and PZ-A2 and the calculated pore pressure at piezometer PZ-A3 correspond with the field measurements reasonably well, which indicates the assumed boundary conditions, hydraulic conductivities, and the hydraulic conductivity ratio used in the seepage analysis are reasonable. The calculated total head contours represent the results of seepage analysis and are presented in Figure 6. The phreatic surface will be used for the static stability analysis.

Critical Exit Gradient

A critical exit gradient is calculated as the gradient that causes seepage pressures in an upward direction to exceed the downward force of the soil. In this case, the calculated factor of safety (FS) with respect to the escape gradient (FS_G) can be defined as:

$$FS_{gradient} = i_c / i \qquad (1)$$

where i is the escape gradient in the soil at the exit point. SLIDE computes values of the escape gradient. The hydraulic gradient associated with escape gradient near an unrestrained soil surface is termed the critical gradient, i_c, which can be computed as:

$$i_c = (\gamma - \gamma_w) / \gamma_w \qquad (2)$$

where γ is the total unit weight of the soil and γ_w is the unit weight of water. For the clayey dike material such as the Upper Dike Fill and Lower Dike Fill, γ is approximately 120 pounds per cubic feet (pcf) and the γ_w is 62.4 pcf. Therefore, the calculated i_c is ≈0.9.

Investigators have recommended ranges for FS_G from 1.5 to 5 according to US Army Corps of Engineers (USACE) Engineering Manual 1110-2-1901 [USACE 1986]. In the absence of specific design guidance, Geosyntec assumed a value in the mid-range of these values and selected a target FS_G = 3 in this calculation package.

Contour plots of the vertical hydraulic gradient and the phreatic surface computed in SLIDE are shown in Figure 8. The negative value indicates the water flows downward and the positive value indicates the water flows upward. Due to the different hydraulic conductivities of different layers, the contour lines are discontinuous at the material boundaries. The results indicate that the calculated vertical hydraulic gradient, i, ranges from 0 to 0.06 along the outboard slope of Raised Dike and from 0 to 0.3 along the slope of the East Dike. The calculated maximum i is located at the toe of the East Dike. Using Equation (1), the minimum FS_G is calculated as 3. Therefore, the slope of the Raised Dike and the slope of the East Dike meet the design criteria for escape gradient at the seepage exits.

STABILITY ANALYSES

Methodology

Static stability analyses were performed using Spencer's method [Spencer 1973], as implemented in SLIDE, the same program used in the previously referenced seepage analysis. Two failure modes were considered in the analyses: (i) rotational failure modes (i.e., circular slip surfaces); and (ii) translational failure modes (i.e., block slip surfaces). The purpose of the stability analyses is to evaluate the calculated factor of safety for these two potential relatively deep-seated failure modes.

Spencer's method is chosen to analyze the rotational failure modes and the translational failure modes. Spencer's method, which satisfies both vertical and horizontal force equilibrium and moment equilibrium, is considered to be more rigorous than other methods, including the simplified Janbu method [Janbu, 1973] and the simplified Bishop method [Bishop, 1955].

Input Parameters

Information required for the static stability analyses includes slope geometry, subsurface ash/soil stratigraphy, phreatic surface computed from the seepage analysis, and material properties of the subsurface soils along the selected cross section.

Target Factors of Safety

Target factors of safety for these conditions are identified in Section 1.4.2 of TVA's 7 December 2009 report titled "*Facilities Design and Construction Requirements, Volume 2, Rev 1.0.*" In this document, the TVA requirement for post-closure slopes (i.e., long-term conditions) is 1.5. TVA allows a calculated factor of safety of 1.3 for "interim slopes." Geosyntec believes that the heavy construction traffic that is used intermittently at the Site should be considered an interim loading condition that is subject to appropriate operational controls (e.g., load and speed control of the vehicles, monitoring of slope performance, etc.). Following this logic, Geosyntec believes that under the construction vehicle loading, the target calculated FS should be greater than 1.30.

Truck Loading

TVA requested that Geosyntec consider the effects of construction traffic that may traverse the Raised Dike haul road will have on the stability of the Raised Dike. A typical truck (i.e., a Caterpillar 740 articulated truck) was considered for the slope stability analyses. The configuration of the truck load is presented in Figure 9. According to the specifications for the Caterpillar 740, the magnitude of the load on each row of tires is calculated as 2,800 psf for a loaded truck and 1,280 psf for an unloaded truck. TVA indicated that only unloaded trucks would be used. To provide a complete assessment, Geosyntec considered the case of both loaded and unloaded articulated trucks.

Results

The minimum FS for the East Dike at Cross Section A-A was calculated. The results are summarized in Table 7. As shown in this table, all calculation results are greater than the target values of 1.5 for long-term loading conditions. The calculated critical failure surface for each potential failure mode is shown graphically in Figures 10 (rotation) and 11 (translation).

With regards to the Raised Dike, analyses were performed to evaluate the slope stability with and without the consideration of construction traffic. The stability analysis used the calculated water levels from the seepage analysis. When considering construction traffic, an offset distance of 5 ft from the crest of the Raised Dike to the edge of the truck tire was imposed to recognize recommended and safe construction practices in proximity to sideslopes in the absence of physical barriers (i.e., Jersey barriers). The analyses were performed for the short-term, undrained loading condition assuming the excess pore water pressure generated due to the truck load had not dissipated. The undrained shear strength properties presented in Table 6 were applied to the soft pond ash, dense bottom ash, and clayey foundation soil.

The results for the analyses with and without construction loading are summarized in Table 8. The calculated critical failure surfaces for each potential failure mode are shown graphically in Figures 12 to 17. The calculated factors of safety for the Raised Dike without construction traffic are greater than 1.5 and are believed to be appropriate for long-term conditions at the site. The calculated factors of safety for the Raised Dike under construction traffic are greater than 1.3 and are believed to be appropriate for short-term conditions at the site.

In recognition of conditions in which the pore pressures of the Lower Dike Fill layer of the East Dike increase, Geosyntec performed a limited series of stability analyses considering the long-term loading conditions. In the stability analysis, Geosyntec applied a separate piezometric line for the Lower Dike Fill layer. Results are shown in Figure 18 through 21 and summarized in Table 9. The calculated minimum FS decreases from 1.53 to 1.20 when the pore pressure of the Lower Dike Fill layer increases from 0.5 feet to 2 feet above the existing ground surface. From the record of the piezometers PZ-A3 and PZ-B3, the measured water levels range from 0.25 to 1.5 feet above the existing ground surface due to the confining effect of the Upper Fill Layer. To improve the local stability in the event of elevated water pressures, control surface erosion, and reduce the potential loss of fines from the East Dike foundation, Geosyntec recommends a rock blanket be placed along the outboard slope of the East Dike. A conceptual design of the rock blanket is shown in Figure 22. The results of the stability analysis including the addition of this conceptual rock blanket indicate that the minimum FS is increased with the installation of the rock blanket. The results are graphically shown in Figures 23 through 26. The calculated minimum FS are greater than the target values of 1.5 for long-term loading conditions.

CONCLUSIONS

The results from the seepage analyses indicated a shallow phreatic surface within the Raised Dike and the East Dike. These elevated water levels are confirmed by the observation of seepage location along the slope above the East Dike as shown in Figure 2. The minimum factor of safety of escape gradient is calculated as 3 for the slopes of the Raised Dike and East Dike. The result from the seepage model indicate that the slopes of the Raised Dike and East Dike meets the current criteria for escape gradient.

The stability analysis performed by Geosyntec indicates that the East Dike has adequate calculated factors of safety against a deep-seated failure mechanism in long term conditions. These results indicate that the East Dike is stable with respect to the potential formation of relatively deep-seated failures that would compromise the retention of the Raised Dike. Geosyntec also considered the potential adverse impacts of elevated pore pressures in the Lower Dike Fill layer of the East Dike. Results indicate that stability is increased by including a stabilizing rock blanket drain along the face of the East Dike.

Additionally, Geosyntec considered the potential for both circular rotation and block sliding failure modes and calculated factor of safety values under static loading conditions for the Raised Dike haul road embankment. Table 8 summarizes the calculation results for the various referenced long-term and short-term loading conditions, as well as the target values of FS for these conditions. As noted in the table, the analyses explicitly consider the condition that the trucks will travel no closer than 5 ft from the edge of the Raised Dike haul road embankment. For each analysis, the calculated FS values exceed the target values. Therefore, the Raised Dike haul road achieves the target stability requirements of TVA for both short-term loading conditions with traffic and long-term loading conditions without traffic.

RECOMMENDATIONS

In recognition of conditions in which the water pressures of the Lower Dike Fill layer of the East Dike increase, Geosyntec performed a limited series of stability analyses considering the long-term loading conditions. As demonstrated, the calculated minimum FS decreases from 1.53 to 1.20 if the elevated water pressure of the Lower Dike Fill layer increases from 0.5 feet to 2 feet above the existing ground surface. To improve the local stability in the event of elevated water pressures, control surface erosion, and reduce the potential loss of fines from the East Dike foundation, Geosyntec recommends a minimum 2-ft thick rock blanket be placed along the downstream slope of the East Dike. The calculated minimum FS after installation of the rock blanket is greater than the target values of 1.5 for long-term loading conditions. Geosyntec understands that this report will be provided to Stantec and that the detailed design and construction drawings of the rock blanket will be provided by Stantec to be consistent with other rehabilitation measures along the Intake Channel sideslopes.

In addition, to address potential safety issues and prevent local instability adjacent the sideslope in the absence of physical barriers, Geosyntec recommends that a minimum offset distance of 5 feet be maintained from the crest of the Raised Dike to the edge of truck tires and appropriate controls (e.g., loading and control of the vehicles, monitoring of slope performances, etc.) be implemented when heavy construction traffic is used at the Site.

REFERENCES

Bishop, A. (1955), *The Use of the Slip Circle in the Stability Analysis of Slopes*, Geotechnique, Volume 5, No. 1, Jan 1955, pp. 7-17.

Geosyntec Consultants (2009a), *Technical Summary – Proposed Modification Regarding Spacing/Depth of Prefabricated Vertical Drains at Ball Field Temporary Ash Disposal Site*, March 17, 2009.

Geosyntec Consultants (2009b), *Slope Stability Analyses for Dike 2*, July 31, 2009.

Geosyntec Consultants (2009c), *Rapid Dewatering System and Filter Press System Foundation Assessment*, December 16, 2009.

Hammer, D.P., and Blackburn, E.D. (1977), *Design and Construction of Retaining Dikes for Containment of Dredged Material*, Technical Report D-77-9, U.S. Army Engineer Water Experiment Station, Vicksburg, Mississippi, August 1977, pp. 93.

Janbu, N. (1973), *Slope Stability Computations*, Casagrande Memorial Volume, R. C. Hirschfield and S. J. Poulos, Eds., John Wiley, New York, 1973, pp. 47-86.

Spencer, E. (1973), *The Thrust Line Criterion in Embankment Stability Analysis*, Géotechnique, Vol. 23, No. 1, pp. 85-100, March 1973.

U.S. Army Corps of Engineers (USACE) (1986), *Engineering and Design - Seepage Analysis and Control for Dams*, Engineering Manual EM 1110-2-1901, September 30 1986, pp. 4-24.

Tables

Table 1. Summary of Borings

Boring No.	Northing	Easting	Ground Elevation (ft)	Boring Termination Depth (ft)	Boring Termination Elevation (ft)
A-1	553306.68	2439676.67	757.01	54.1	702.9
A-2	553255.32	2439700.02	754.51	50.2	704.3
A-3	553231.32	2439727.62	747.09	44.4	702.7
B-1	553531.64	2439911.34	759.29	47.1	712.2
B-2	553469.68	2439946.54	753.17	48.0	705.2
B-3	553416.90	2439942.30	748.49	40.3	708.2

Note:

1. The northing, easting, and ground elevation at each boring location was provided by Jacobs on 22 April 2010.
2. The piezometers were screen at the bottom of the well. The screen length was 5 feet.

Table 2. Summary of Piezometers

Piezometer No.	Piezometer Depths (ft)	Ground Elevation [1](ft)	Screen Depth (ft)	Layer Screened In
PZ-A1	24.77	757.02	22.77-24.77	Lower Dike Fill
PZ-A2	14.02	754.82	9.02-14.02	Upper Dike Fill
PZ-A3[2]	25.86	747.09	20.86-25.86	Lower Dike Fill
PZ-B1	25.37	759.45	20.37-25.37	Lower Dike Fill
PZ-B2	20.02	753.17	15.02-20.02	Lower Dike Fill
PZ-B3[2]	25.87	748.49	10.87-15.87	Lower Dike Fill

Note:

1. The piezometer ground surface elevation at each piezometer location was provided by Jacobs on 22 April 2010.
2. The Lower Dike Fill layer is potentially a confined/pressurized layer.

Table 3. Summary of Consolidated – Undrained Triaxial Shear Testing

Boring No.	Sample Interval (ft)	USCS Classification	Material Zone	Average Total Unit Weight (pcf)	CU Triaxial Strength	
					c' (psf)	ϕ' (°)
A-2	7-9	CL	Upper Dike Fill	131	210	30.3
A-2	23-25, 25-27, 27-29	CL	Lower Dike Fill	129	0	33.4
A-2	35-37	CL	Clayey Foundation Soil	127	95	30.0
B-1	18-20	ML	Pond Ash	99	490	32.6

Note:

1. Laboratory testing results provided by MACTEC in April 2010 (see Attachment 2).

Table 4. Summary of Permeability Testing

Boring No.	Sample Interval (ft)	USCS Classification	Total Unit Weight (pcf)	Permeability (cm/s)
A-1	33-35	CL	131	5.3 x 10-8
A-2	9-11	CL	137	5.9 x 10-6
A-2	25-27	CL	120	1.7 x 10-7
A-2	33-35	CL	127	4.4 x 10-8
A-3	10.5-12.5	CL	124	8.4 x 10-8

Note:

1. Laboratory testing results provided by MACTEC in April 2010 (see Attachment 2).

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

Table 5. Material Properties for Seepage Analysis

Material Layers	Permeability		Source
	Vertical k_v (cm/s)	k_h/k_v	
Crust Layer	3×10^{-5}	10	Note 1
Upper Dike Fill	1.7×10^{-7}	10	Note 2
Lower Dike Fill	1.7×10^{-7}	10	Note 2
Soft Pond Ash	3×10^{-5}	10	Note 1
Dense Bottom Ash	3×10^{-5}	10	Note 1
Haul Road Rock Embankment	1×10^{-3}	1	Note 3
Clayey Foundation Soil	4.4×10^{-8}	10	Note 2
Sandy Foundation Soil	1×10^{-5}	10	Note 3

Notes:

1. Based on *Fly Ash, Bottom Ash and Scrubber Gypsum Study* performed by Law Engineering at KIF site in 1995.
2. Based on laboratory testing results provided by MACTEC during this study (see Attachment 2).
3. Typical values for gravel and sands.

Table 6. Material Properties for Stability Analysis

Material Layers	Total Unit Weight (pcf)	Drained Shear Strength		Undrained Shear Strength
		c' (psf)	φ' (°)	
Crust Layer	120	500	10	N/A
Upper East Dike Fill	125	200	30	N/A
Lower East Dike Fill	120	0	30	N/A
Soft Pond Ash	75	0	25[1]	$Su/\sigma_v' = 0.8$[2]
Dense Bottom Ash	100	0	30	$Su/\sigma_v' = 0.8$[2]
Haul Road Rock Embankment	135	0	35	N/A
Clayey Foundation Soil	125	0	30	$Su/\sigma_v' = 0.25$[3]
Sandy Foundation Soil	125	0	30	N/A

Note:

1. The strength values recommended for the soft pond ash materials are based on previous [Geosyntec 2009a, 2009b, 2009c] documents. The values are conservative in comparison to the laboratory testing results provided by MACTEC during this study (see Attachment 2).
2. The undrained shear strength ratio for the soft pond ash and the dense bottom ash was considered to be 0.8 based on the CU test on the fly ash sample.
3. A typical value of 0.25 was considered for the undrained shear strength ratio for the clayey foundation soil.

Table 7. Results of Slope Stability Analysis for East Dike and Raised Dike (Long Term Condition)

Failure Mode	Analyzed Condition	Calculated FS	Target FS	Is FS OK?	Results Shown in Figure
Circular Slip	Long Term	1.62	1.5	Yes	10
Block Slip	Long Term	1.57	1.5	Yes	11

Notes:

1. Factors of safety presented in this table were calculated using Spencer's method for both the circular slip mode and the block slip mode.

Table 8. Results of Slope Stability Analysis with Traffic Load for Raised Dike Haul Road (Short Term Condition)

Traffic load	Failure Mode	Analyzed Condition	Calculated FS	Target FS	Is FS OK?	Results Shown in Figure
No Traffic	Circular Slip	Long Term	1.64	1.5	Yes	12
	Block Slip (Raised Dike Area)		1.78	1.5	Yes	13
Loaded Truck	Circular Slip	Short Term	1.32	1.3	Yes	14
	Block Slip (Raised Dike Area)		1.61	1.3	Yes	15
Unloaded Truck	Circular Slip	Short Term	1.34	1.3	Yes	16
	Block Slip (Raised Dike Area)		1.99	1.3	Yes	17

Notes:

1. Stability analysis used calculated water levels and pore pressures from the seepage analysis.
2. Factors of safety presented in this table were calculated using Spencer's method for both the circular slip mode and the block slip mode.
3. An offset distance of 5 ft from the crest of the Raised Dike haul road to the edge of the truck tire was considered in the slope stability analyses.

Table 9. Results of Slope Stability Analysis for Water Pressure Increases at East Dike with and without Rock Blanket (Long Term Condition)

Water Pressure Above Ground Surface (ft)	Calculated FS	Results Shown in Figure	Calculated FS After Installation of Rock Blanket	Results Shown in Figure
0.5	1.53	18	2.09	23
1.0	1.45	19	2.03	24
1.5	1.38	20	1.97	25
2.0	1.20	21	1.85	26

Figures

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

Figure 1. Site Location

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

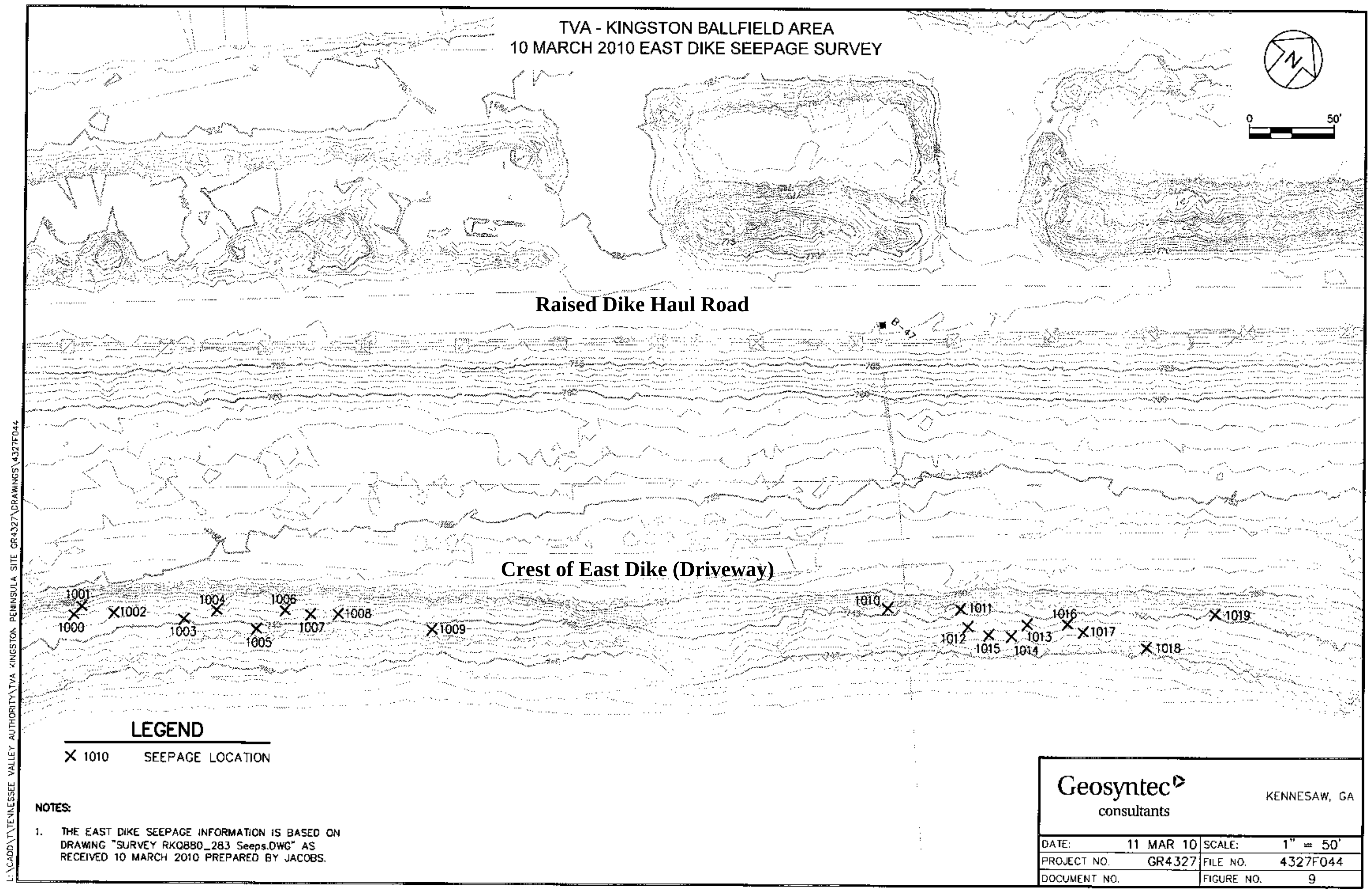


Figure 2. Seep Locations (Topographic Plan provided by Jacobs on 10 March 2010)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

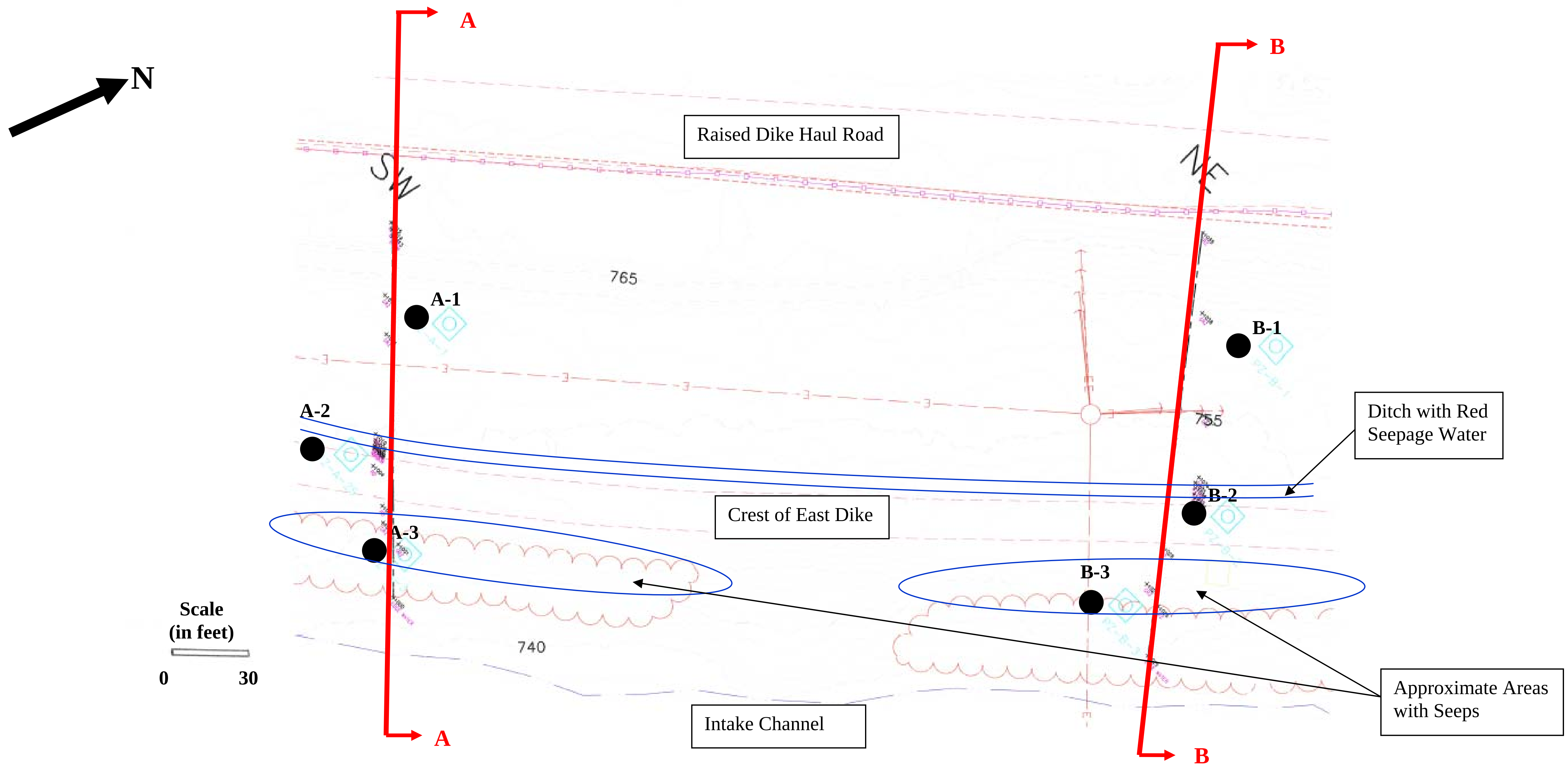


Figure 3. Boring and Cross Section Location Plan (Plan provided by Jacobs on 12 May 2010)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

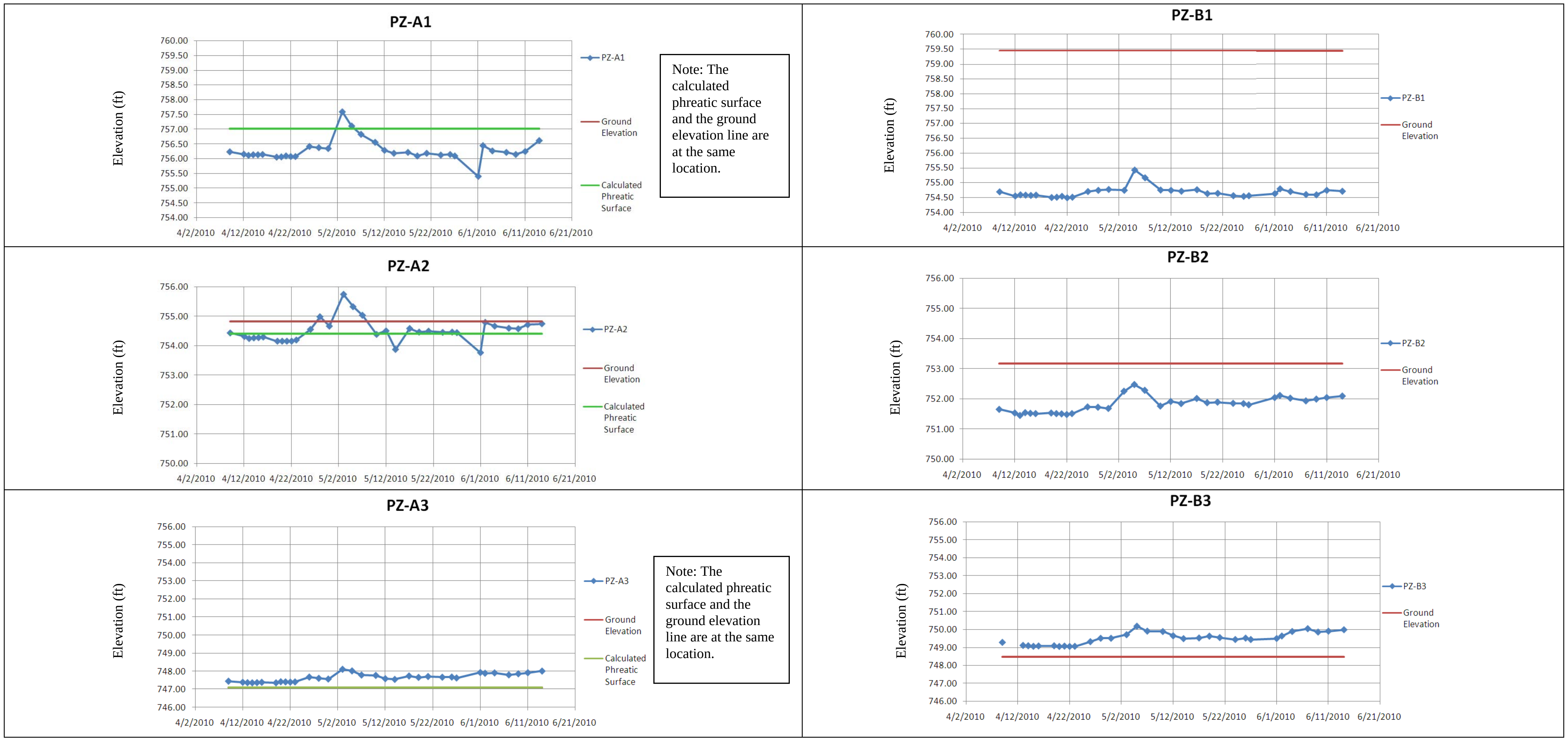
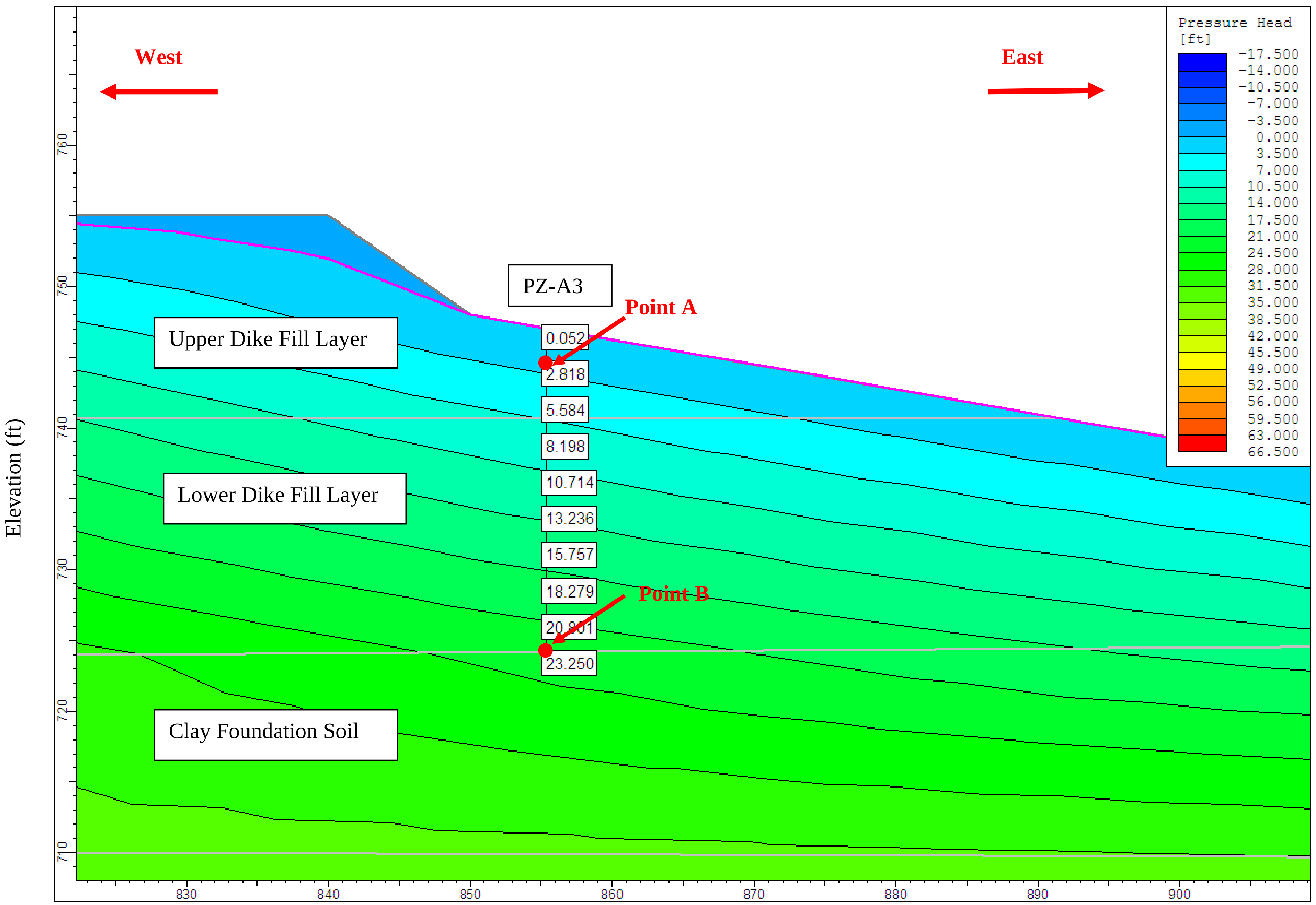


Figure 4. Summary of Piezometer Readings (to Date 14 June 2010)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105



Point A (Center of Upper Dike Fill Layer):

Pressure Head Based on Seepage Analysis: 2.8 ft
Theoretical Hydro-Static Pressure Head: 747-735.2=2.8 ft

Point B (Center Screen Location of Piezometer PZ-A3):

Pressure Head Based on Seepage Analysis: 23.25 ft
Theoretical Hydro-Static Pressure Head: 747-724=23 ft
Piezometer A-3 Water Lever should be 23.25-23=0.25 ft higher than the ground surface. This indicates that Point B is slightly pressurized.

Figure 5. Pressure Head Contour Lines (Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

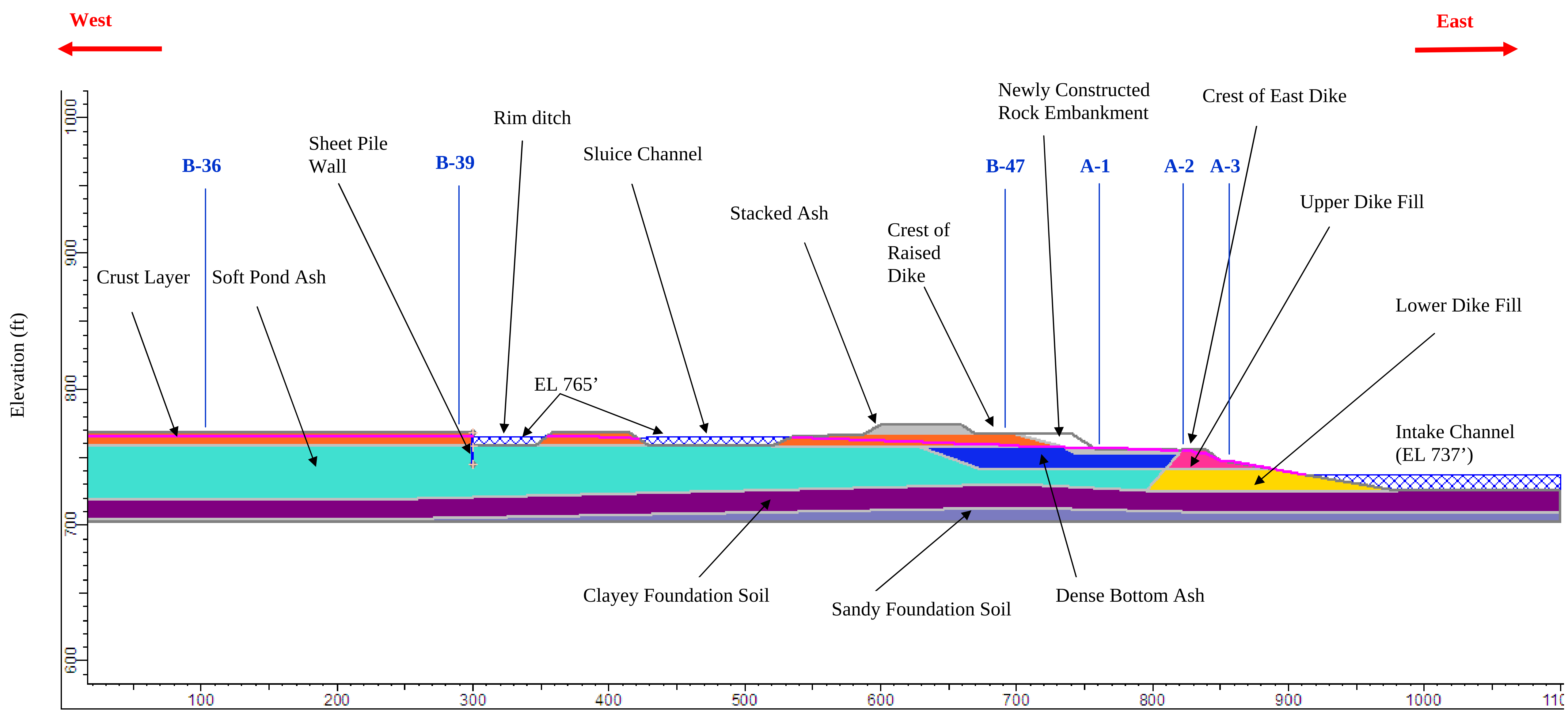


Figure 6. Surface Geometry and Subsurface Stratigraphy (Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

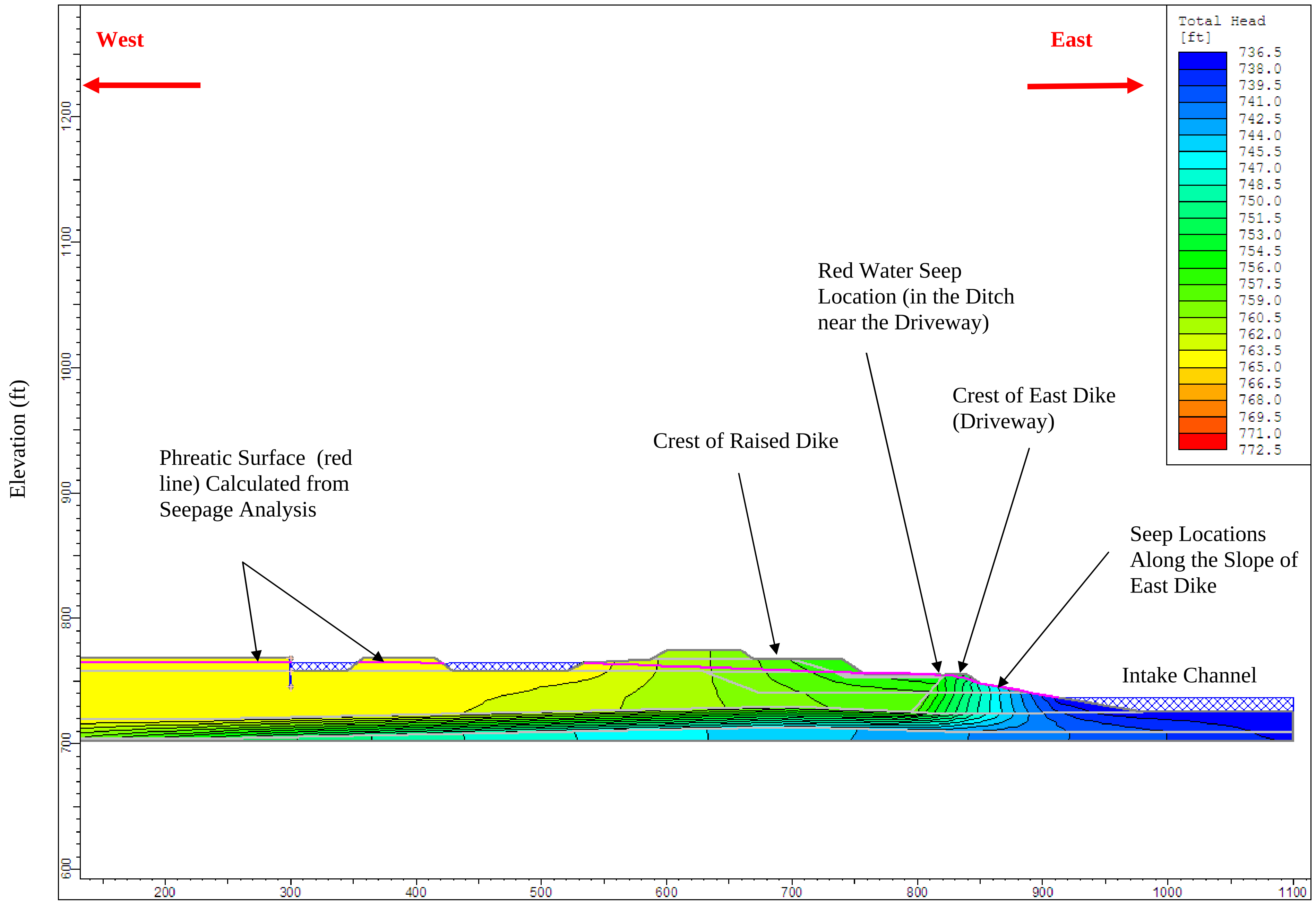


Figure 7. Results of Seepage Analysis with Total Head Contour Lines

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

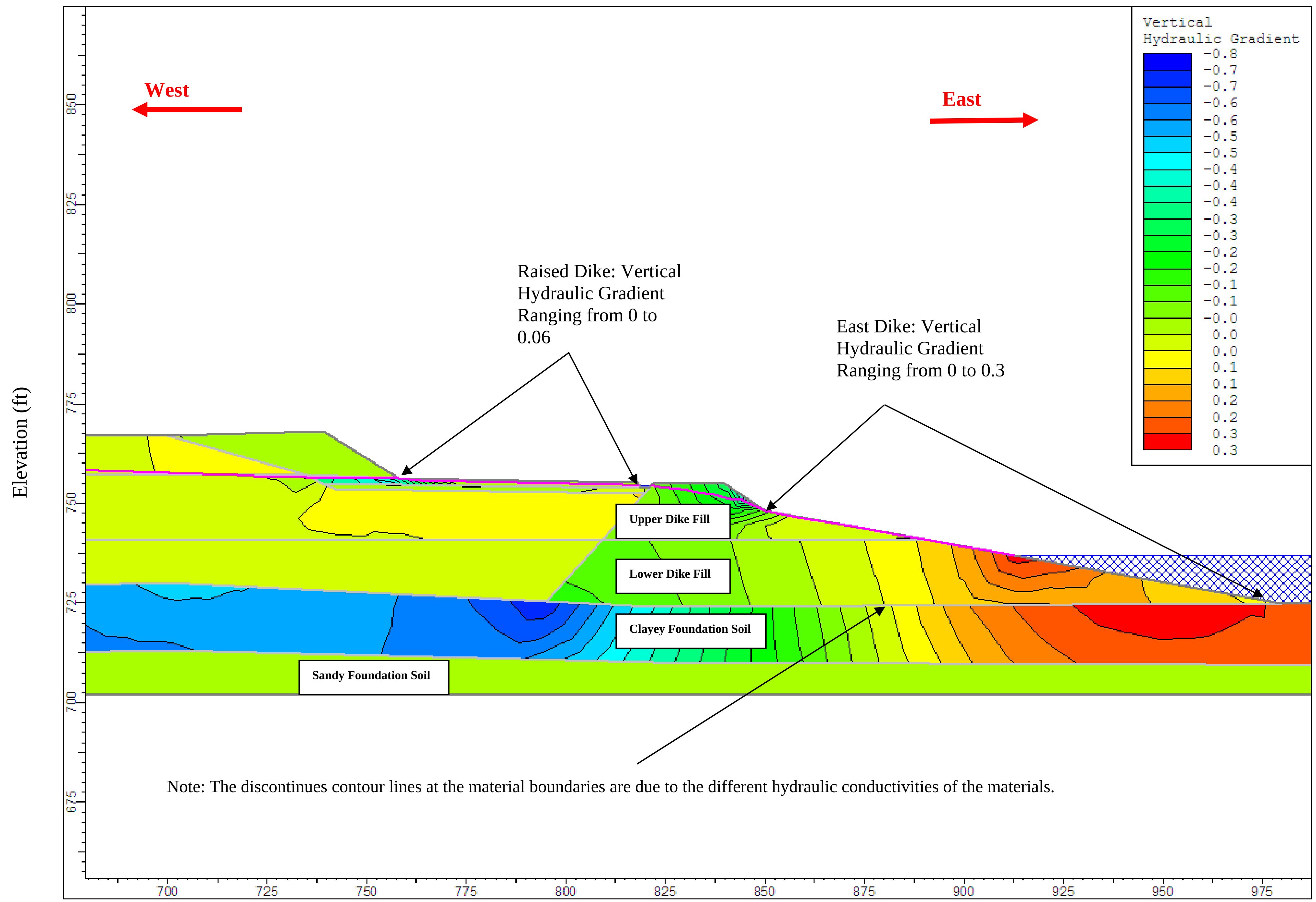


Figure 8. Results of Seepage Analysis with Vertical Hydraulic Gradient Contour Lines (Cross Section A-A)

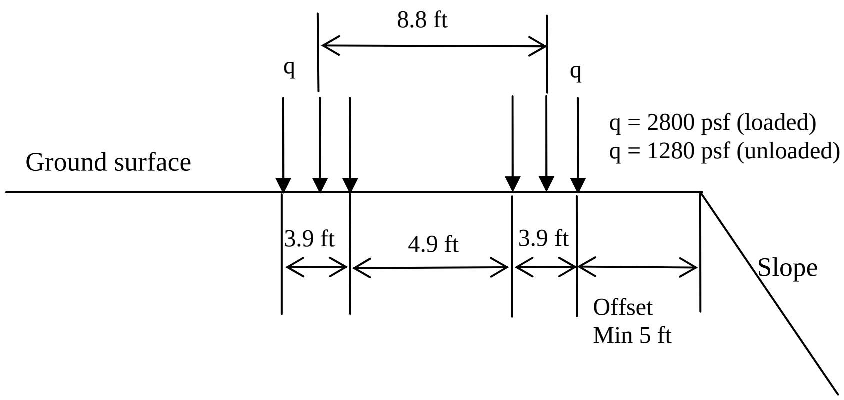


Figure 9. Truck Load Configuration

Notes:

1. Truck loading is calculated based on Caterpillar 740 truck.

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

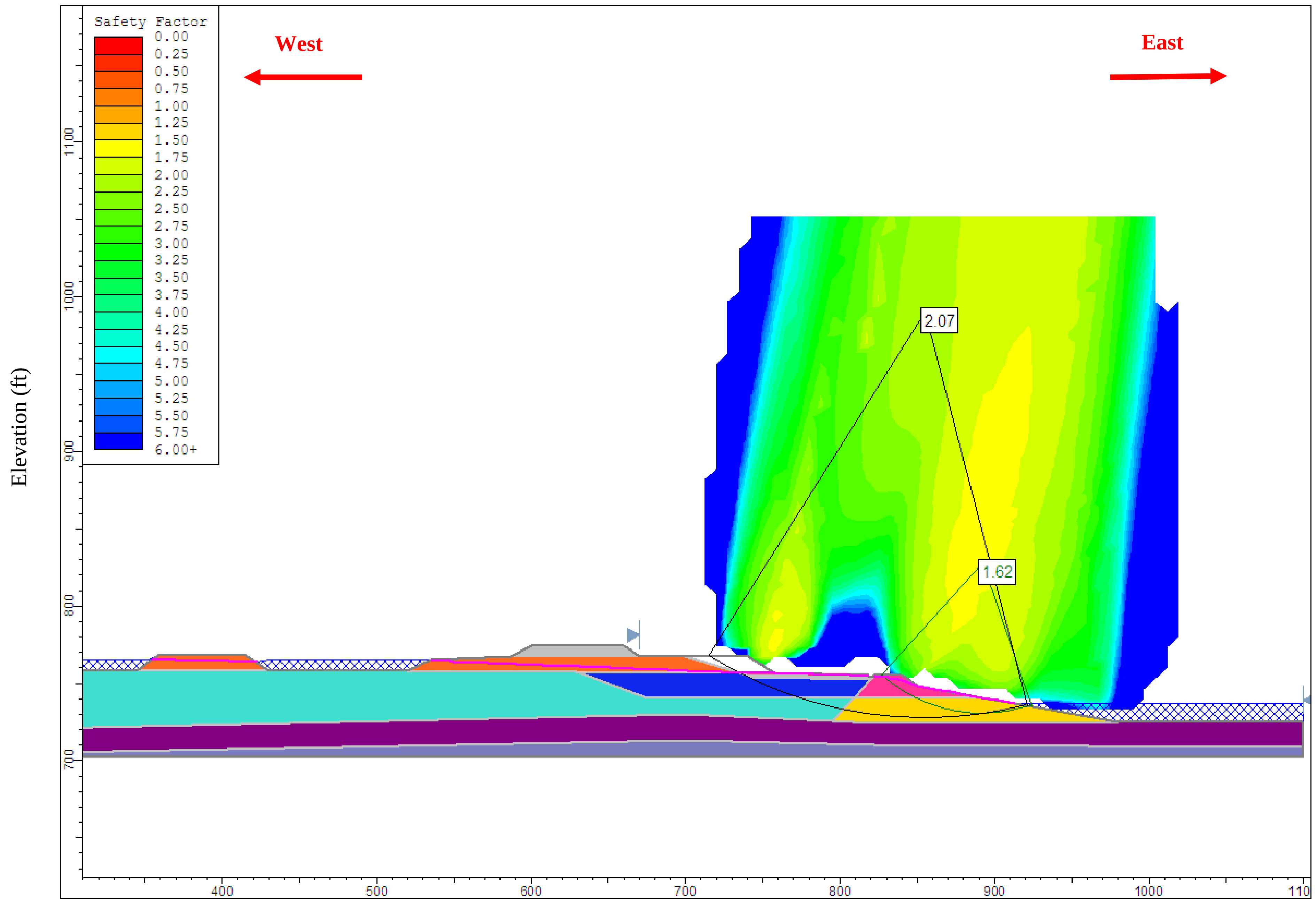


Figure 10. Results of Stability Analysis (Circular-Type Critical Surface, Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

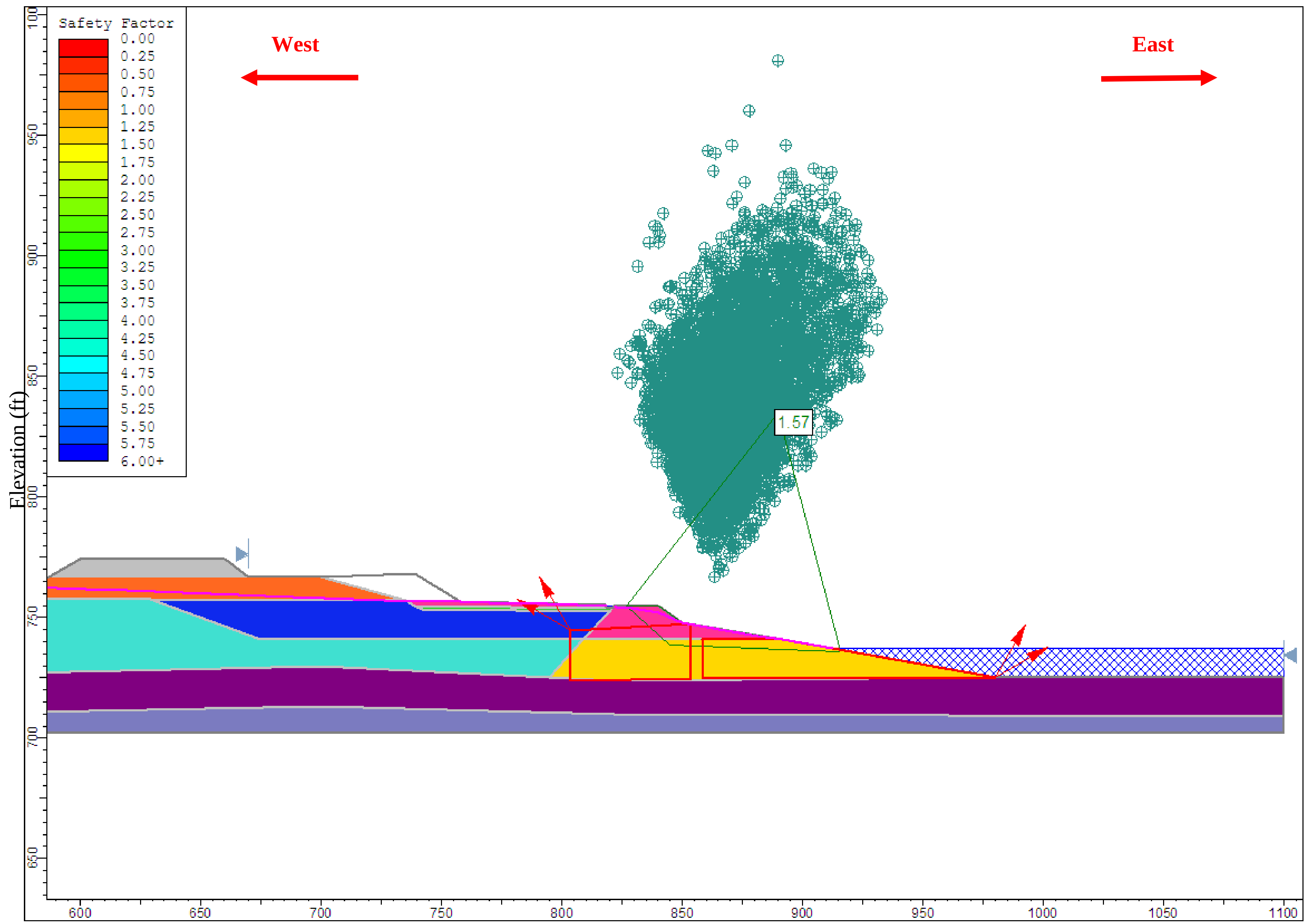


Figure11. Results of Stability Analysis (Block-Type Critical Surface, Near East Dike, Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

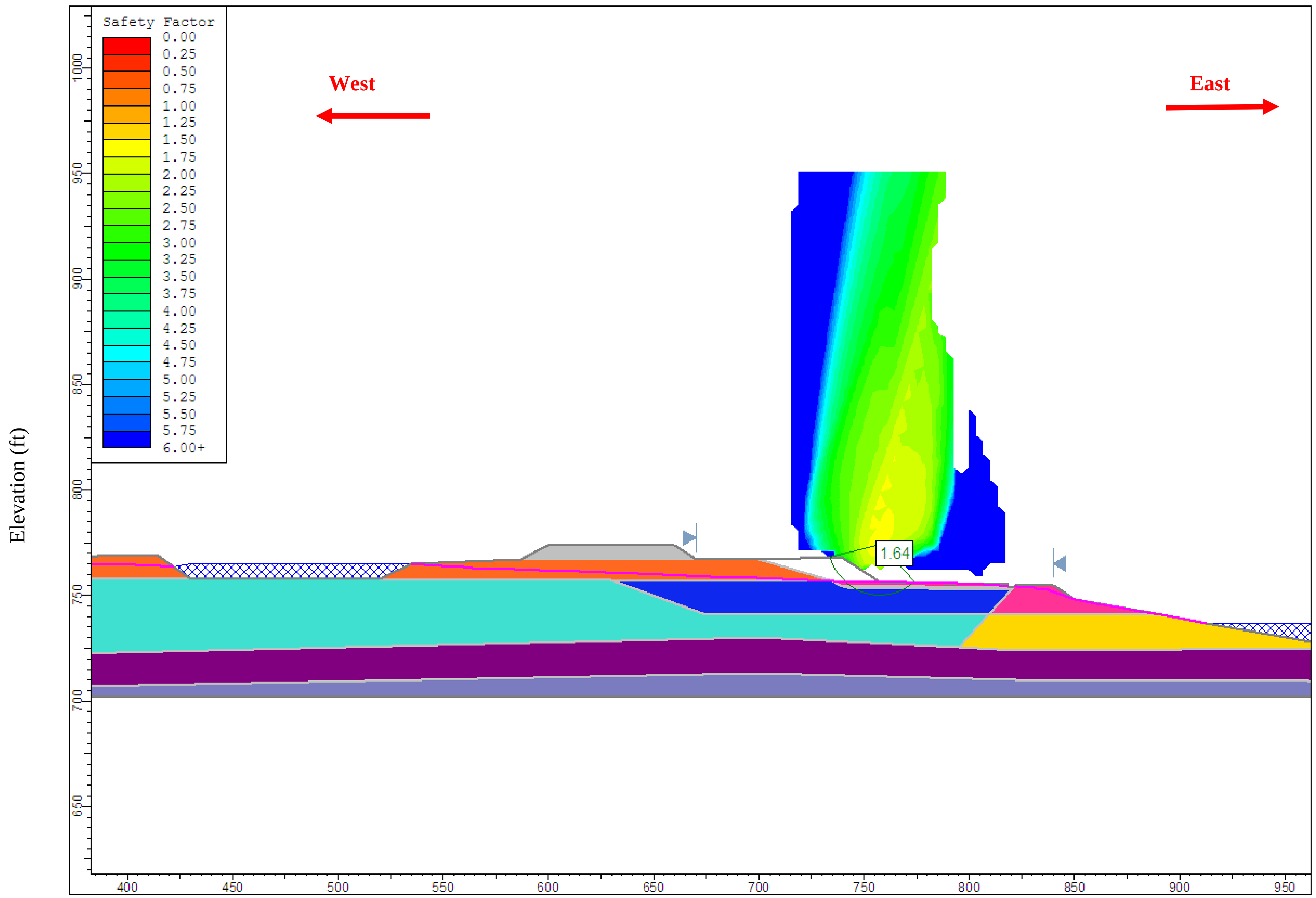


Figure 12. Results of Stability Analysis for Raised Dike Haul Road (Circular Type Critical Surface, No Traffic, Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

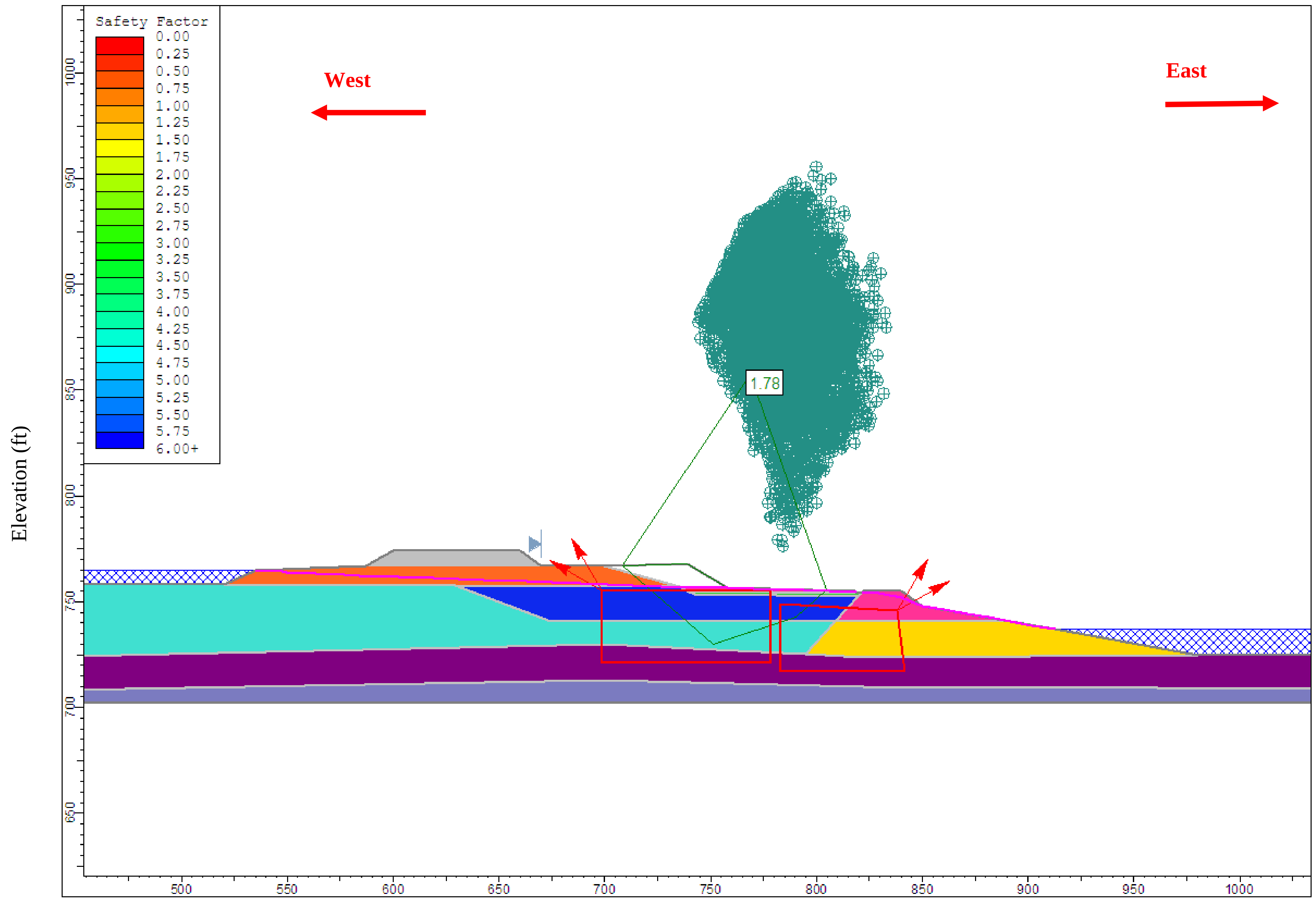


Figure 13. Results of Stability Analysis for Raised Dike Haul Road (Block Type Critical Surface, No Traffic, Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

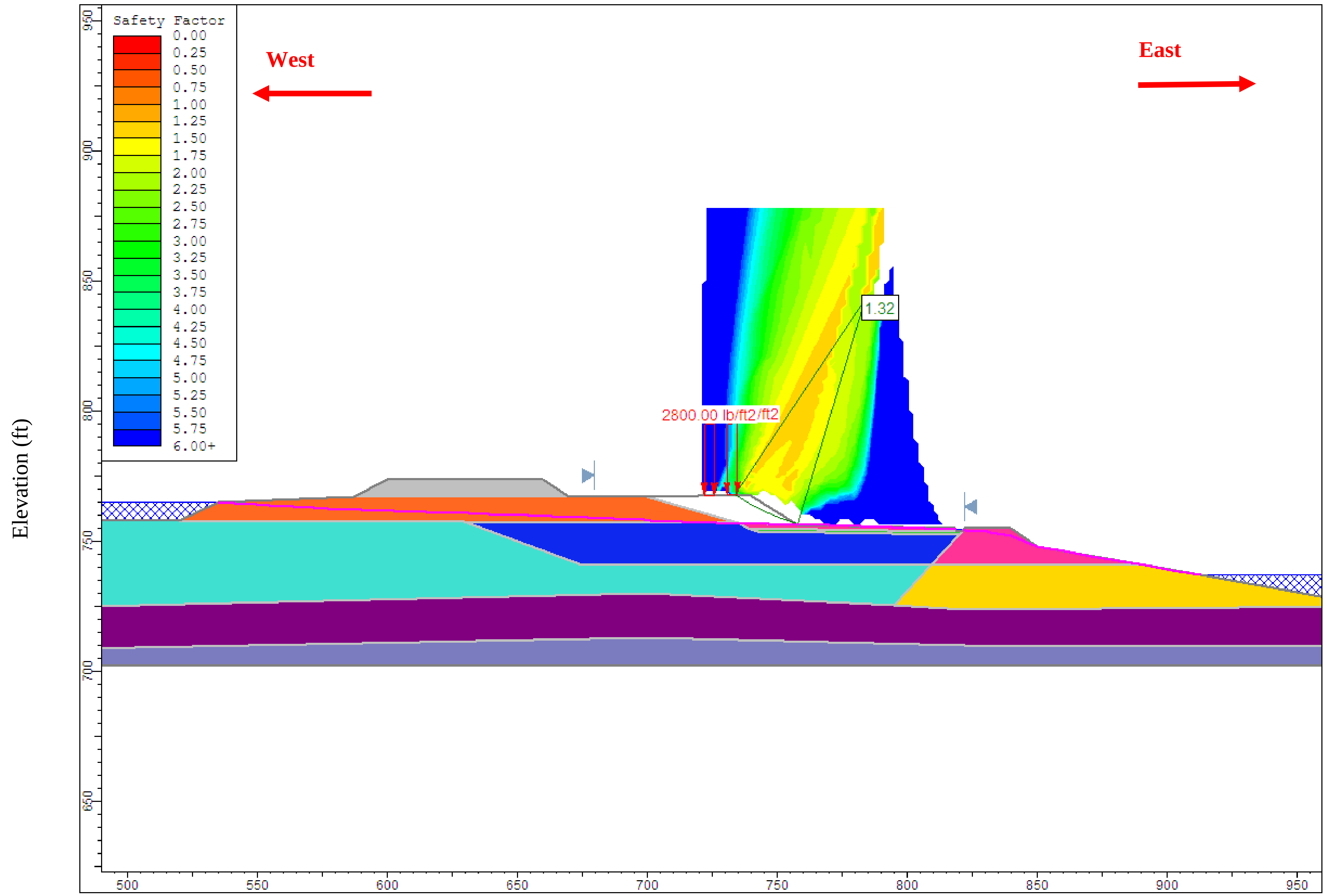


Figure 14. Results of Stability Analysis for Raised Dike Haul Road (Circular Type Critical Surface, Loaded Truck, Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

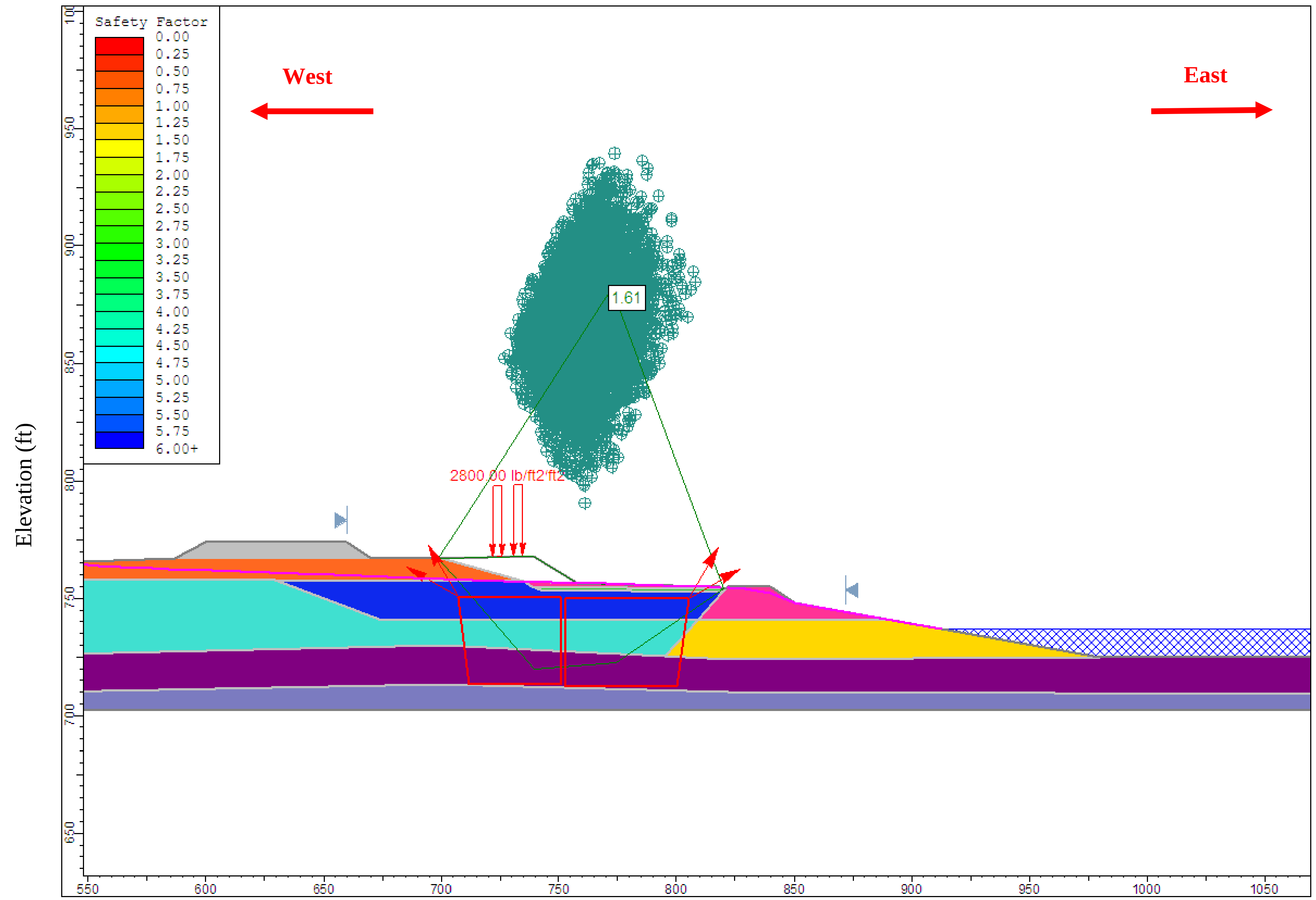


Figure 15. Results of Stability Analysis for Raised Dike Haul Road (Block Type Critical Surface, Loaded Truck, Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

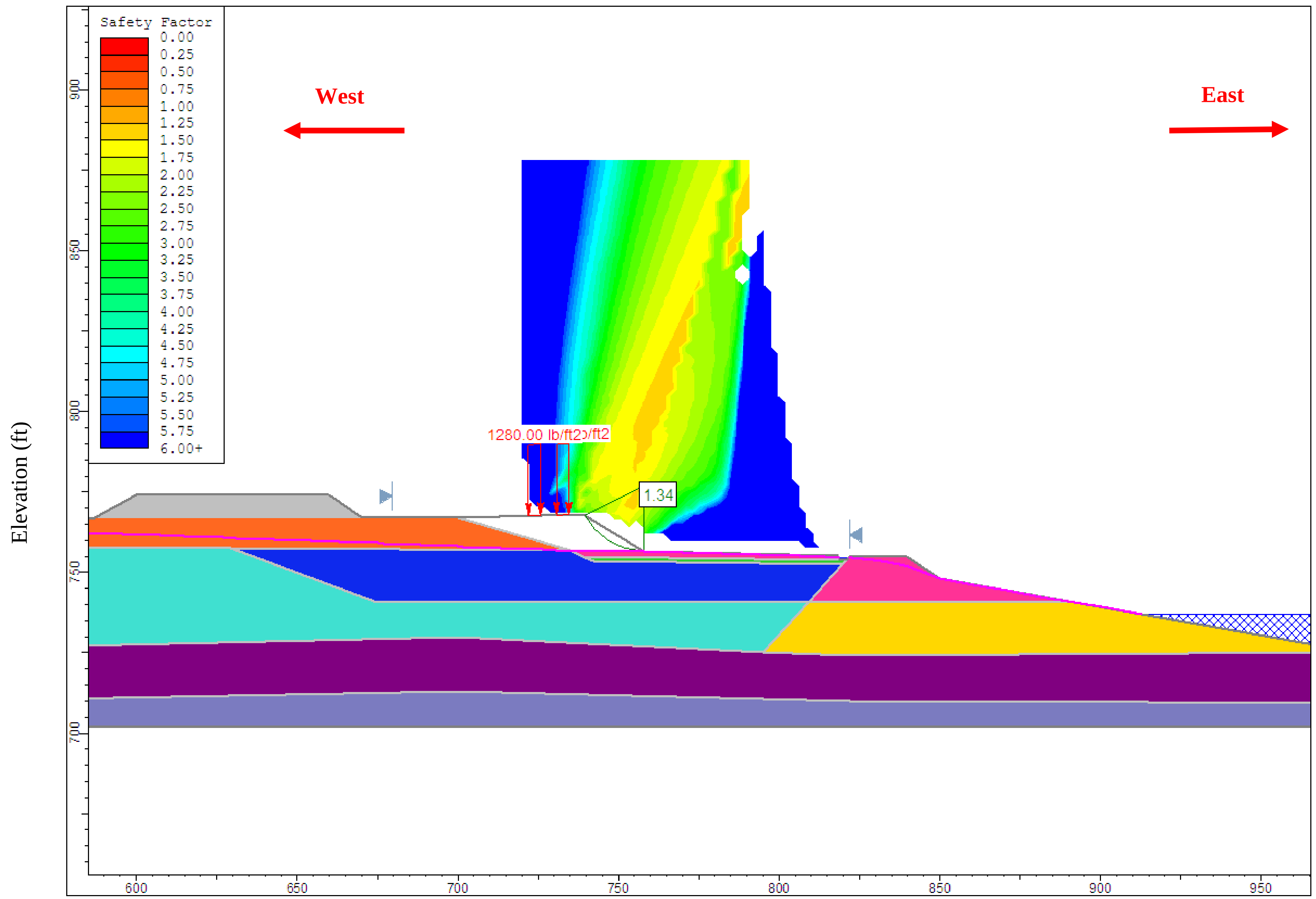


Figure 16. Results of Stability Analysis for Raised Dike Haul Road (Circular Type Critical Surface, Unloaded Truck, Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

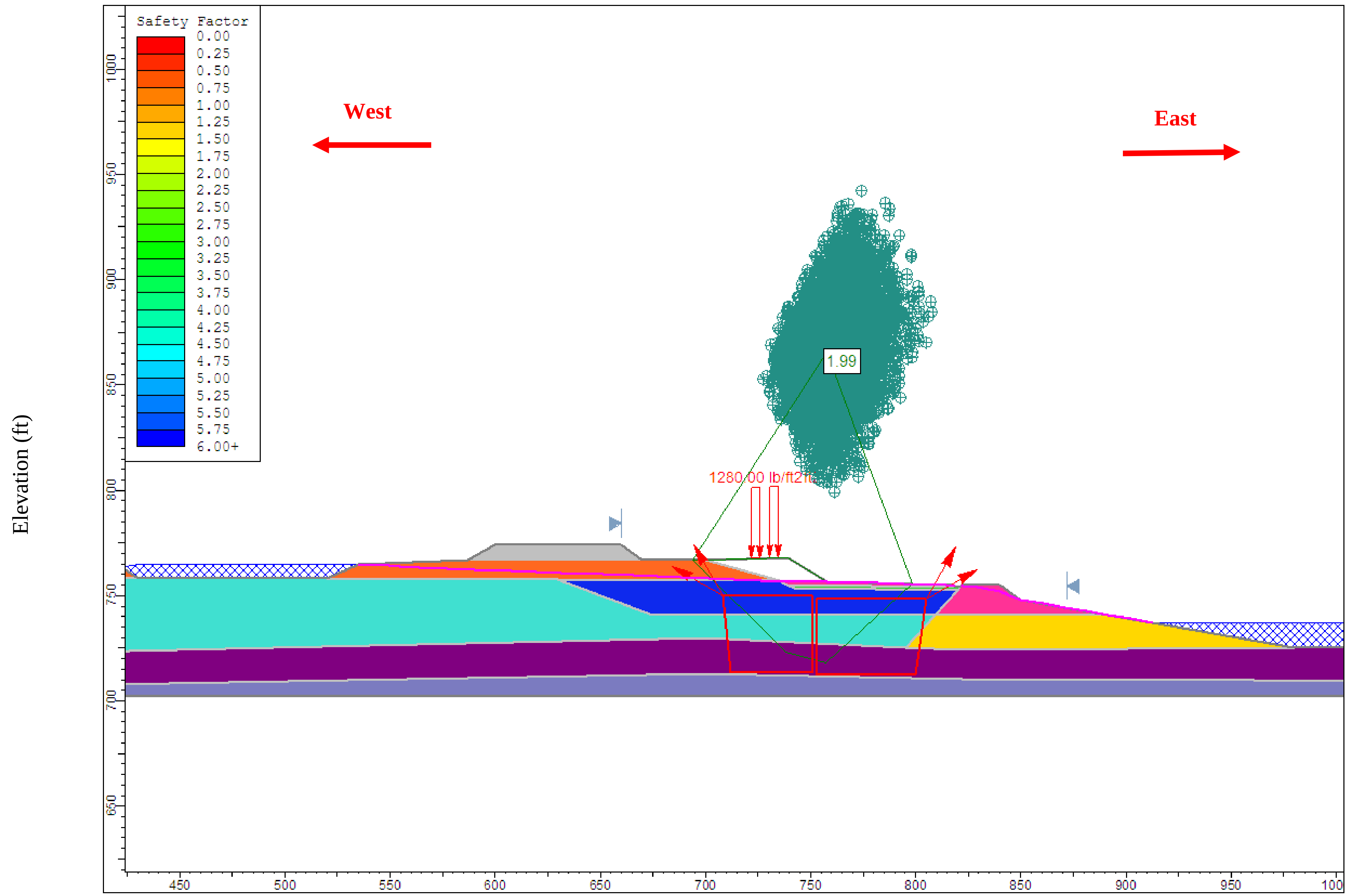


Figure 17. Results of Stability Analysis for Raised Dike Haul Road (Block Type Critical Surface, Unloaded Truck, Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

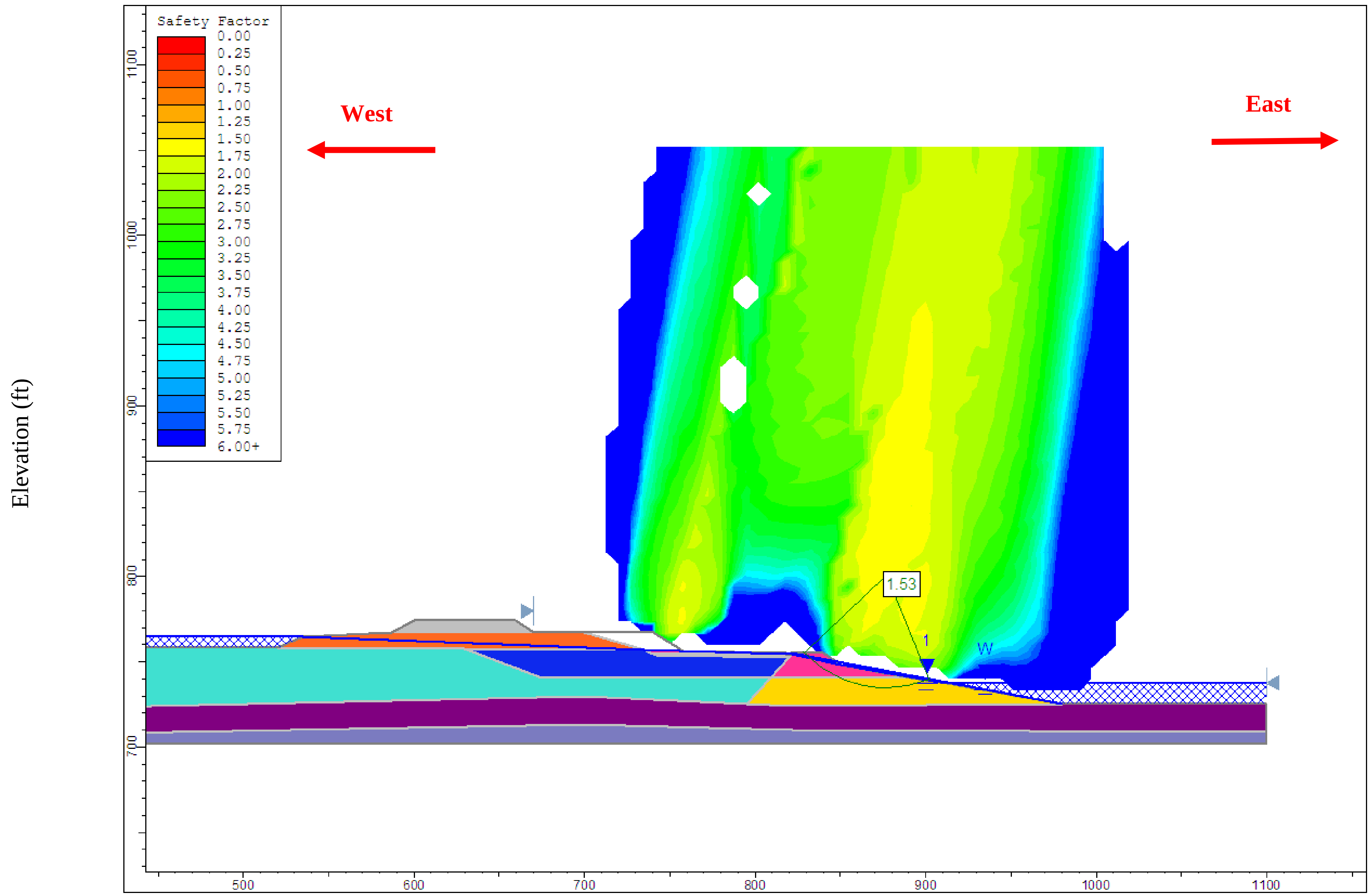


Figure 18. Results of Stability Analysis for East Dike (Circular Type Critical Surface, Lower Dike Fill Water Pressure 0.5 ft above Ground Surface, Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

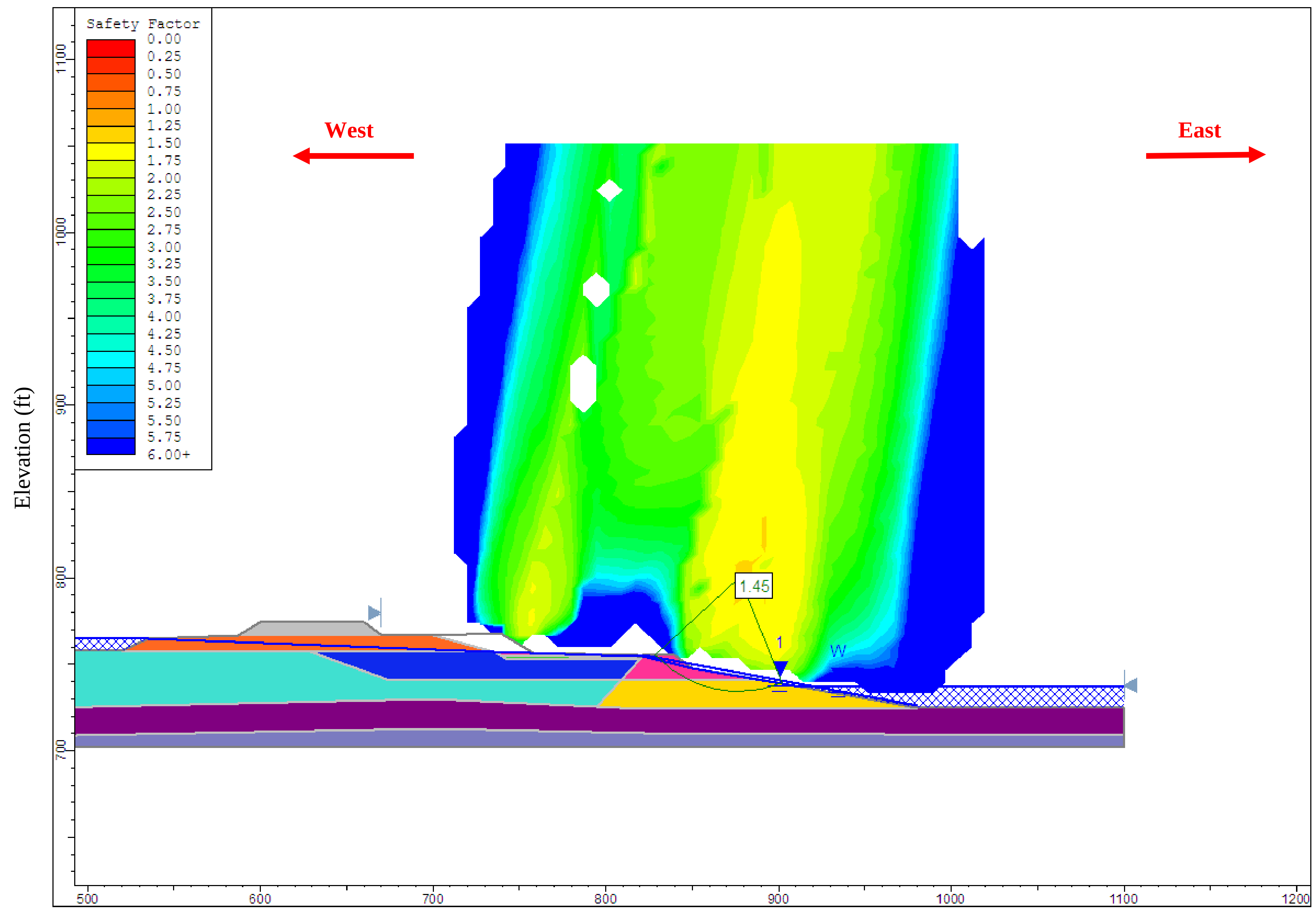


Figure 19. Results of Stability Analysis for East Dike (Circular Type Critical Surface, Lower Dike Fill Water Pressure 1 ft above Ground Surface, Cross Section A-A)

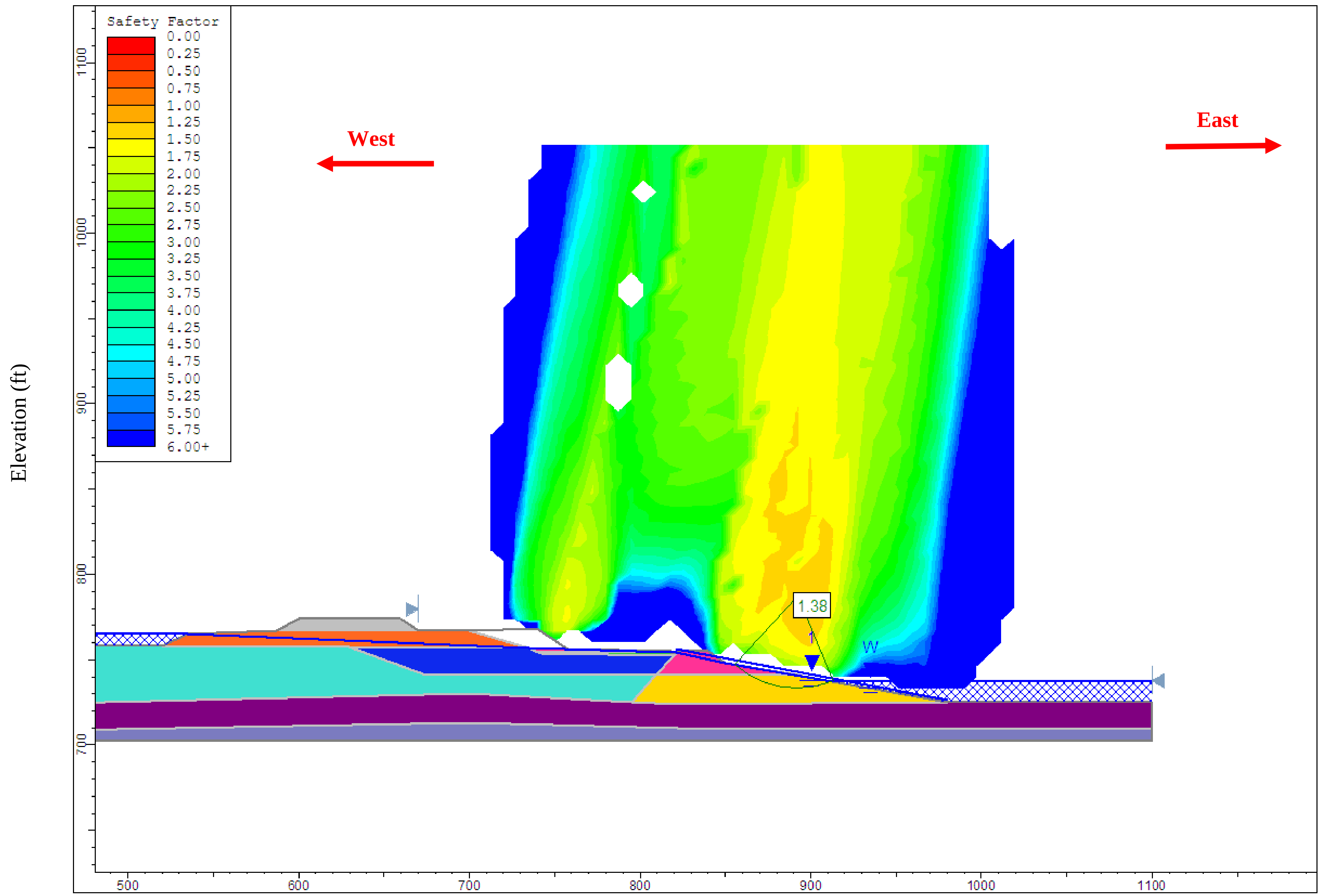


Figure 20. Results of Stability Analysis for East Dike (Circular Type Critical Surface, Lower Dike Fill Water Pressure 1.5 ft above Ground Surface, Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

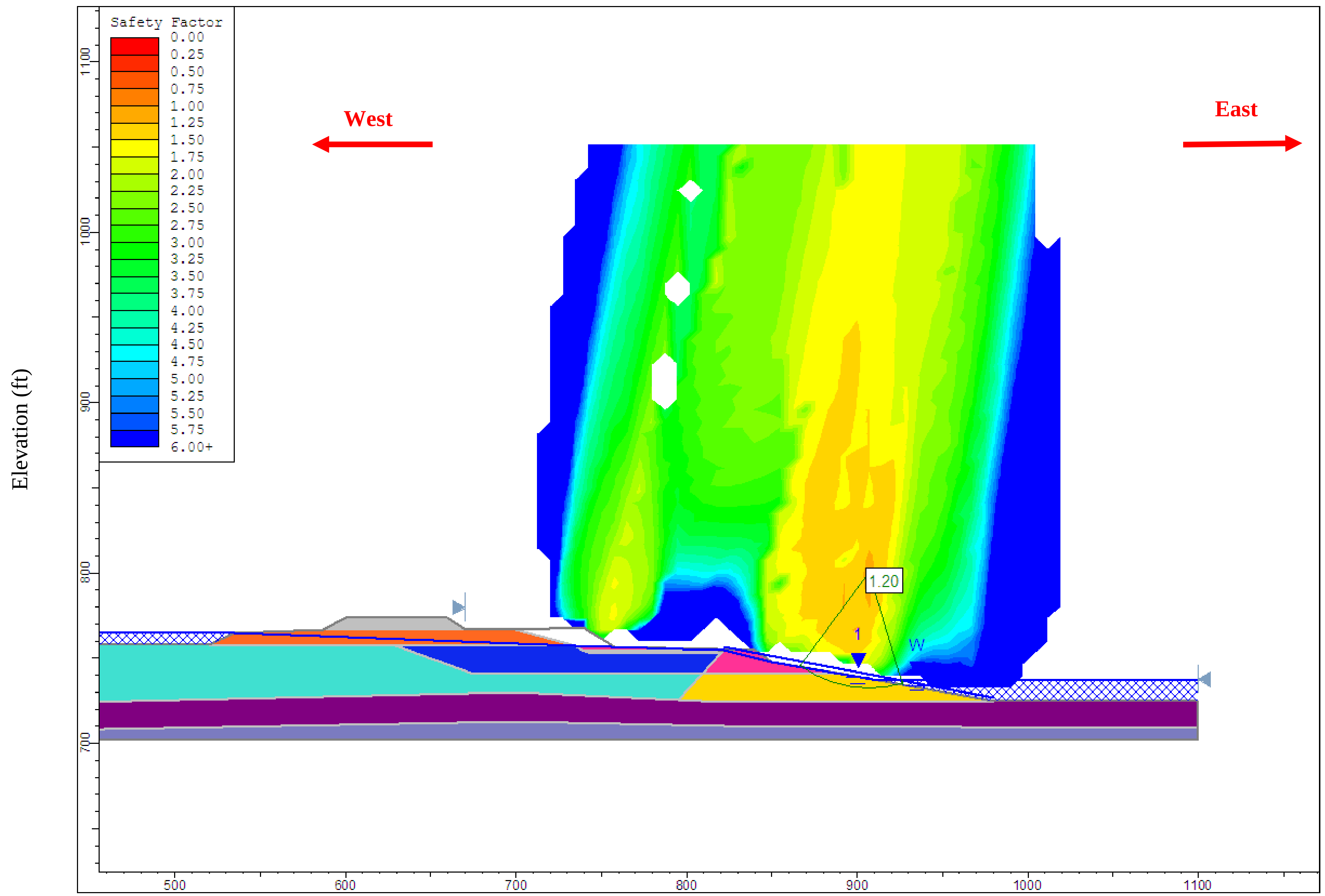


Figure 21. Results of Stability Analysis for East Dike (Circular Type Critical Surface, Lower Dike Fill Water Pressure 2 ft above Ground Surface, Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

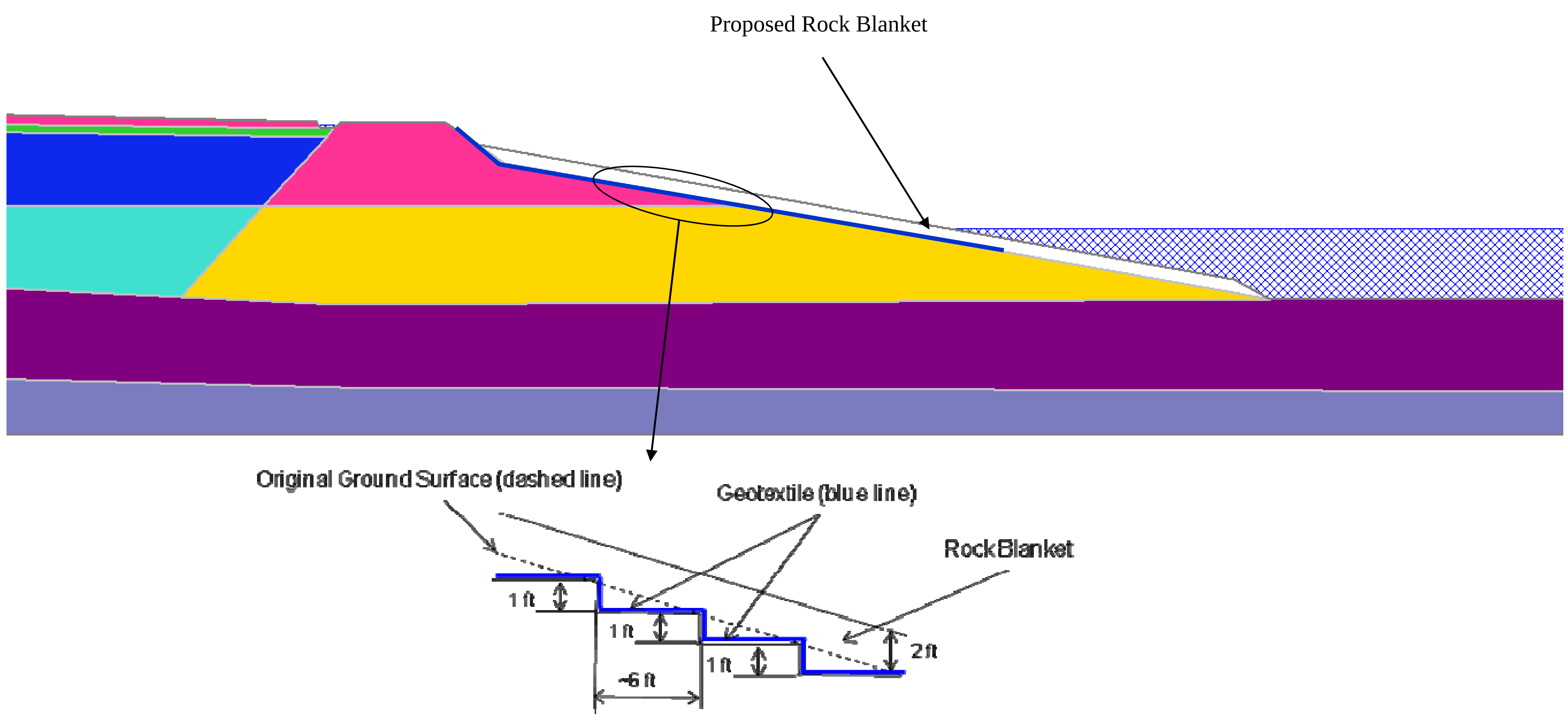


Figure 22. Conceptual Rock Blanket Design for East Dike

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

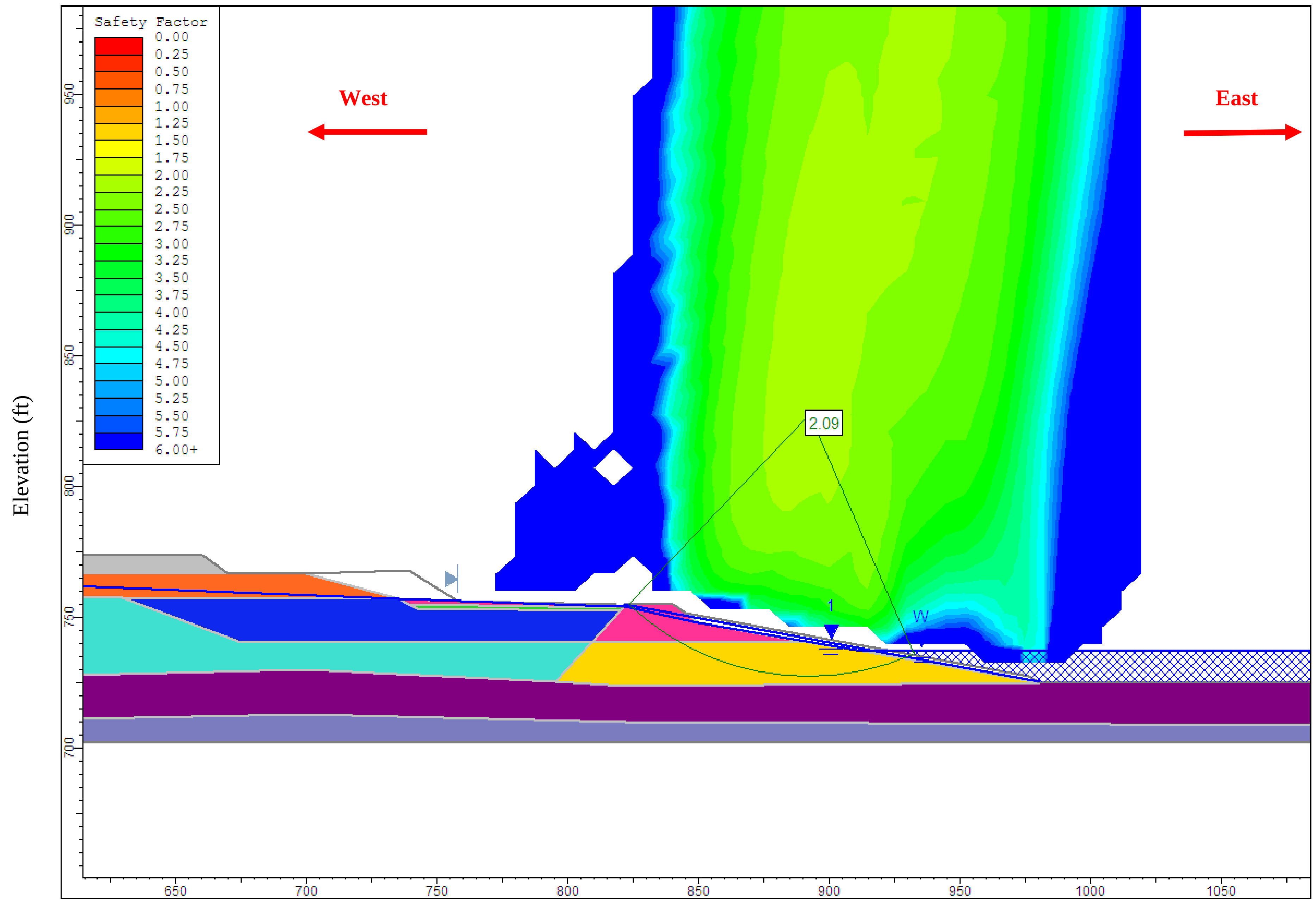


Figure 23. Results of Stability Analysis (Based on Conceptual Rock Blanket Design, Lower Dike Fill Water Pressure 0.5 ft above Ground Surface Cross Section A-A)

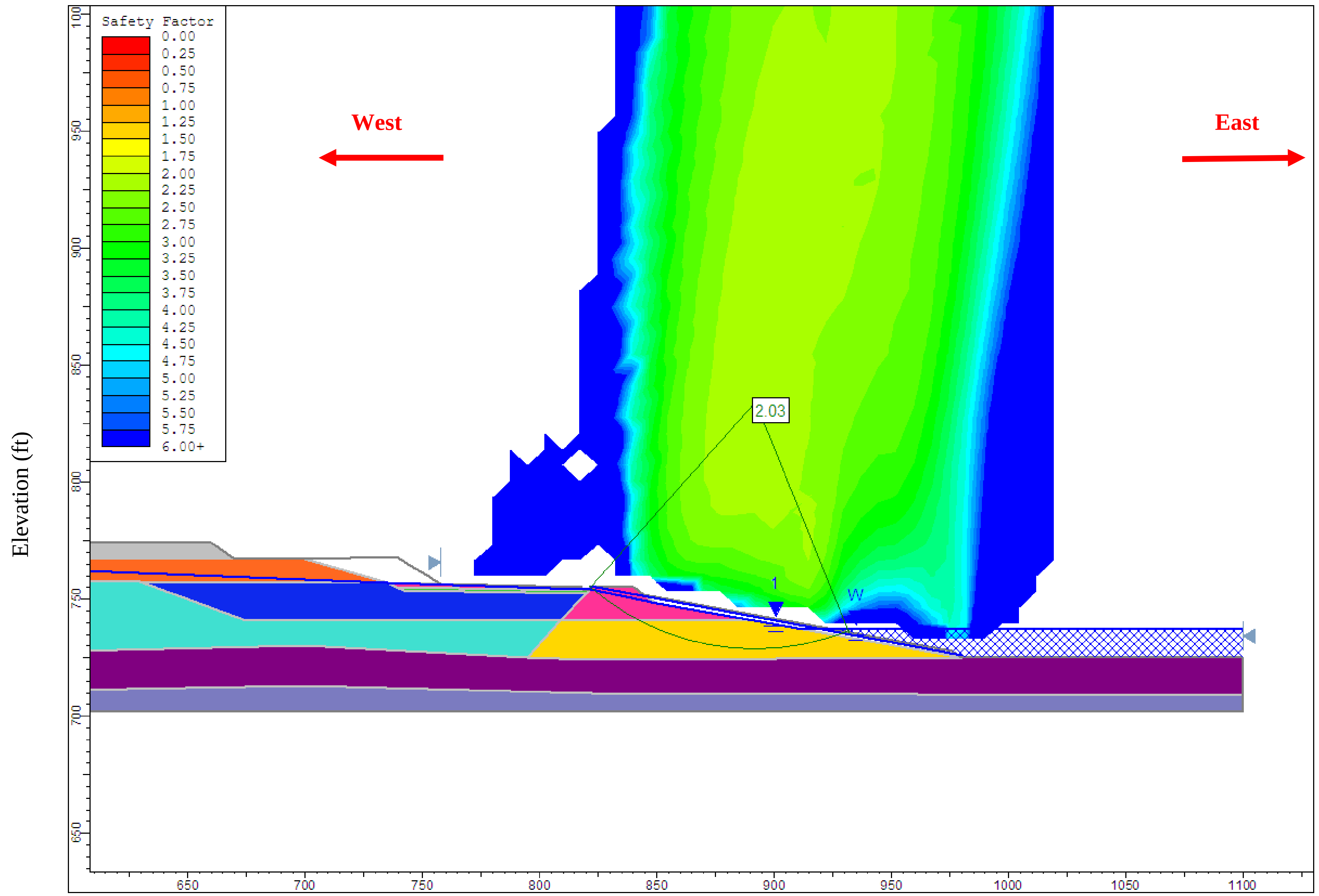


Figure 24. Results of Stability Analysis (Based on Conceptual Rock Blanket Design, Lower Dike Fill Water Pressure 1 ft above Ground Surface Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

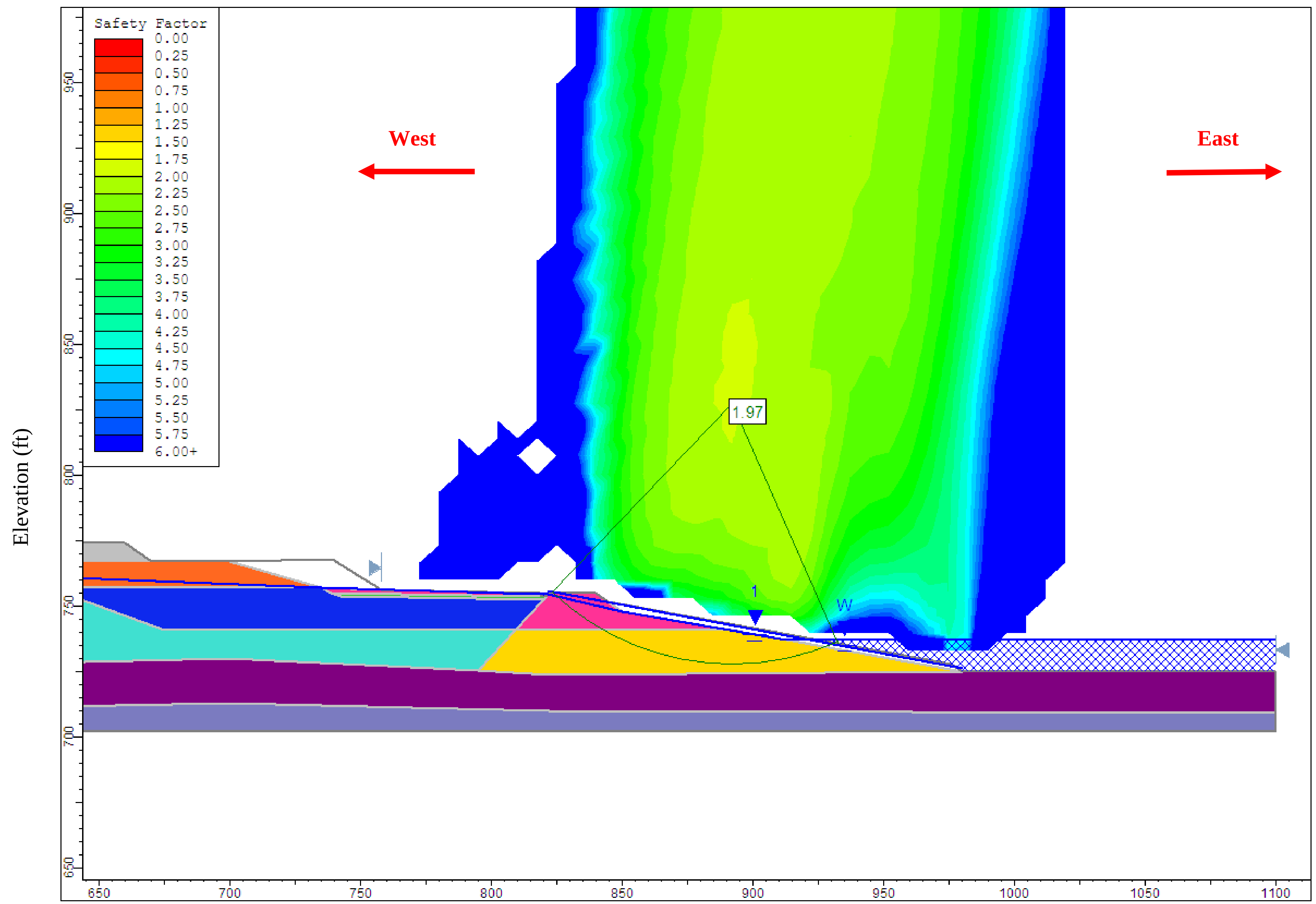


Figure 25. Results of Stability Analysis (Based on Conceptual Rock Blanket Design, Lower Dike Fill Water Pressure 1.5 ft above Ground Surface Cross Section A-A)

Written by: J. Wang **Date:** 6/30/10 **Reviewed by:** J. Simons/R. Bachus **Date:** 6/30/10

Client: TVA **Project:** Dredge Cells Recovery **Project/ Proposal No.:** GR4327 **Task No.:** 105

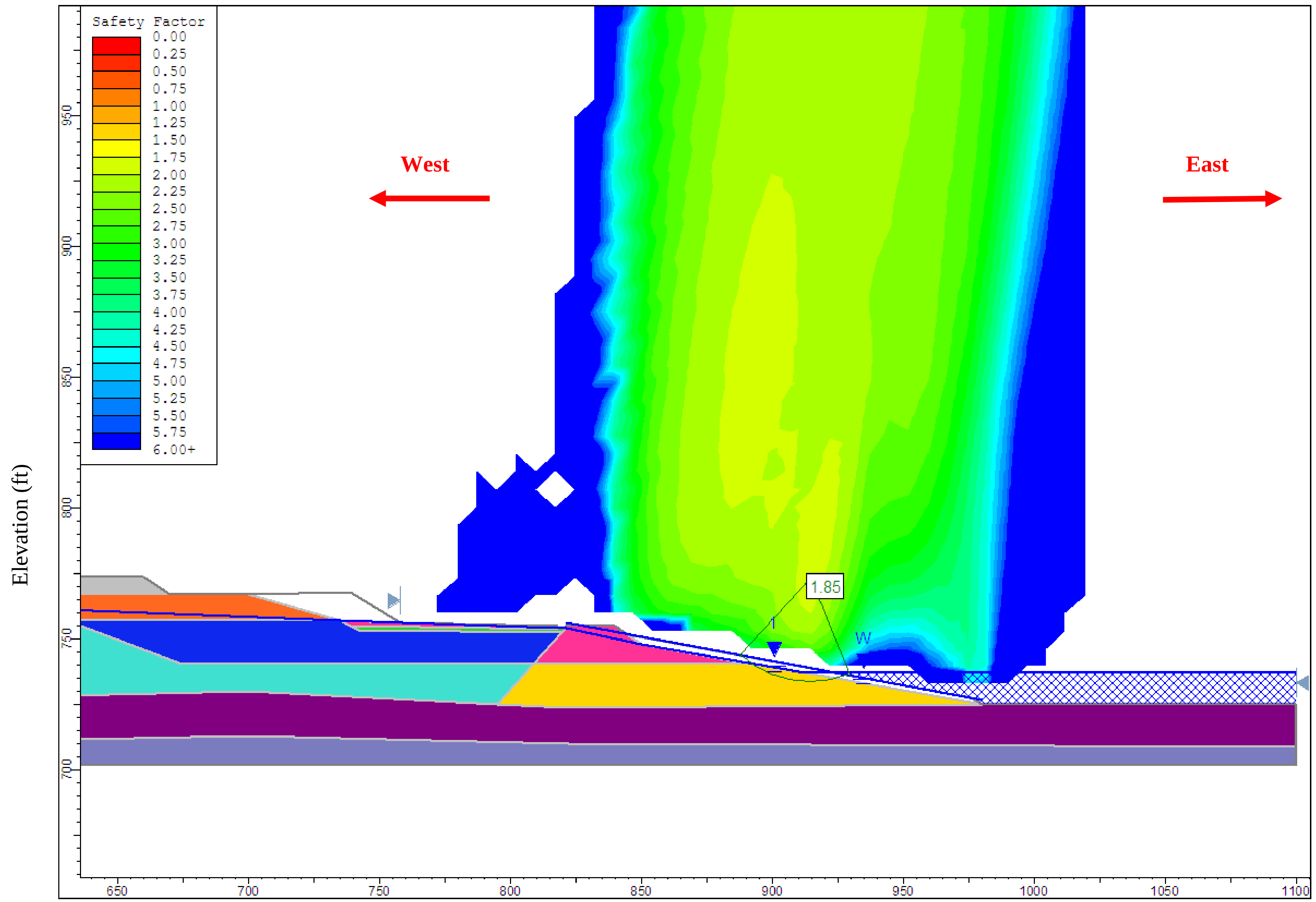


Figure 26. Results of Stability Analysis (Based on Conceptual Rock Blanket Design, Lower Dike Fill Water Pressure 2 ft above Ground Surface Cross Section A-A)

APPENDIX A – BORING LOGS

SOIL CLASSIFICATION AND REMARKS

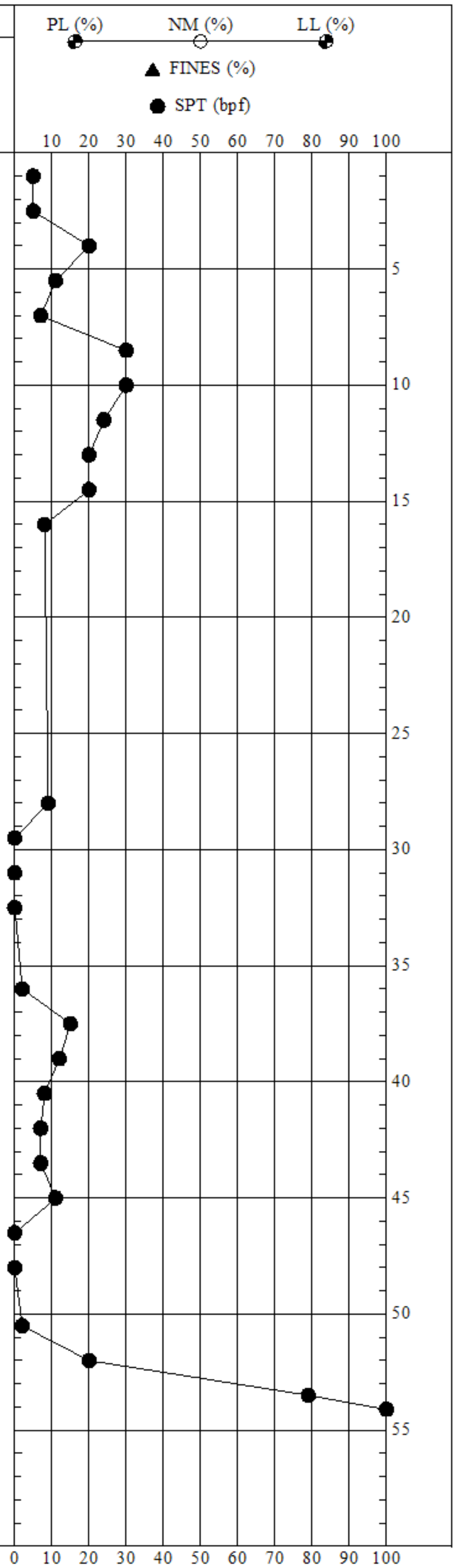
SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS
0	TOPSOIL WITH ROOTS AND GRASS
	FIRM, RED TO REDDISH BROWN, MOIST TO WET, SILTY CLAY WITH CHERT, ROOTS AND WOOD FRAGMENTS - FILL
	FIRM, WET, GRAY, GRAVEL - FILL NOTE: A THIN LAYER OF BOTTOM ASH AT BOTTOM OF SPT-4
	LOOSE TO VERY FIRM, BLACK, WET, SILTY SAND (BOTTOM ASH) WITH TRACE SILT - FILL
15	LOOSE, BLACK, WET, BOTTOM ASH WITH TRACES OF SILT - FILL
	STIFF TO VERY SOFT, WET, BLACK, SILT (FLY ASH), WITH TRACE BROWN TO GRAY, SILTY CLAY - FILL
	VERY SOFT TO FIRM, GRAY, MOIST, SILTY CLAY WITH REDDISH-ORANGE MOTTLING AND IRON STAINING - ALLUVIUM
	VERY LOOSE TO FIRM, GRAY, WET, SILTY SAND - ALLUVIUM
	VERY HARD, GREENISH GRAY TO BLUISH BLACK, WET, WEATHERED SANDSTONE AND WEATHERED SHALE - RESIDUUM
54.1	BORING TERMINATED AT 54.1'

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60
Elev (ft): 757.0, 752.0, 747.0, 742.0, 737.0, 732.0, 727.0, 722.0, 717.0, 712.0, 707.0, 702.0, 697.0

SAMPLES

IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
SPT-1	2-2-3
SPT-2	1-2-3
SPT-3	3-9-11
SPT-4	5-6-5
SPT-5	1-2-5
SPT-6	13-14-16
SPT-7	9-17-13
SPT-8	5-11-13
SPT-9	11-10-10
SPT-10	4-9-11
SPT-11	3-4-4
SPT-12	2-4-5
SPT-13	WOH
SPT-14	WOH
SPT-15	WOH
UD-1	2.0-2.0
SPT-16	0-0-2
SPT-17	4-6-9
SPT-18	3-5-7
SPT-19	2-3-5
SPT-20	3-3-4
SPT-21	2-3-4
SPT-22	4-5-6
SPT-23	WOH
SPT-24	WOH
SPT-25	WOH-1-1
SPT-26	2-3-17
SPT-27	61-25-54
SPT-28	100/0.1



SOIL 3043101017_01_ALT.GPJ LAW_GIBB.GDT 4/29/10

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State
Logged By: N.J.S.
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Seep Area

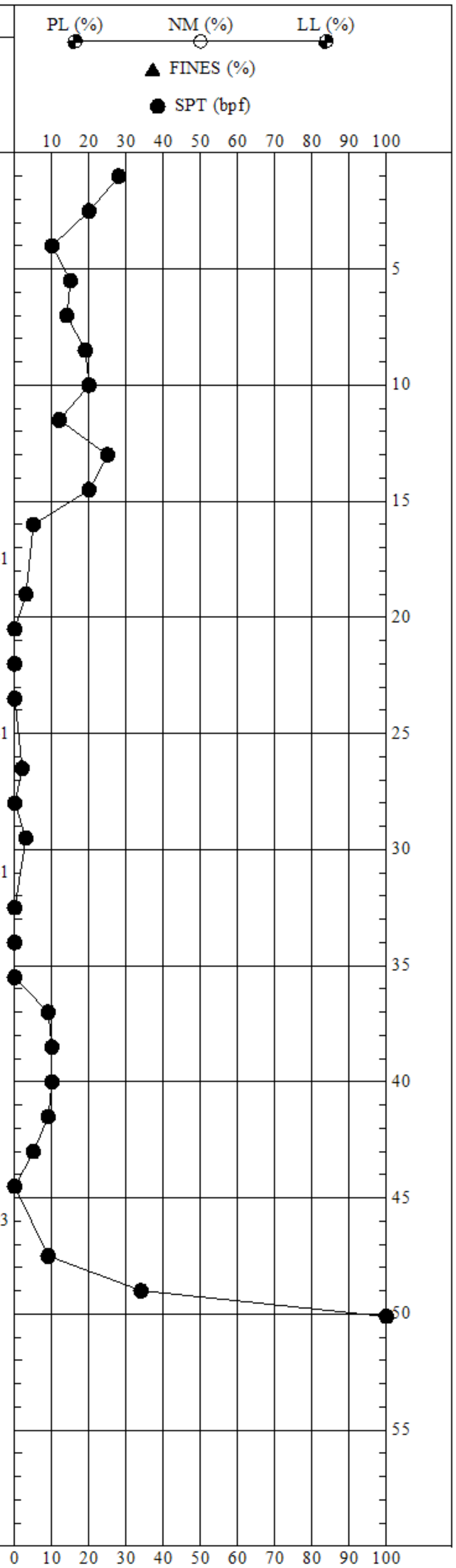
DRILLED: March 31, 2010 **BORING NO.:** A-1

PROJ. NO.: 3043-10-1017 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)
	SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.		
0	FIRM TO VERY STIFF, BROWN, MOIST, SILTY CLAY - FILL		755.0
	FIRM, MOIST, SILTY SAND (BOTTOM ASH) - FILL		
	STIFF TO FIRM, GRAYISH BROWN, MOIST TO WET, SILTY CLAY WITH SHALE FRAGMENTS - FILL		
5			750.0
10			745.0
15	VERY SOFT TO FIRM, YELLOWISH BROWN, WET, SILTY CLAY WITH WEATHERED SHALE FRAGMENTS - FILL		740.0
20			735.0
25			730.0
30	VERY SOFT TO STIFF, GREENISH GRAY, WET, SILTY CLAY / CLAYEY SILT - ALLUVIUM		725.0
35			720.0
40			715.0
45	VERY LOOSE TO LOOSE, WET, GREENISH, SAND - ALLUVIUM		710.0
	VERY HARD, DARK GRAY, DRY TO MOIST, HIGHLY WEATHERED SANDSTONE - RESIDUUM		
50	BORING TERMINATED AT 50.2'		705.0
55			700.0
60			695.0

SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
SPT-1		5-12-16
SPT-2		10-13-7
SPT-3		4-3-7
SPT-4		8-8-7
SPT-5		4-6-8
SPT-6		6-8-11
SPT-7		9-12-8
SPT-8		3-8-4
SPT-9		8-12-13
SPT-10		7-9-11
SPT-11		2-2-3
SPT-12		WOH-WOH-1
SPT-13		0-1-2
SPT-14		WOH
SPT-15		WOH
SPT-16		WOH
SPT-17		WOH-WOH-1
SPT-18		WOH-1-1
SPT-19		WOH
SPT-20		WOH-2-1
SPT-21		WOH-WOH-1
SPT-22		WOH
SPT-23		WOH
SPT-24		WOH
SPT-25		1-3-6
SPT-26		2-4-6
SPT-27		2-3-7
SPT-28		1-4-5
SPT-29		4-3-2
SPT-30		WOH
SPT-31		WOH-WOH-3
SPT-32		1-2-7
SPT-33		1-12-22
SPT-34		17-100/0.1



SOIL 3043101017_01_ALT.GPJ LAW_GIBB.GDT 4/29/10

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State
Logged By: J.C.M.
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Seep Area

DRILLED: March 29, 2010 **BORING NO.:** A-2

PROJ. NO.: 3043-10-1017 **PAGE** 1 **OF** 1

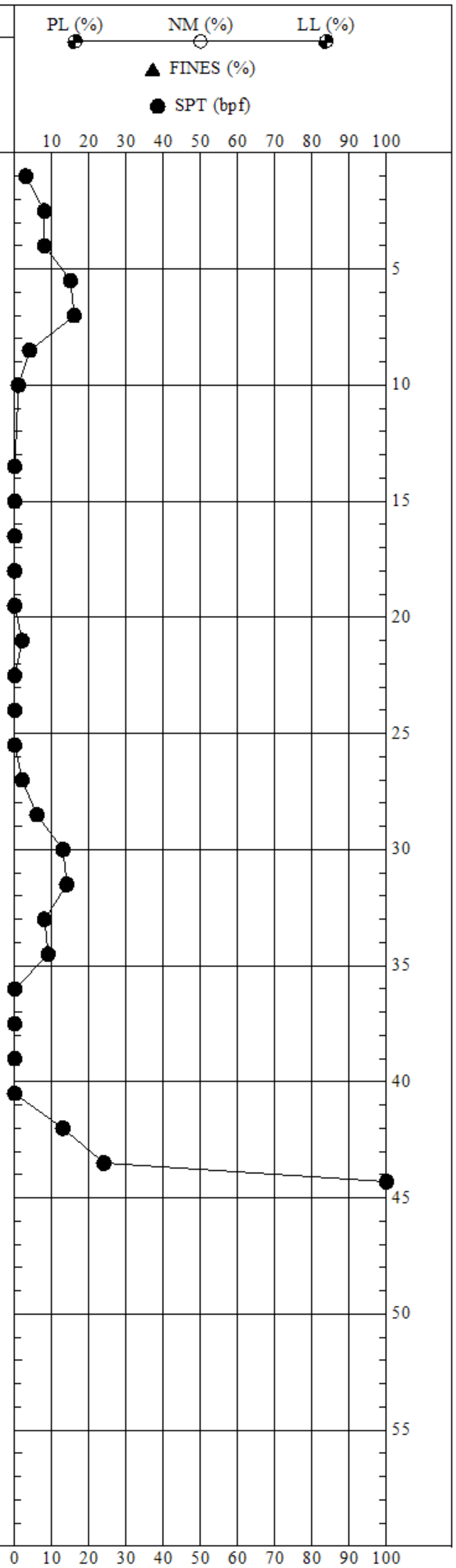
MACTEC

SOIL 3043101017_01_ALT.GPJ LAW GIBB.GDT 4/29/10

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	ELEV (ft)
0	SOFT TO STIFF, DARK GRAY, MOIST TO WET, SILTY CLAY / CLAYEY SILT WITH WEATHERED SHALE FRAGMENTS, WOOD, AND ROOTS - FILL	747.0
5		742.0
	VERY STIFF TO VERY SOFT, WET, BROWN, CLAYEY SILT TO SILTY CLAY WITH WEATHERED SHALE FRAGMENTS - FILL	
10		737.0
15		732.0
20		727.0
	VERY SOFT TO FIRM, DARK GRAY, MOIST TO WET, SILTY CLAY TO CLAYEY SILT WITH WEATHERED SHALE FRAGMENTS - ALLUVIUM	
25		722.0
30		717.0
35		712.0
	VERY LOOSE TO DENSE, DARK GRAY, WET, SILTY SAND WITH WEATHERED SHALE FRAGMENTS - ALLUVIUM NOTE: N-VALUE IN SPT-29 WAS INFLATED BECAUSE OF THE PRESENCE OF REFUSAL MATERIAL.	
40		707.0
	AUGER REFUSAL AT 44.35'	
45		702.0
50		697.0
55		692.0
60		687.0

SAMPLES

IDENT	N-COUNT (1st 6" 2nd 6" 3rd 6")
SPT-1	1-2-1
SPT-2	4-4-4
SPT-3	1-3-5
SPT-4	4-7-8
SPT-5	4-6-10
SPT-6	2-2-2
SPT-7	0-0-1
UD-1	0.6-2.0
SPT-8	WOH
SPT-9	WOH
SPT-10	WOH
SPT-11	WOH
SPT-12	WOH
SPT-13	0-1-1
SPT-14	WOH
SPT-15	WOH
SPT-16	WOH
SPT-17	0-0-2
SPT-18	1-2-4
SPT-19	2-5-8
SPT-20	2-5-9
SPT-21	2-3-5
SPT-22	3-4-5
SPT-23	WOH
SPT-24	WOH
SPT-25	WOH
SPT-26	WOH
SPT-27	0-0-13
SPT-28	4-8-16
SPT-29	100/0.3



REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State
Logged By: N.J.S.
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Seep Area

DRILLED: April 1, 2010 **BORING NO.:** A-3

PROJ. NO.: 3043-10-1017 **PAGE 1 OF 1**

MACTEC

SOIL CLASSIFICATION AND REMARKS

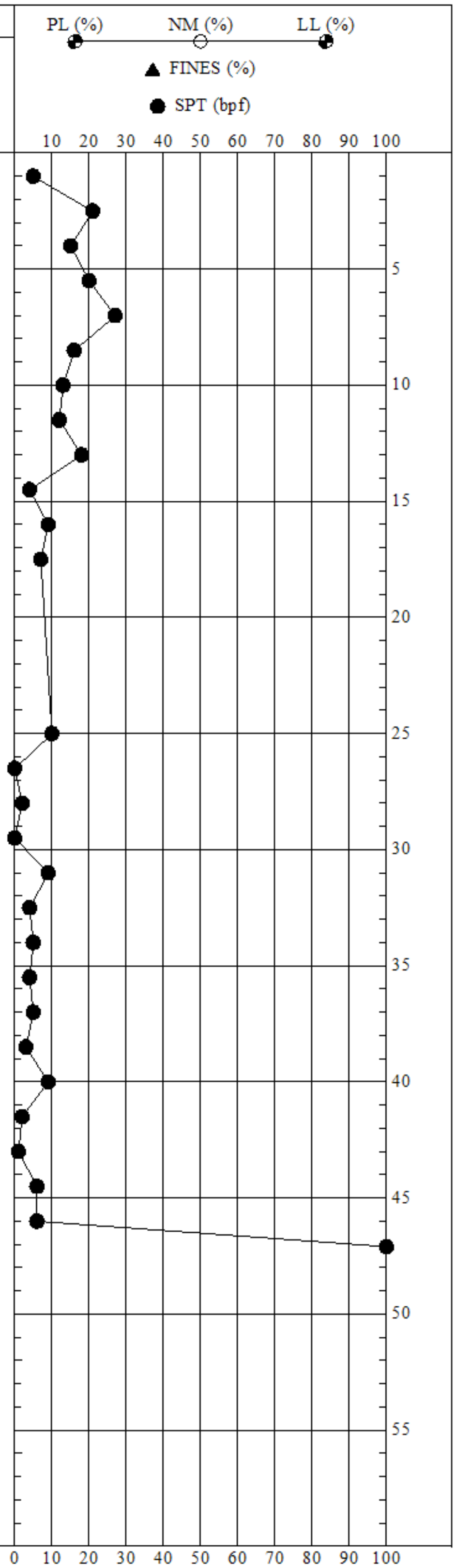
SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0 – ~1.5	FIRM, YELLOWISH RED, MOIST, SILTY CLAY WITH CHERT, LIMESTONE, AND ROOT FRAGMENTS - FILL	759.0
~1.5 – ~16.5	VERY FIRM TO VERY LOOSE, BLACK, WET, SILTY COARSE SAND (BOTTOM ASH) WITH COAL FRAGMENTS - FILL	
~16.5 – ~28.5	LOOSE TO VERY LOOSE, DARK GRAY, WET, SILT (FLY ASH) - FILL	
~28.5 – ~47	VERY LOOSE TO LOOSE, DARK BROWN, WET, SILTY SAND WITH SANDSTONE FRAGMENTS - ALLUVIUM	
~47 – 47.1	VERY HARD, LIGHT BROWN GRAY, WEATHERED SANDSTONE - RESIDUUM	
	AUGER REFUSAL AT 47.1'	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60 ft; Elevation scale: 759.0, 754.0, 749.0, 744.0, 739.0, 734.0, 729.0, 724.0, 719.0, 714.0, 709.0, 704.0, 699.0 ft. Water level symbol at approx. 15 ft.

SAMPLES

IDENT	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
SPT-1	2-2-3
SPT-2	5-11-10
SPT-3	6-8-7
SPT-4	6-9-11
SPT-5	16-17-10
SPT-6	3-5-11
SPT-7	4-5-8
SPT-8	6-6-6
SPT-9	8-9-9
SPT-10	2-2-2
SPT-11	4-4-5
SPT-12	2-3-4
UD-1	2.0-2.0
UD-2	2.0-2.0
UD-3	2.0-2.0
SPT-13	5-7-3
SPT-14	WOH
SPT-15	0-1-1
SPT-16	WOH
SPT-17	2-3-6
SPT-18	2-2-2
SPT-19	1-2-3
SPT-20	WOH-2-2
SPT-21	1-2-3
SPT-22	1-1-2
SPT-23	1-4-5
SPT-24	1-1-1
SPT-25	1-0-1
SPT-26	WOH-2-4
SPT-27	1-4-2
SPT-28	17-100/0.1



REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State
Logged By: N.J.S.
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Seep Area

DRILLED: April 1, 2010 **BORING NO.:** B-1

PROJ. NO.: 3043-10-1017 **PAGE** 1 **OF** 1

MACTEC

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Seep Area

DRILLED: March 27, 2010 **BORING NO.:** B-2

PROJ. NO.: 3043-10-1017 **PAGE** 1 **OF** 1

MACTEC

SOIL CLASSIFICATION AND REMARKS

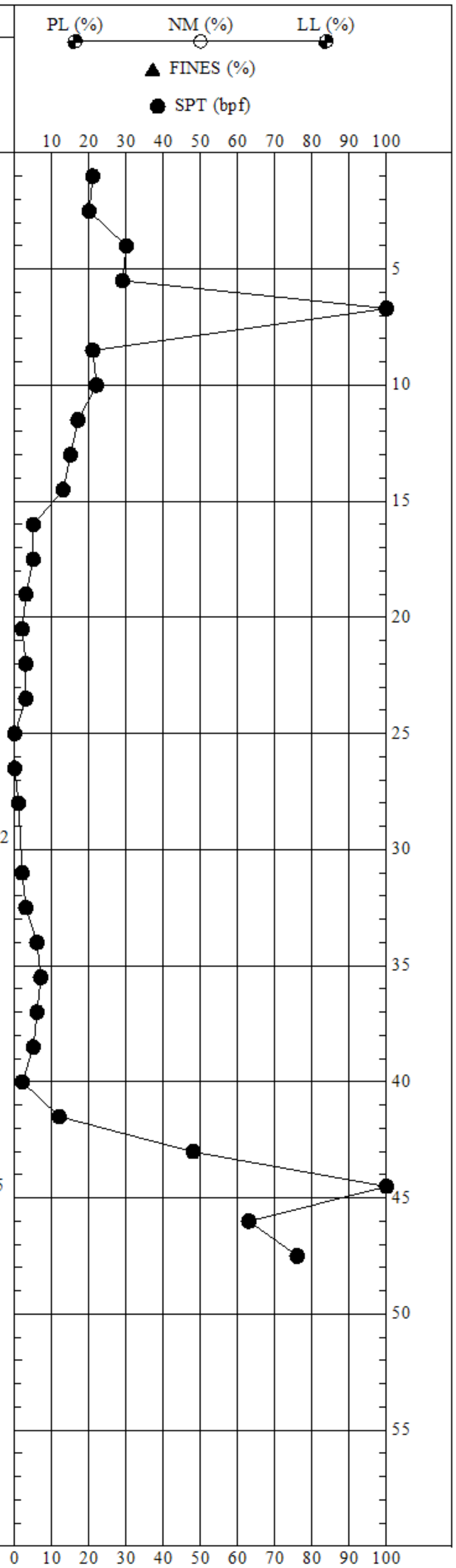
SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	ELEV (ft)	SOIL CLASSIFICATION AND REMARKS
0	753.0	VERY STIFF TO SOFT, BROWN TO DARK GRAY, MOIST TO WET, SILTY SANDY CLAY WITH WEATHERED SHALE, WEATHERED CHERT AND LIMESTONE FRAGMENTS - FILL NOTE: SPT-5 REFUSED ON LARGE ROCK FRAGMENTS.
25.5		VERY LOOSE TO LOOSE, BROWN, WET, SILTY SAND WITH OCCASIONAL ROUNDED PEBBLES - ALLUVIUM
41		FIRM TO VERY DENSE, BROWN, WET, SAND WITH SANDSTONE AND SHALE FRAGMENTS - ALLUVIUM NOTE: N-VALUES WERE INFLATED BY THE PRESENCE OF SANDSTONE AND SHALE FRAGMENTS.
48		VERY HARD, DARK GRAY, WEATHERED SHALE - RESIDUUM
		BORING TERMINATED AT 48.0'

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60 ft; Elevation scale: 753.0, 748.0, 743.0, 738.0, 733.0, 728.0, 723.0, 718.0, 713.0, 708.0, 703.0, 698.0, 693.0 ft.

SAMPLES

IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
SPT-1	5-8-13
SPT-2	12-10-10
SPT-3	15-9-21
SPT-4	7-11-18
SPT-5	11-50/0.2
SPT-6	22-10-11
SPT-7	3-8-14
SPT-8	3-8-9
SPT-9	3-6-9
SPT-10	5-7-6
SPT-11	2-2-3
SPT-12	2-3-2
SPT-13	1-1-2
SPT-14	1-1-1
SPT-15	1-1-2
SPT-16	1-1-2
SPT-17	WOH
SPT-18	WOH
SPT-19	0-0-1
SPT-20	WOH-WOH-2
SPT-21	0-0-2
SPT-22	0-2-1
SPT-23	1-3-3
SPT-24	3-3-4
SPT-25	2-3-3
SPT-26	3-2-3
SPT-27	1-1-1
SPT-28	1-4-8
SPT-29	2-20-28
SPT-30	15-26-50/0.5
SPT-31	17-25-38
SPT-32	33-38-38



REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State

Logged By: L.S.

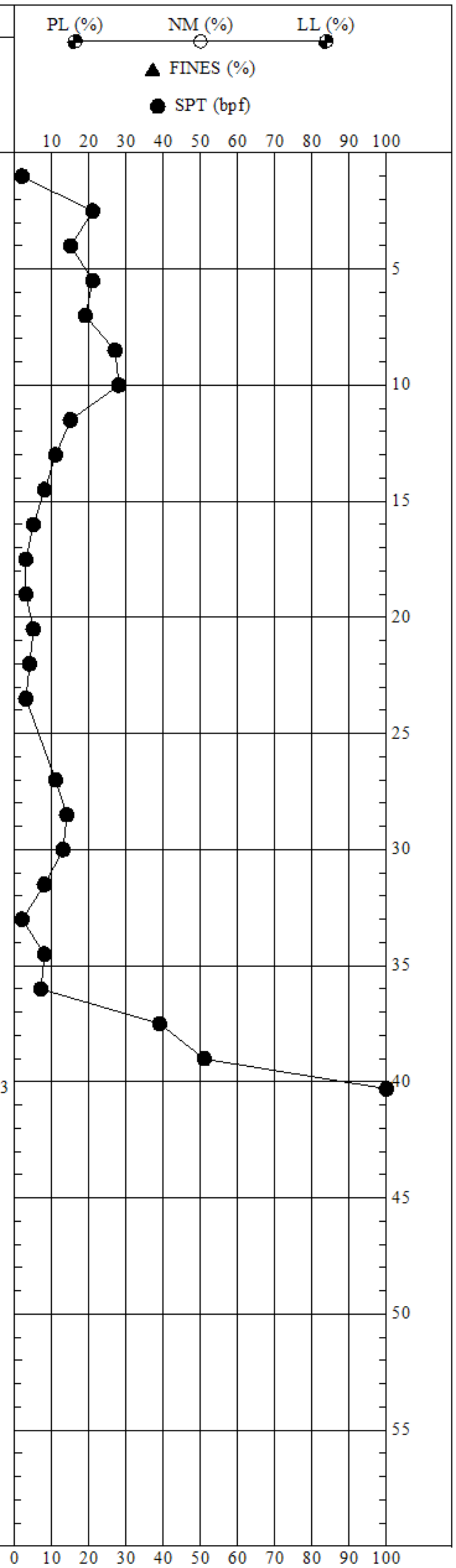
Checked By:

SOIL 3043101017_01_ALT.GPJ LAW GIBB.GDT 4/29/10

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	ELEV (ft)
0	VERY STIFF TO SOFT, BROWN, MOIST TO WET, SILTY CLAY / CLAYEY SILT WITH WEATHERED SHALE AND SANDSTONE FRAGMENTS - FILL	748.0
5		743.0
10		738.0
15		733.0
20		728.0
22.5	SOFT TO STIFF, RED-BROWN TO RED-ORANGE, MOIST TO WET, CLAYEY SILT - ALLUVIUM	
25		723.0
29	LOOSE TO DENSE, DARK BROWN, WET, SILTY SAND WITH WEATHERED SHALE AND SANDSTONE FRAGMENTS - ALLUVIUM	
30		718.0
35		713.0
40	VERY HARD, DARK GRAYISH BROWN, WEATHERED SANDSTONE - RESIDUUM	708.0
	AUGER REFUSAL AT 40.3'	
45		703.0
50		698.0
55		693.0
60		688.0

SAMPLES

IDENT	N-COUNT (1st 6", 2nd 6", 3rd 6")
SPT-1	3-1-1
SPT-2	3-14-7
SPT-3	2-5-10
SPT-4	5-13-8
SPT-5	3-7-12
SPT-6	7-12-15
SPT-7	6-12-16
SPT-8	35-10-5
SPT-9	5-6-5
SPT-10	3-4-4
SPT-11	5-3-2
SPT-12	2-2-1
SPT-13	2-1-2
SPT-14	3-2-3
SPT-15	4-2-2
SPT-16	1-2-1
UD-1	2.0-2.0
SPT-17	4-5-6
SPT-18	3-7-7
SPT-19	5-6-7
SPT-20	5-5-3
SPT-21	1-1-1
SPT-22	7-4-4
SPT-23	15-5-2
SPT-24	5-10-29
SPT-25	7-25-26
SPT-26	31-35-100/0.3



REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State
Logged By: N.J.S.
Checked By:

SOIL TEST BORING RECORD

PROJECT: TVA Kingston Seep Area

DRILLED: April 6, 2010 **BORING NO.:** B-3

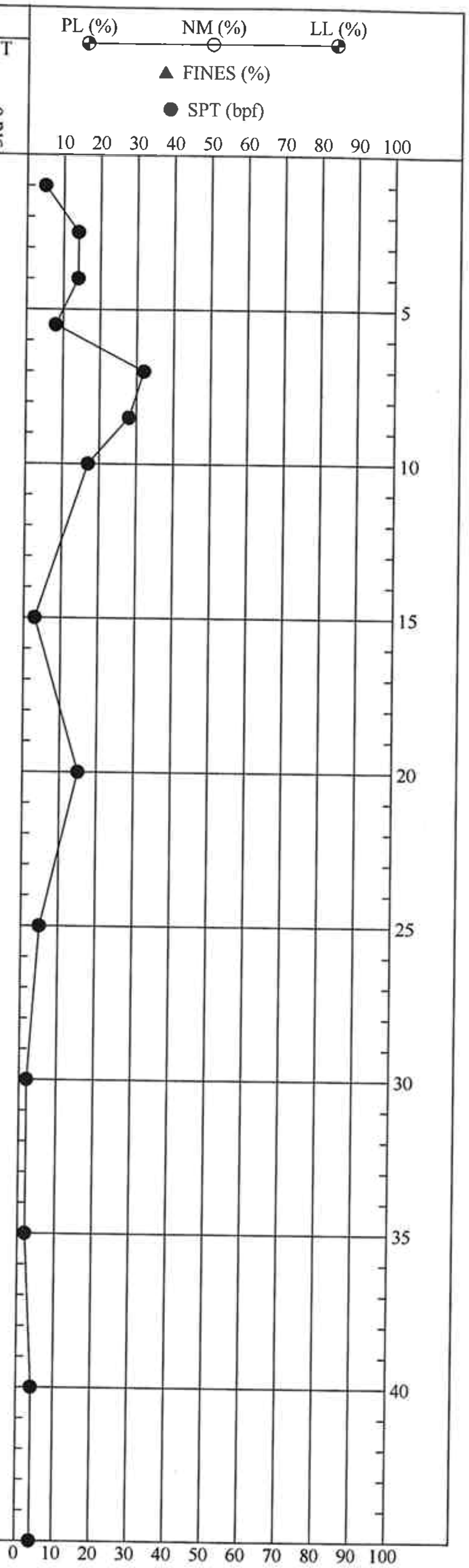
PROJ. NO.: 3043-10-1017 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	DRY, SILTY CLAY WITH GRANULAR-SIZED STONE FRAGMENTS	769.5
	FIRM, DARK GRAY, DRY, SILT (FLY ASH) WITH A PEBBLE-SIZED FRAGMENTS	
5	FIRM, DARK GRAY, MOIST, SILT (FLY ASH) WITH A PEBBLE-SIZED FRAGMENTS	764.5
	OFFSET B-36 3.1 FEET NORTH WEST.	
	DENSE, LIGHT GRAY, SLIGHTLY MOIST, SILTY SAND (BOTTOM ASH)	
	FIRM, DARK GRAY, MOIST, SILTY SAND (BOTTOM ASH) WITH GRANULAR TO PEBBLE-SIZED MATERIAL THROUGHOUT	
10		759.5
15	SOFT, GRAY, WET, SILT (FLY ASH) WITH SILTY SAND (BOTTOM ASH)	754.5
20	STIFF, VERY DARK GRAY, WET, SILTY SAND (BOTTOM ASH)	749.5
25	LOOSE, VERY DARK GRAY, WET, SILTY SAND (BOTTOM ASH) WITH SLAG	744.5
30	VERY LOOSE, BLACK TO VERY DARK GRAY, WET, SILTY SAND (BOTTOM ASH) WITH SLAG	739.5
35		734.5
40	SOFT, DARK GRAY, WET, SILT (FLY ASH), WITH A FEW COAL / SLAG FRAGMENTS	729.5
45	SOFT, DARK GRAY, MOIST, SILT (FLY ASH)	724.5

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

SAMPLES IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
SPT-1	1-2-3
SPT-2	1-4-10
SPT-3	7-7-7
SPT-4	5-4-4
SPT-5	6-18-14
SPT-6	7-12-16
SPT-7	5-8-9
SPT-8	1-1-2
SPT-9	0-6-9
SPT-10	1-2-3
SPT-11	1-1-1
SPT-12	0-1-1
SPT-13	1-2-2
SPT-14	2-2-2



SOIL NO LEGEND 3043081022_01.GPJ LAW_GIBB.GDT 2/25/09

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. B-36 ENCOUNTERED REFUSAL AT APPROXIMATELY 6.0 FEET. THE BORING WAS OFFSET 3.1 FEET NORTHWEST.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State
Logged By: JET
Checked By: ALB

SOIL TEST BORING RECORD

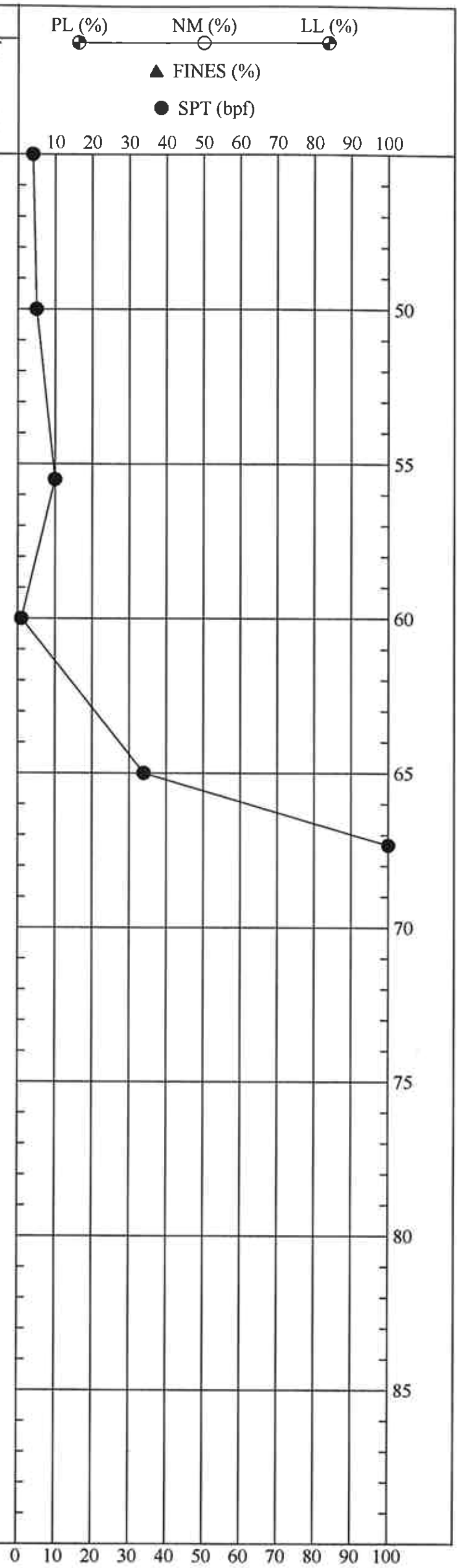
PROJECT: TVA Kingston - Phase I Geotube Disposal Area

DRILLED: January 29, 2009 **BORING NO.:** B-36

PROJ. NO.: 3043-09-1004 **PAGE** 1 **OF** 2

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
45	SOFT, DARK GRAY, MOIST, SILT (FLY ASH)	724.5			
	FIRM, LIGHT GRAY, SLIGHTLY MOIST, SILT (FLY ASH)				
50		719.5	SPT-15		0-2-3
			UD-1		2.0-2.0
55	STIFF, MOTTLED BROWNISH-YELLOW AND LIGHT GRAY, SLIGHTLY MOIST, SILTY CLAY TO LIGHT GRAY SANDY SILT (BOTTOM ASH)	714.5	SPT-16		2-5-5
60	VERY LOOSE, VERY PALE BROWN, VERY MOIST, MEDIUM TO FINE-GRAINED SAND	709.5	SPT-17		1-0-1
65	DENSE, LIGHT YELLOWISH-BROWN, MOIST, MEDIUM TO COARSE GRAINED SAND AND GRAVEL SIZED ROCK FRAGMENTS	704.5	SPT-18		3-9-25
	VERY HARD, DARK GRAY, MOIST, DARK GRAY, SLIGHTLY WEATHERED SHALE		SPT-19		100/0.33'
	VERY HARD, DARK GRAY, MOIST, SHALE				
	AUGER REFUSAL AT 67.4'				
70		699.5			
75		694.5			
80		689.5			
85		684.5			
90		679.5			



SOIL NO LEGEND 3043081022_01.GPJ LAW_GIBB.GDT 2/25/09

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. B-36 ENCOUNTERED REFUSAL AT APPROXIMATELY 6.0 FEET. THE BORING WAS OFFSET 3.1 FEET NORTHWEST.

SOIL TEST BORING RECORD

PROJECT: TVA Kingston - Phase I Geotube Disposal Area

DRILLED: January 29, 2009 **BORING NO.:** B-36

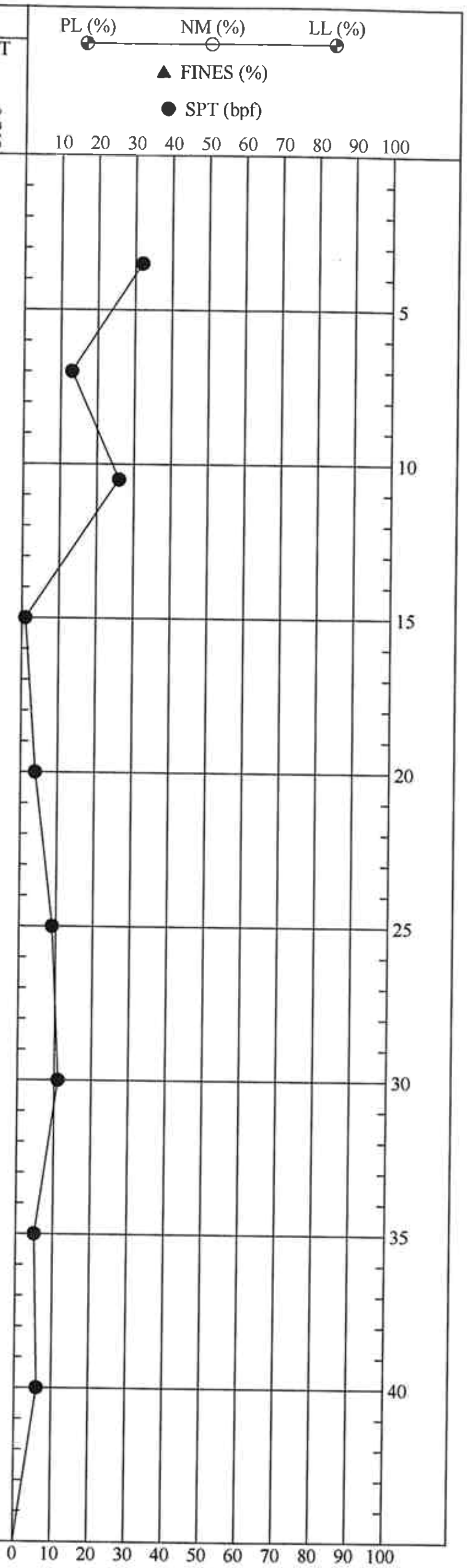
PROJ. NO.: 3043-09-1004 **PAGE 2 OF 2**

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State
Logged By: JET
Checked By: ALB

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	ELEV (ft)	IDENT	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	HARD INTO STIFF, GRAY, DRY TO SLIGHTLY MOIST, SILT (FLY ASH)	769.1	UD-1	2.0-2.0
			SPT-1	7-12-20
5		764.1	UD-2	2.0-2.0
			SPT-2	5-6-7
			UD-3	2.0-2.0
10	VERY STIFF, GRAY, DRY TO SLIGHTLY MOIST, SILT (FLY ASH)	759.1	SPT-3	9-14-12
15	VERY LOOSE, VERY DARK GRAY, WET, SILTY SAND (BOTTOM ASH) WITH COAL / SLAG FRAGMENTS	754.1	SPT-4	0-0-1
20	VERY LOOSE, VERY DARK GRAY, VERY MOIST, SILTY SAND (BOTTOM ASH), WITH COAL / ROCK FRAGMENTS	749.1	SPT-5	1-3-1
25	LOOSE, BLACK, VERY MOIST, SILTY SAND (BOTTOM ASH), WITH ROCK / SLAG FRAGMENTS	744.1	SPT-6	3-5-4
30	FIRM INTO LOOSE, BLACK, WET, SILTY SAND (BOTTOM ASH), WITH ROCK / SLAG FRAGMENTS	739.1	SPT-7	3-6-5
35		734.1	SPT-8	2-2-3
40	FIRM INTO VERY SOFT, DARK GRAY, WET, SILT (FLY ASH)	729.1	SPT-9	1-3-3
	UD-4: NO RECOVERY		UD-4	0.0-2.0
45		724.1		



REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. NO 24 HOUR WATER LEVEL WAS TAKEN DUE TO CAVE IN AT 7.2 FEET.

SOIL TEST BORING RECORD

PROJECT: TVA Kingston - Phase I Geotube Disposal Area

DRILLED: January 31, 2009 **BORING NO.:** B-39

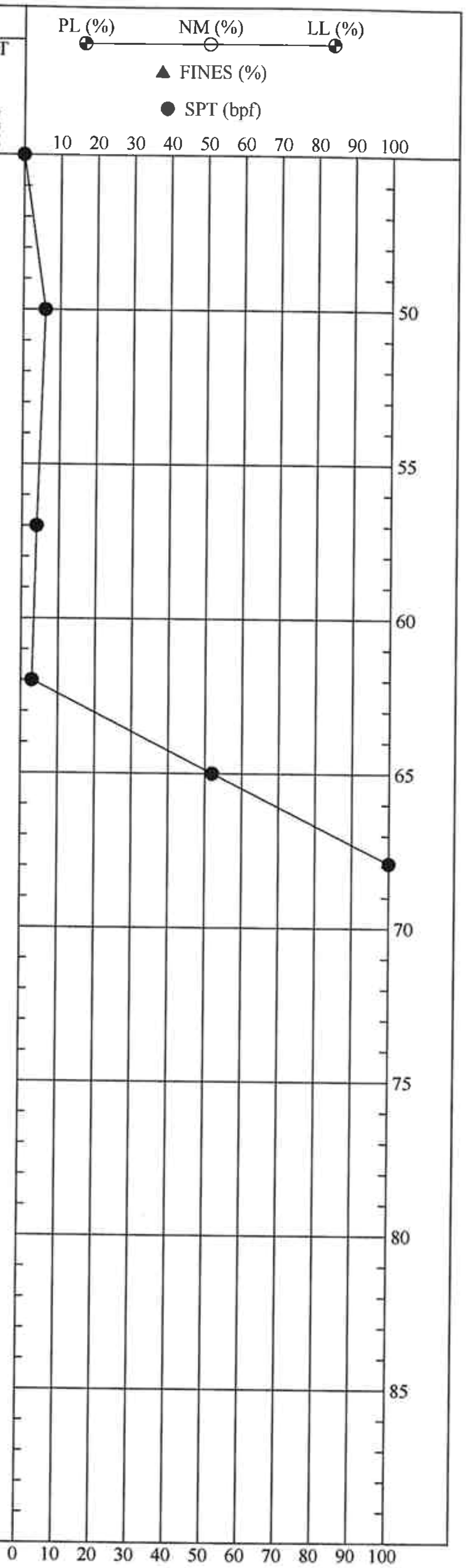
PROJ. NO.: 3043-09-1004 **PAGE** 1 **OF** 2

MACTEC

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State
Logged By: JET
Checked By: ALB

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
45	FIRM INTO VERY SOFT, DARK GRAY, WET, SILT (FLY ASH)	724.1	SPT-10		WOH
	FIRM, LIGHT GRAY, MOTTLED YELLOW, SLIGHTLY MOIST, SILTY CLAY				
50		719.1	SPT-11		0-2-4
55		714.1	UD-5		2.0-2.0
	SOFT, LIGHT GRAY, SANDY SILT		SPT-12		0-2-2
60		709.1			
	VERY LOOSE, YELLOWISH-BRONW, WET, FINE TO MEDIUM SAND TO SANDY SILT		SPT-13		0-1-2
	VERY DENSE, YELLOWISH-BROWN, MOIST, COARSE SAND WITH ROCK FRAGMENTS				
65		704.1	SPT-14		0-17-35
	VERY HARD, GRAY, SILTY, WEATHERED SHALE AUGER REFUSAL AT 67.9'		SPT-15		100/0.4'
70		699.1			
75		694.1			
80		689.1			
85		684.1			
90		679.1			



SOIL NO LEGEND 3043081022_01.GPJ LAW_GIBB.GDT 2/25/09

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. NO 24 HOUR WATER LEVEL WAS TAKEN DUE TO CAVE IN AT 7.2 FEET.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State
Logged By: JET
Checked By: ALB

SOIL TEST BORING RECORD

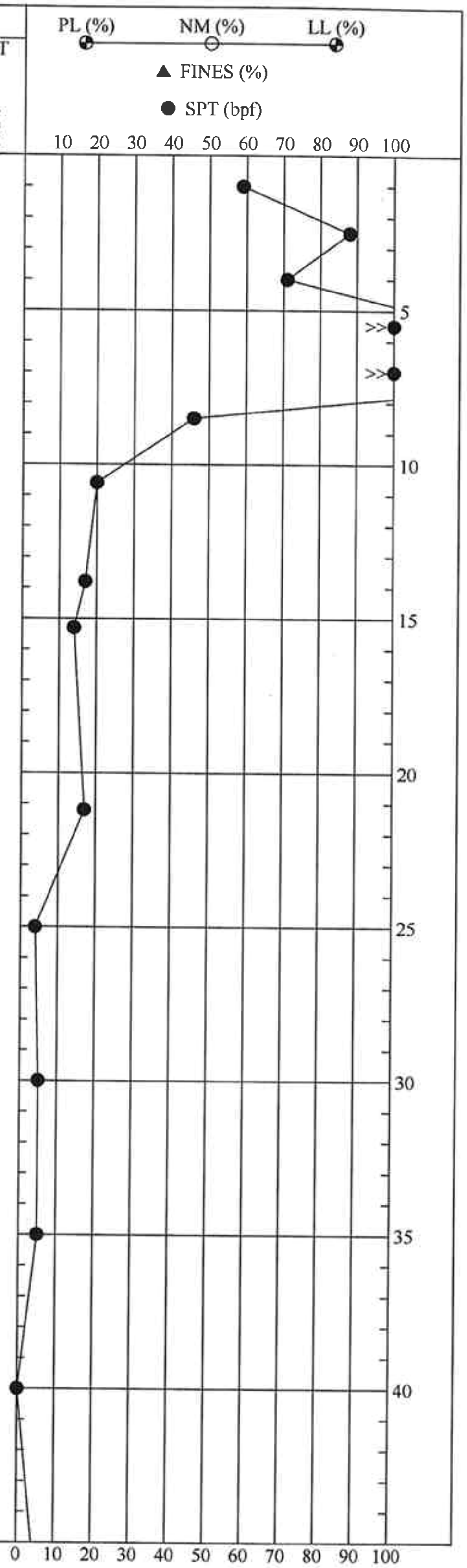
PROJECT: TVA Kingston - Phase I Geotube Disposal Area

DRILLED: January 31, 2009 **BORING NO.:** B-39

PROJ. NO.: 3043-09-1004 **PAGE 2 OF 2**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
0	VERY HARD, DARK GRAY, DRY, SILT (FLY ASH) WITH YELLOWISH-BROWN, SILTY CLAY WITH CRUSHED STONE	767.0	SPT-1		11-25-34
	VERY DENSE, GRAY, DRY, SILTY SAND (BOTTOM ASH) WITH COAL / SLAG FRAGMENTS (NOTE: THE SPT VALUES APPEAR TO HAVE BEEN AMPLIFIED BY ROCK FRAGMENTS IN THE SAMPLE INTERVAL.)		SPT-2		31-43-45
			SPT-3		23-26-45
5		762.0	SPT-4		12-58-64
			SPT-5		30-94-76
	DENSE, DARK GRAY, SLIGHTLY MOIST, SILTY SAND (BOTTOM ASH) WITH COAL / SLAG FRAGMENTS		SPT-6		22-23-23
			UD-1		0.6-0.6
10	FIRM, DARK GRAY, MOIST, SILTY SAND (BOTTOM ASH) WITH COAL / SLAG FRAGMENTS	757.0	SPT-7		11-10-10
	FIRM, DARK GRAY, WET, SILTY SAND (BOTTOM ASH) WITH COAL / SLAG FRAGMENTS		UD-2		0.3-0.8
			SPT-8		2-5-12
15	FIRM, DARK GRAY, WET, SILTY SAND (BOTTOM ASH) WITH COAL / SLAG FRAGMENTS	752.0	SPT-9		6-6-8
20	FIRM, VERY DARK GRAY, WET, SILTY SAND (BOTTOM ASH) WITH COAL / SLAG FRAGMENTS UD-3: NO RECOVERY	747.0	UD-3		0.0-1.2
			SPT-10		4-10-7
	UD-4:NO RECOVERY		UD-4		0.0-2.0
25	VERY LOOSE, BLACK, WET, SILTY SAND (BOTTOM ASH) WITH COAL / SLAG FRAGMENTS	742.0	SPT-11		0-2-2
30	FIRM, DARK GRAY, MOIST TO WET, SILT (FLY ASH)	737.0	SPT-12		2-2-3
	UD-5: NO RECOVERY		UD-5		0.0-2.0
35		732.0	SPT-13		1-1-4
40	VERY SOFT, LIGHT YELLOWISH-BROWN, VERY MOIST, SILTY CLAY	727.0	SPT-14		WOH
			UD-6		0.0-2.0
45	SOFT, BROWNISH-YELLOW, VERY MOIST TO WET, SANDY SILT	722.0			



SOIL NO LEGEND 3043081022_01.GPJ LAW_GIBB.GDT 2/25/09

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

SOIL TEST BORING RECORD

PROJECT: TVA Kingston - Phase I Geotube Disposal Area

DRILLED: January 31, 2009 **BORING NO.:** B-47

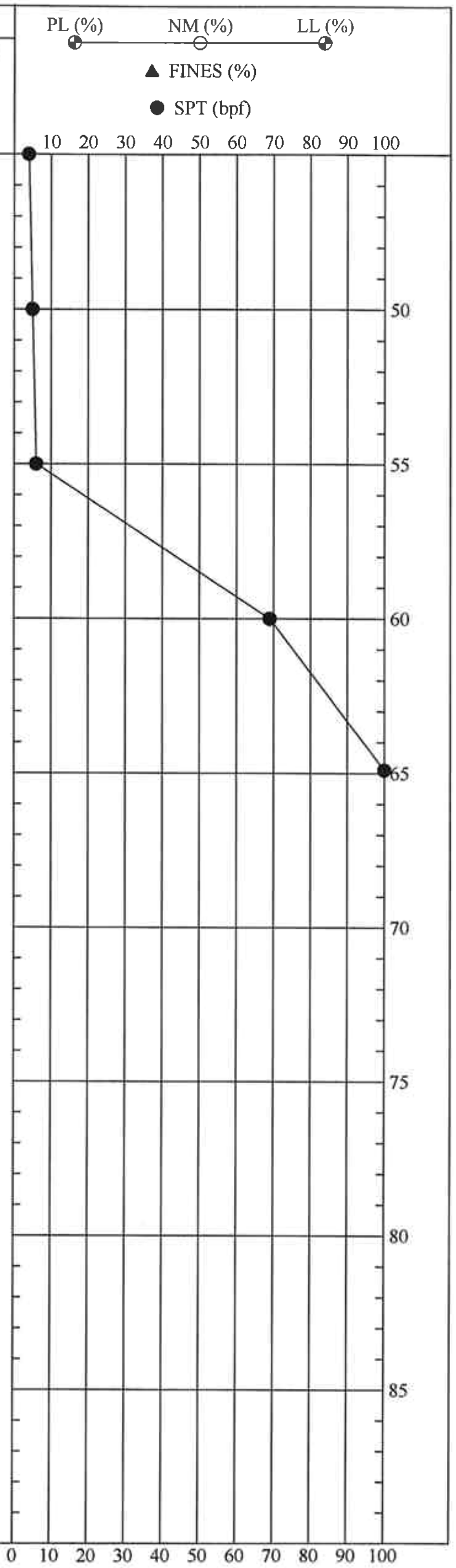
PROJ. NO.: 3043-09-1004 **PAGE** 1 **OF** 2

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State
Logged By: JET
Checked By: ALB

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
45	UD-6: NO RECOVERY SOFT, BROWNISH-YELLOW, VERY MOIST TO WET, SANDY SILT	722.0	SPT-15		0-2-2
50	FIRM, REDDISH-YELLOW TO BROWNISH-YELLOW, WET, SANDY SILT	717.0	SPT-16		2-3-2
55	LOOSE, BROWNISH-YELLOW, WET, SAND	712.0	SPT-17		0-2-4
60	VERY DENSE, YELLOW AND DARK BROWN, SANDSTONE WITH SOME BROWNISH-YELLOW, SAND	707.0	SPT-18		21-32-37
65	VERY HARD, DARK GRAY, WEATHERED SHALE AUGER REFUSAL AT 64.9'	702.0	SPT-19		40-100/0.4'
70		697.0			
75		692.0			
80		687.0			
85		682.0			
90		677.0			



REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Tri-State
Logged By: JET
Checked By: ALB

SOIL TEST BORING RECORD

PROJECT: TVA Kingston - Phase I Geotube Disposal Area

DRILLED: January 31, 2009 **BORING NO.:** B-47

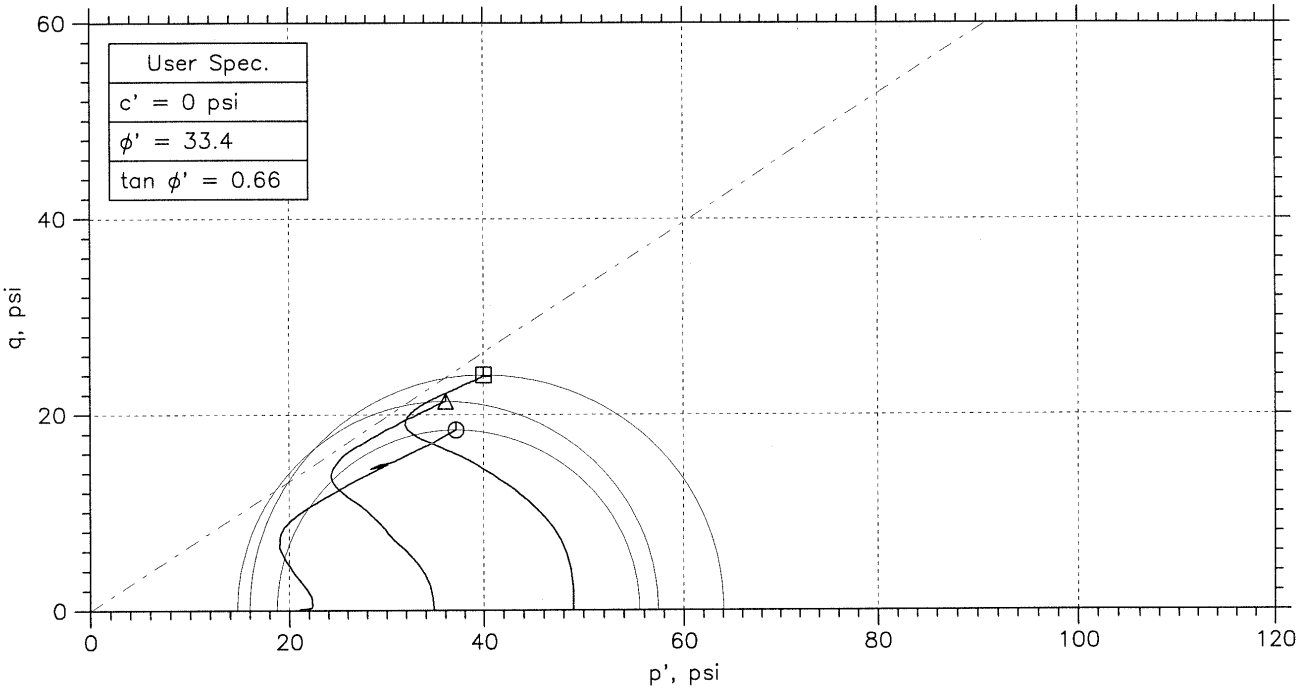
PROJ. NO.: 3043-09-1004 **PAGE** 2 **OF** 2

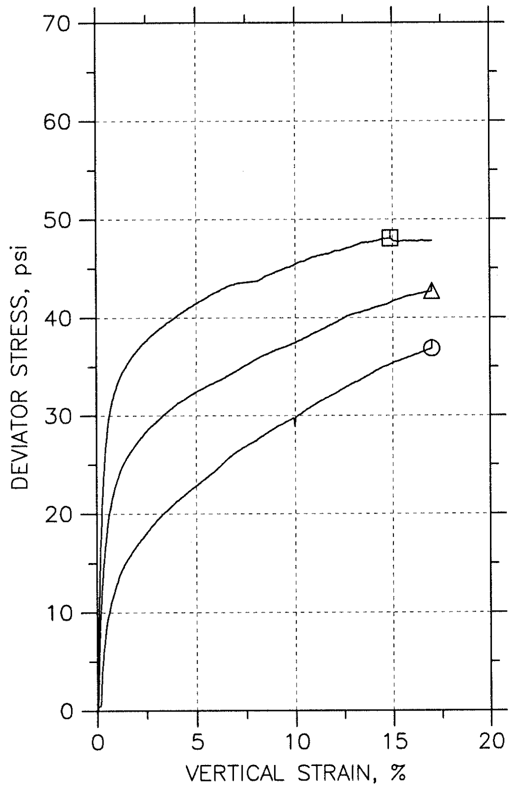
MACTEC

SOIL NO LEGEND 3043081022_01.GPJ LAW_GIBB.GDT 2/25/09

APPENDIX B – LABORATORY TESTING RESULTS

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





		○	△	□	
Symbol		○	△	□	
Sample No.		UD	UD	UD	
Test No.		10109.1	10110.2	10111.3	
Depth		23-25 ft	25-27 ft	27-29 ft	
Initial	Diameter, in	2.841	2.84	2.849	
	Height, in	5.567	5.551	5.546	
	Water Content, %	31.4	23.9	22.4	
	Dry Density, pcf	94.28	105.8	108.	
	Saturation, %	107.6	108.9	107.7	
	Void Ratio	0.788	0.593	0.56	
Before Shear	Water Content, %	26.9	21.4	19.4	
	Dry Density, pcf	97.64	106.9	110.6	
	Saturation*, %	100.0	100.0	100.0	
	Void Ratio	0.726	0.577	0.525	
	Back Press., psi	120.	110.	97.99	
Ver. Eff. Cons. Stress, psi		21.01	35.	49.	
Shear Strength, psi		18.42	21.34	24.03	
Strain at Failure, %		17	17	14.9	
Strain Rate, %/min		0.02	0.02	0.02	
B-Value		0.77	0.91	0.95	
Estimated Specific Gravity		2.7	2.7	2.7	
Liquid Limit		---	---	---	
Plastic Limit		---	---	---	

MACTEC

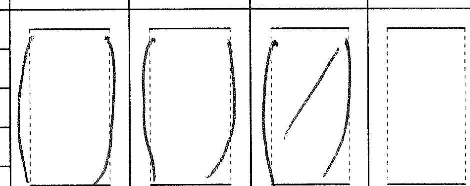
Project: KIF East Dike Seapage

Location: A-2

Project No.: 3043101017

Boring No.: A-2

Sample Type: Undisturbed



Description: Brown Sandy Clay with Gravel

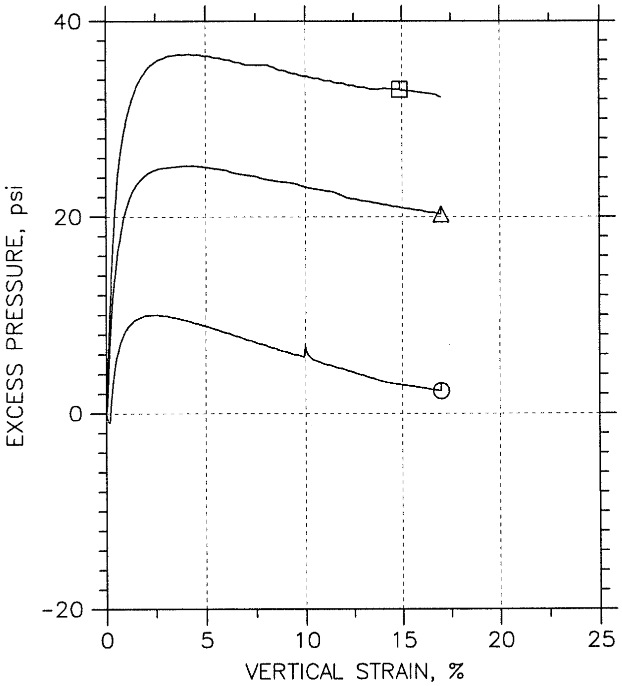
Remarks: ASTM D4767-04

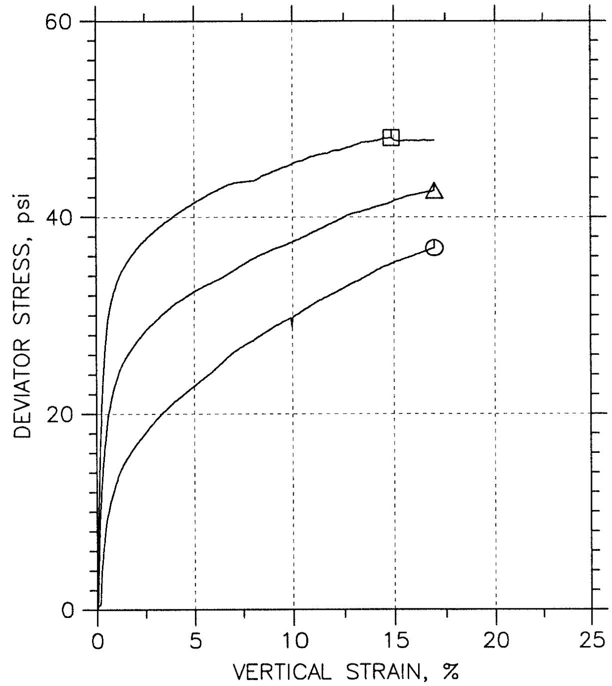
Phase calculations based on start and end of test.

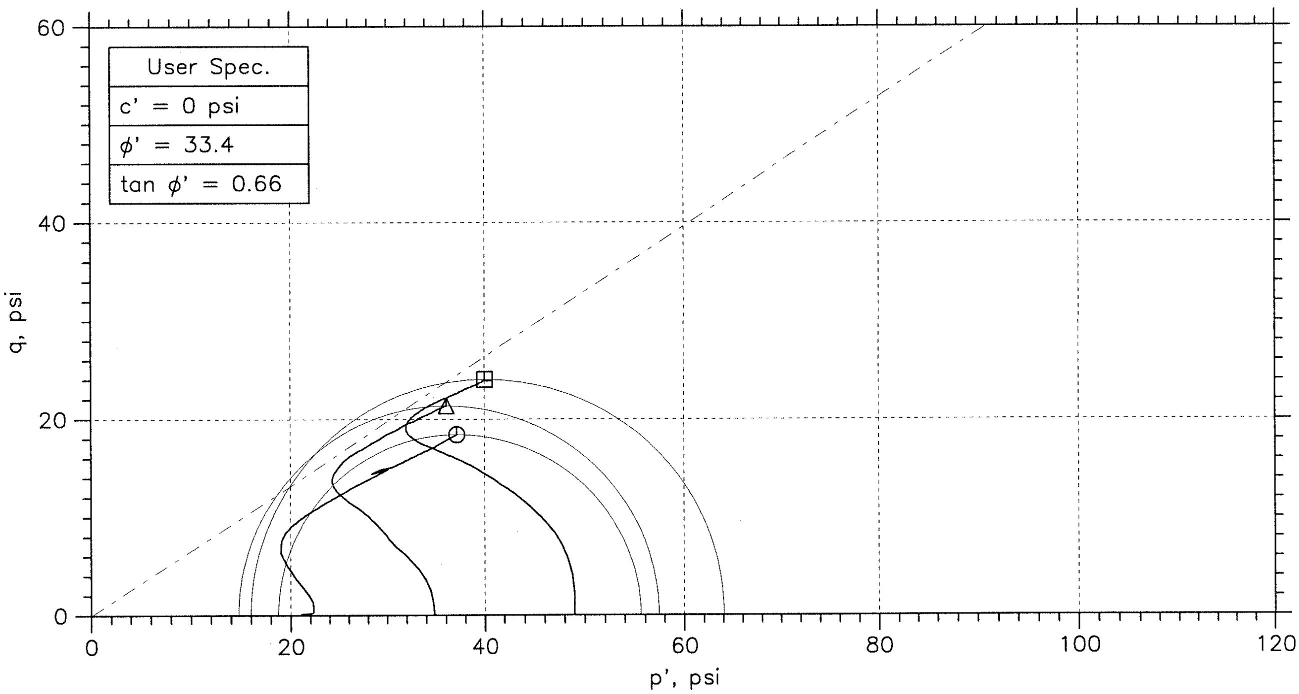
* Saturation is set to 100% for phase calculations.

Tue, 20-APR-2010 13:53:28

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







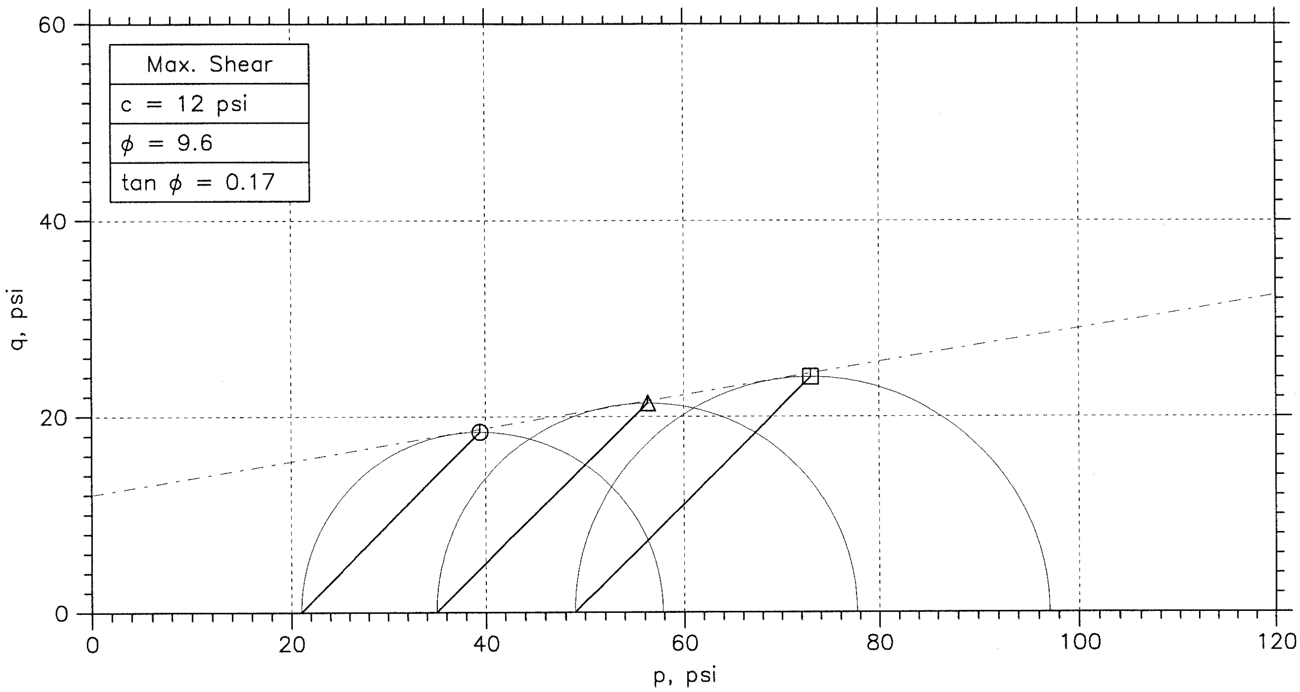
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
○	UD	10109.1	23-25 ft	JW	4/13/10			10109.1_2546.dat
△	UD	10110.2	25-27 ft	JW	4/13/10			10110.2_2547.dat
□	UD	10111.3	27-29 ft	JW	4/13/10			10111.3a_2580.dat

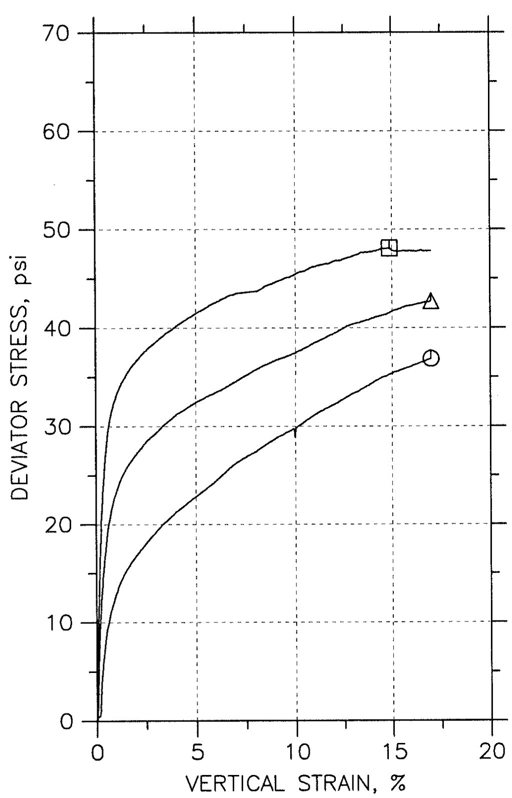
MACTEC

Project: KIF East Dike Seapage	Location: A-2	Project No.: 3043101017
Boring No.: A-2	Sample Type: Undisturbed	
Description: Brown Sandy Clay with Gravel		
Remarks: ASTM D4767-04		

Tue, 20-APR-2010 13:53:28

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

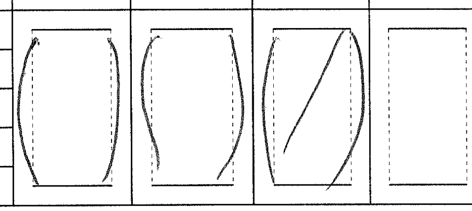




		○	△	□	
Symbol		○	△	□	
Sample No.		UD	UD	UD	
Test No.		10109.1	10110.2	10111.3	
Depth		23-25 ft	25-27 ft	27-29 ft	
Initial	Diameter, in	2.841	2.84	2.849	
	Height, in	5.567	5.551	5.546	
	Water Content, %	31.4	23.9	22.4	
	Dry Density, pcf	94.28	105.8	108.	
	Saturation, %	107.6	108.9	107.7	
	Void Ratio	0.788	0.593	0.56	
Before Shear	Water Content, %	26.9	21.4	19.4	
	Dry Density, pcf	97.64	106.9	110.6	
	Saturation*, %	100.0	100.0	100.0	
	Void Ratio	0.726	0.577	0.525	
	Back Press., psi	120.	110.	97.99	
Ver. Eff. Cons. Stress, psi		21.01	35.	49.	
Shear Strength, psi		18.42	21.34	24.03	
Strain at Failure, %		17	17	14.9	
Strain Rate, %/min		0.02	0.02	0.02	
B-Value		0.77	0.91	0.95	
Estimated Specific Gravity		2.7	2.7	2.7	
Liquid Limit		---	---	---	
Plastic Limit		---	---	---	

MACTEC

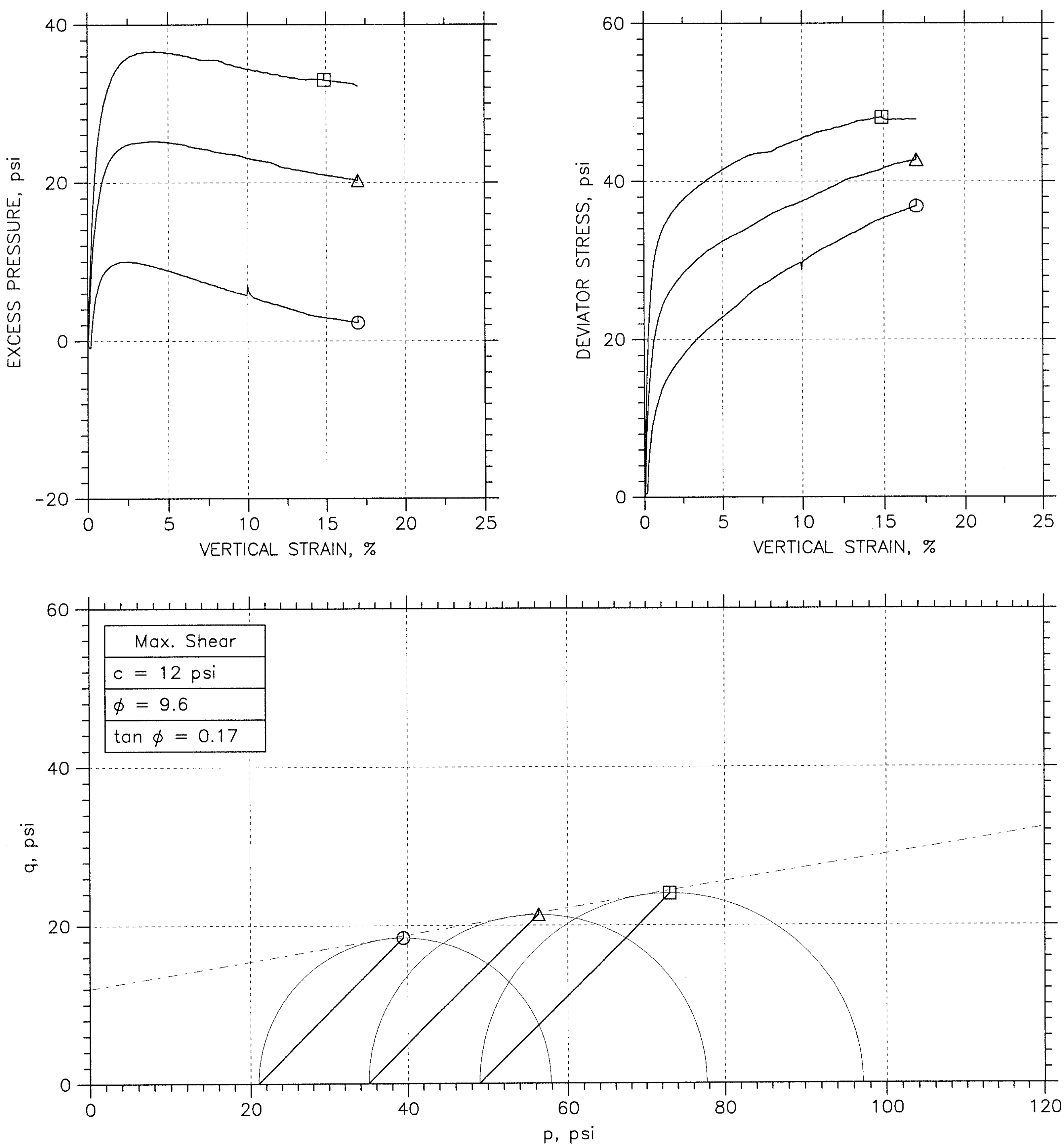
Project: KIF East Dike Seapage
Location: A-2
Project No.: 3043101017
Boring No.: A-2
Sample Type: Undisturbed



Description: Brown Sandy Clay with Gravel
Remarks: ASTM D4767-04
Phase calculations based on start and end of test.
* Saturation is set to 100% for phase calculations.

Tue, 20-APR-2010 13:53:36

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767



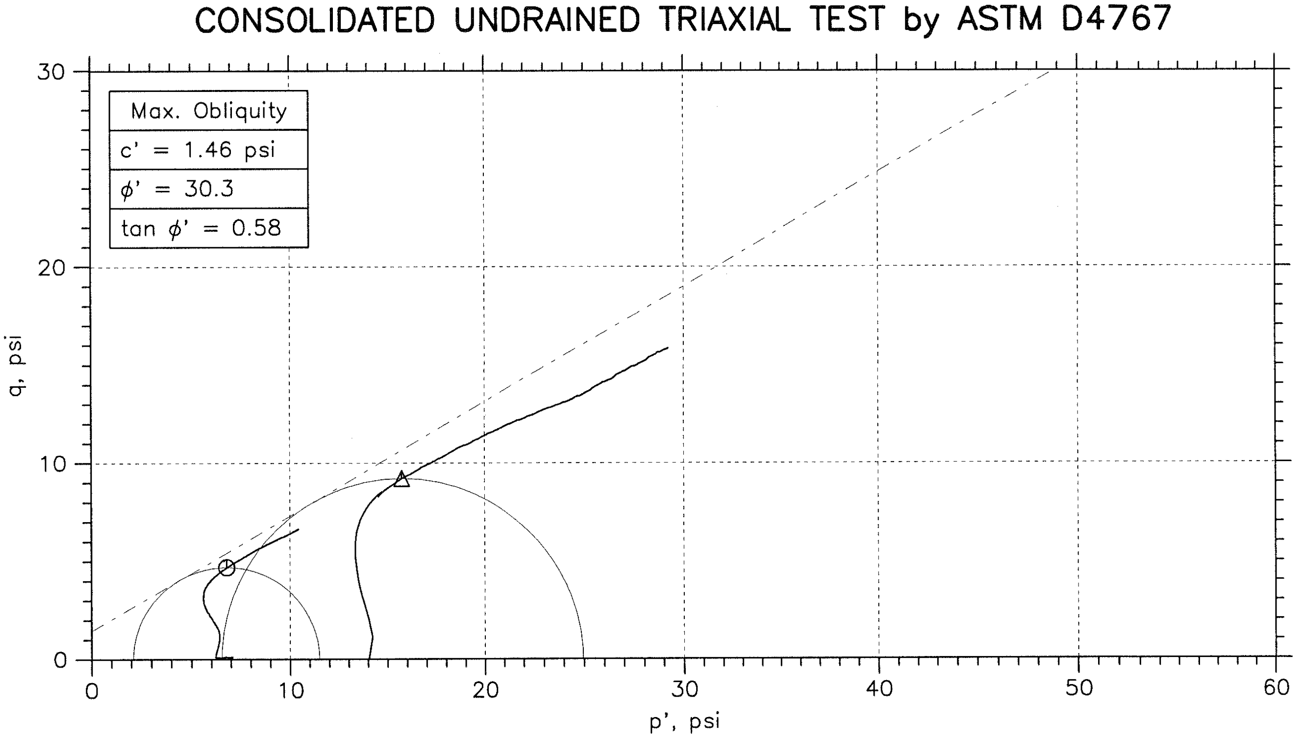
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⦶	UD	10109.1	23-25 ft	JW	4/13/10			10109.1_2546.dat
△	UD	10110.2	25-27 ft	JW	4/13/10			10110.2_2547.dat
⊡	UD	10111.3	27-29 ft	JW	4/13/10			10111.3a_2580.dat

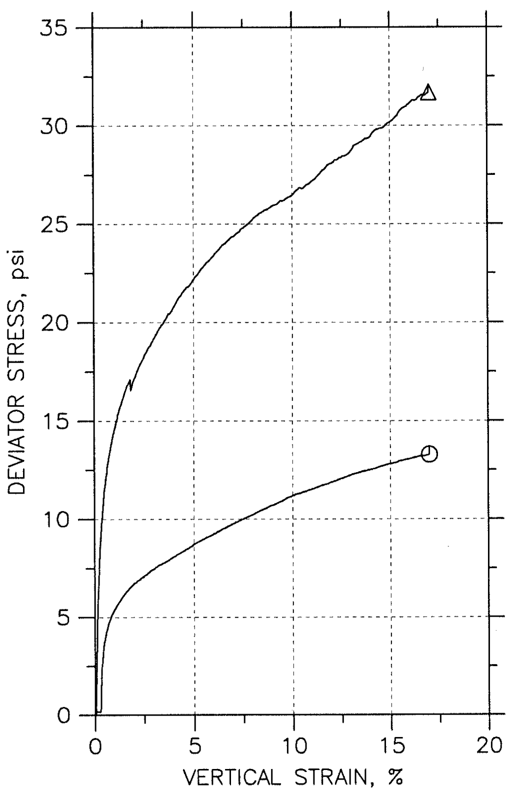
MACTEC

Project: KIF East Dike Seapage	Location: A-2	Project No.: 3043101017
Boring No.: A-2	Sample Type: Undisturbed	
Description: Brown Sandy Clay with Gravel		
Remarks: ASTM D4767-04		

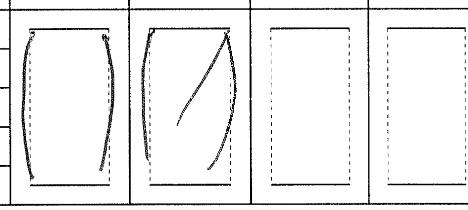
Tue, 20-APR-2010 13:53:36

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		O	Δ		
Sample No.		UD	UD		
Test No.		10107.1	10107.2		
Depth		7-9 ft	7-9 ft		
Initial	Diameter, in	2.85	2.85		
	Height, in	5.953	5.57		
	Water Content, %	20.1	13.1		
	Dry Density, pcf	104.8	119.6		
	Saturation, %	89.2	86.3		
	Void Ratio	0.608	0.409		
Before Shear	Water Content, %	22.4	14.3		
	Dry Density, pcf	105.1	121.6		
	Saturation*, %	100.0	100.0		
	Void Ratio	0.604	0.386		
	Back Press., psi	140.	134.		
Ver. Eff. Cons. Stress, psi		6.994	14.		
Shear Strength, psi		6.636	15.84		
Strain at Failure, %		17	17		
Strain Rate, %/min		0.02	0.02		
B-Value		0.96	0.96		
Estimated Specific Gravity		2.7	2.7		
Liquid Limit		---	---		
Plastic Limit		---	---		



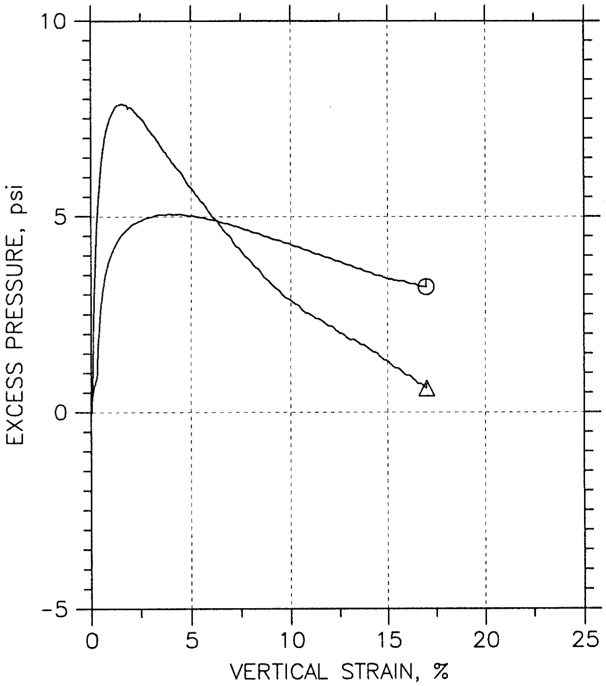
MACTEC	Project: KIF Dike East Seapage
	Location: A-2
	Project No.: 3043101017
	Boring No.: A-2
	Sample Type: Undisturbed
	Description: Gray Clay with Gravel
	Remarks: ASTM D4767-04

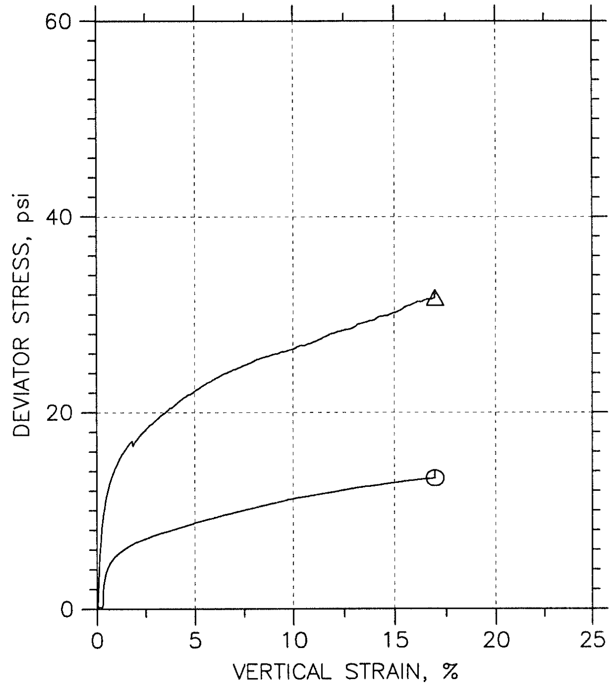
Phase calculations based on start and end of test.

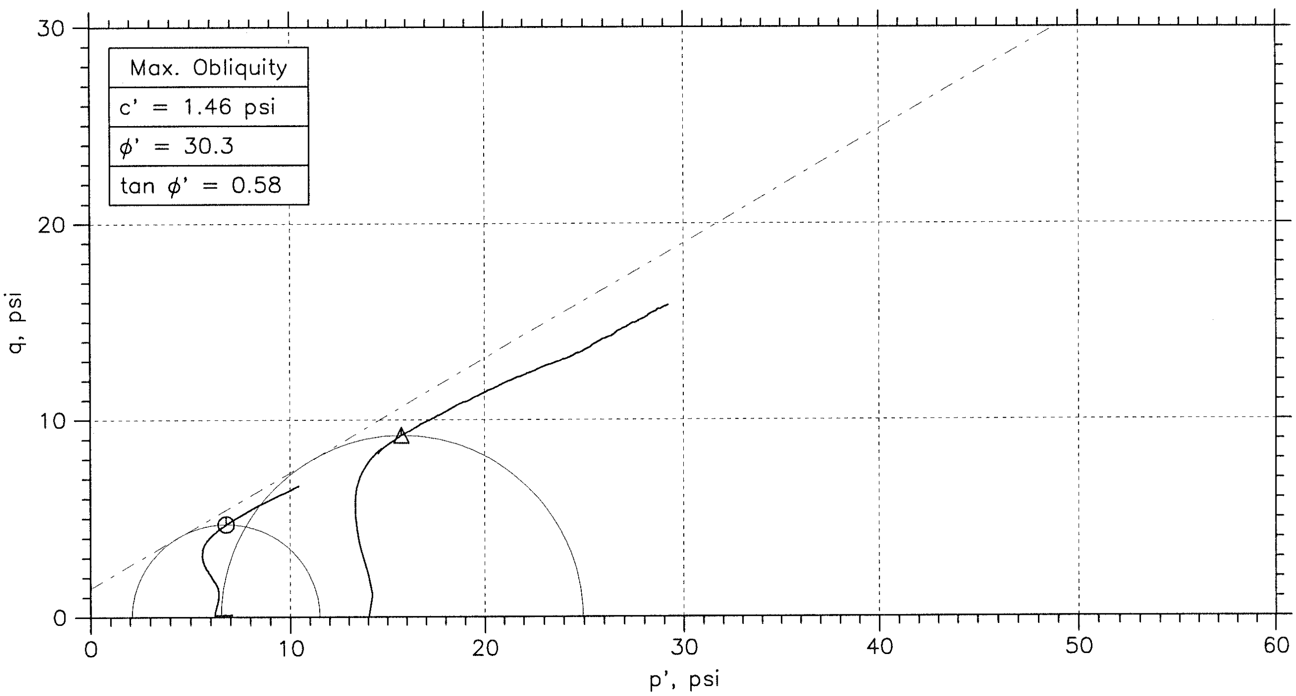
* Saturation is set to 100% for phase calculations.

Tue, 20-APR-2010 13:10:00

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







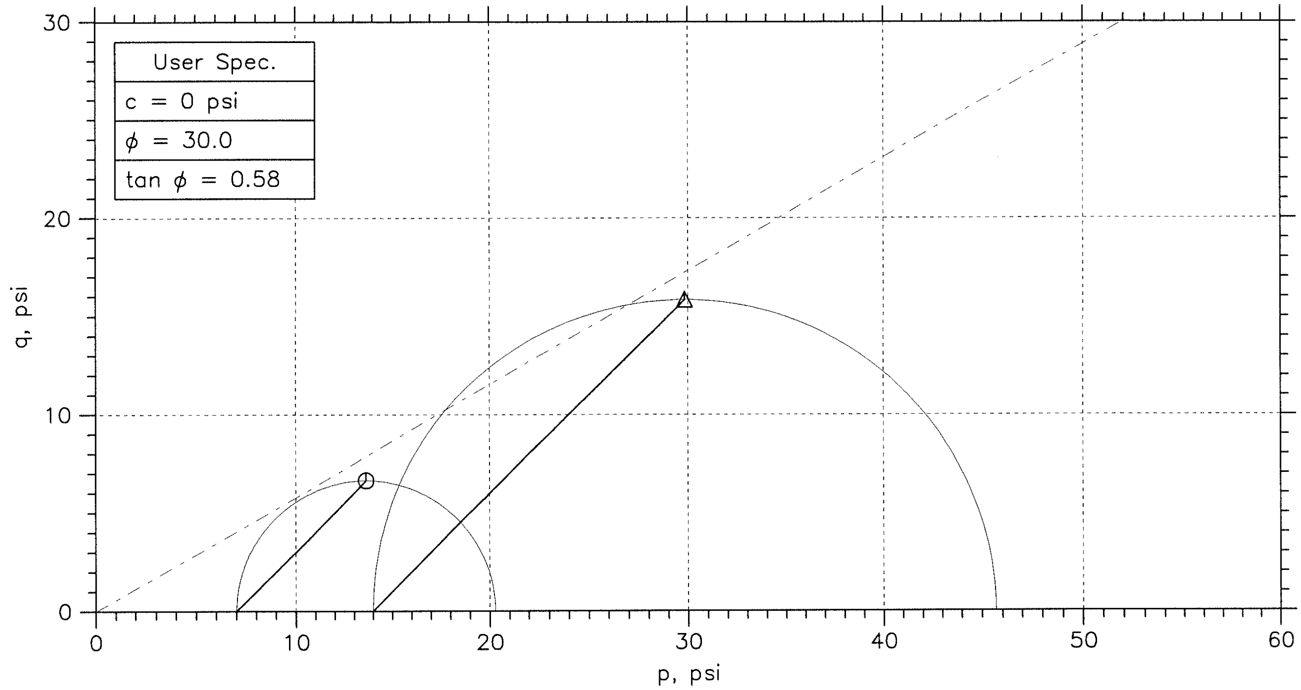
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⦶	UD	10107.1	7-9 ft	JW	4/12/10			10107.1_2583.dat
△	UD	10107.2	7-9 ft	JW	4/12/10			10107.2_2582.dat

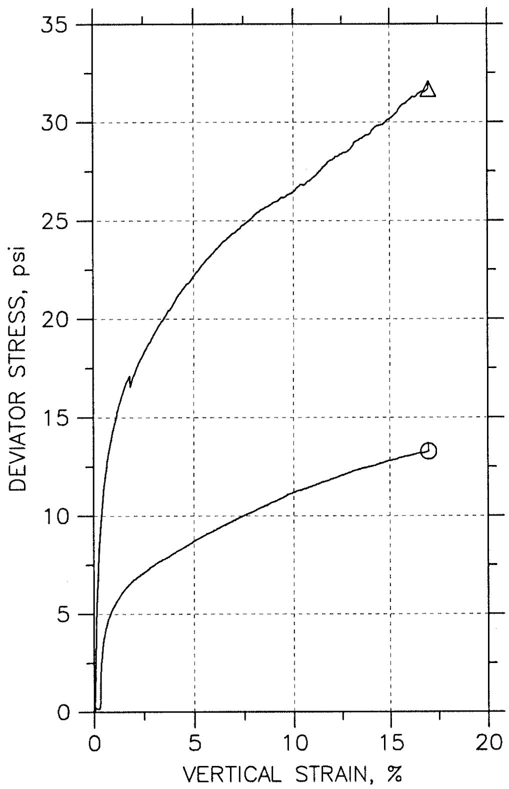
MACTEC

Project: KIF Dike East Seapage	Location: A-2	Project No.: 3043101017
Boring No.: A-2	Sample Type: Undisturbed	
Description: Gray Clay with Gravel		
Remarks: ASTM D4767-04		

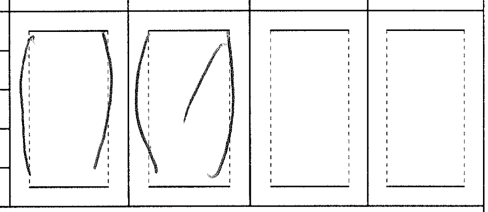
Tue, 20-APR-2010 13:10:00

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		⦶	△		
Sample No.		UD	UD		
Test No.		10107.1	10107.2		
Depth		7-9 ft	7-9 ft		
Initial	Diameter, in	2.85	2.85		
	Height, in	5.953	5.57		
	Water Content, %	20.1	13.1		
	Dry Density, pcf	104.8	119.6		
	Saturation, %	89.2	86.3		
	Void Ratio	0.608	0.409		
Before Shear	Water Content, %	22.4	14.3		
	Dry Density, pcf	105.1	121.6		
	Saturation*, %	100.0	100.0		
	Void Ratio	0.604	0.386		
	Back Press., psi	140.	134.		
Ver. Eff. Cons. Stress, psi		6.994	14.		
Shear Strength, psi		6.636	15.84		
Strain at Failure, %		17	17		
Strain Rate, %/min		0.02	0.02		
B-Value		0.96	0.96		
Estimated Specific Gravity		2.7	2.7		
Liquid Limit		---	---		
Plastic Limit		---	---		



MACTEC

Project: KIF Dike East Seapage

Location: A-2

Project No.: 3043101017

Boring No.: A-2

Sample Type: Undisturbed

Description: Gray Clay with Gravel

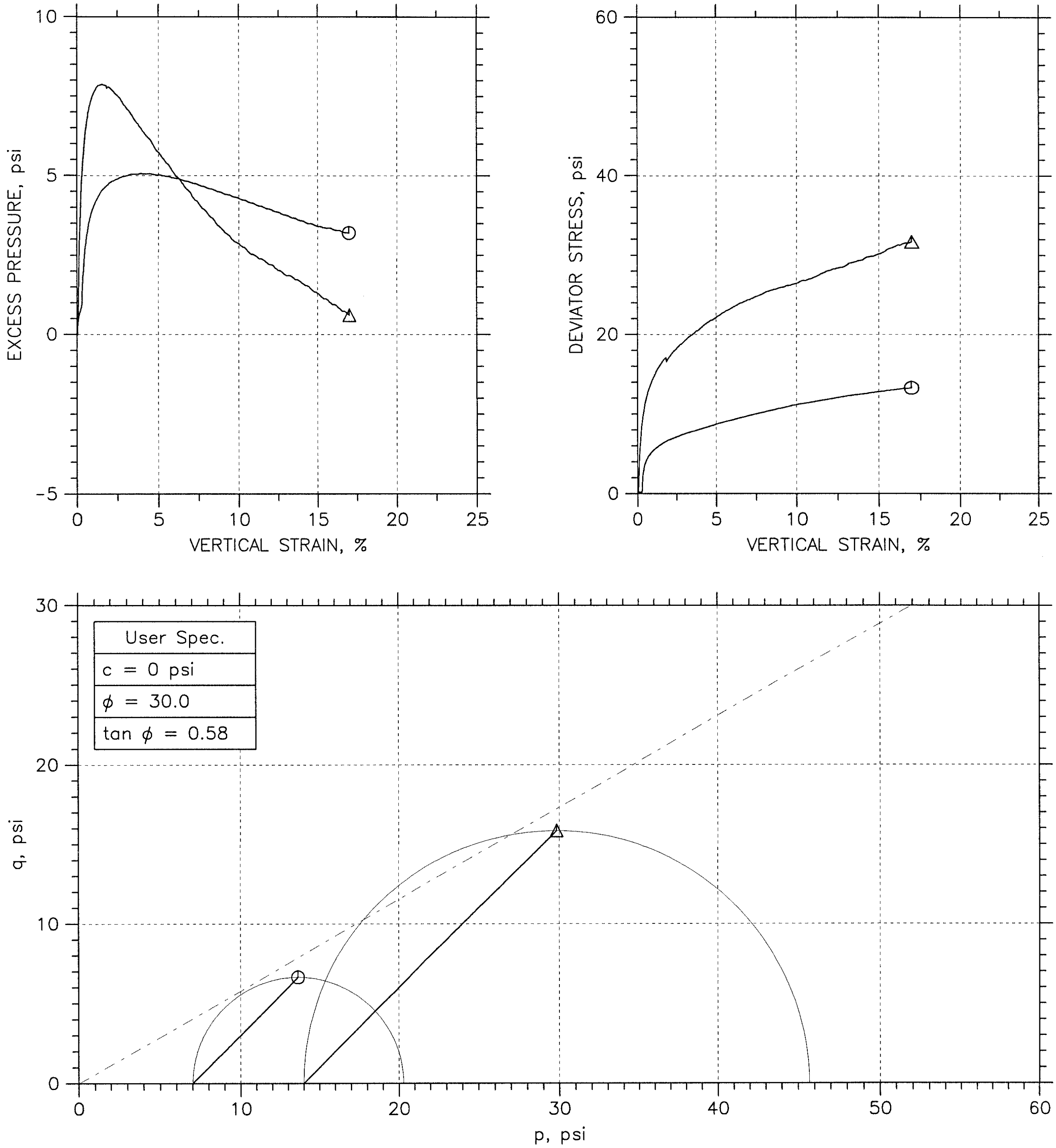
Remarks: ASTM D4767-04

Phase calculations based on start and end of test.

* Saturation is set to 100% for phase calculations.

Tue, 20-APR-2010 13:10:53

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

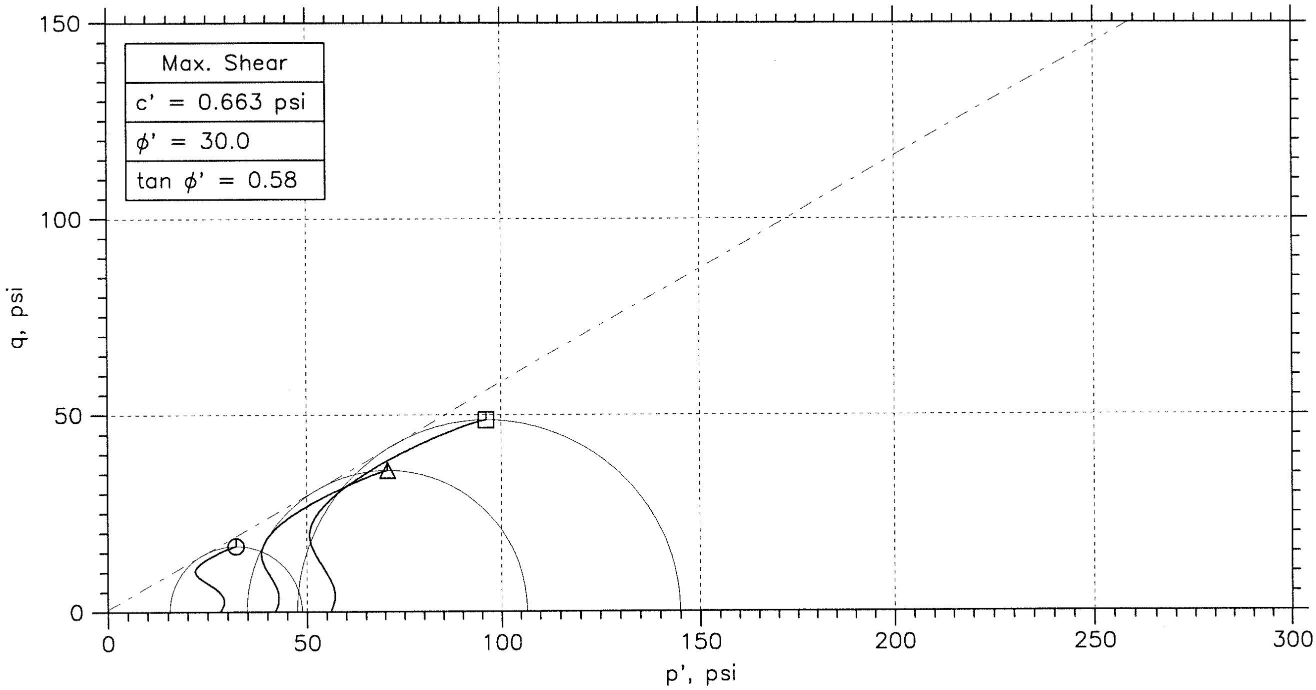


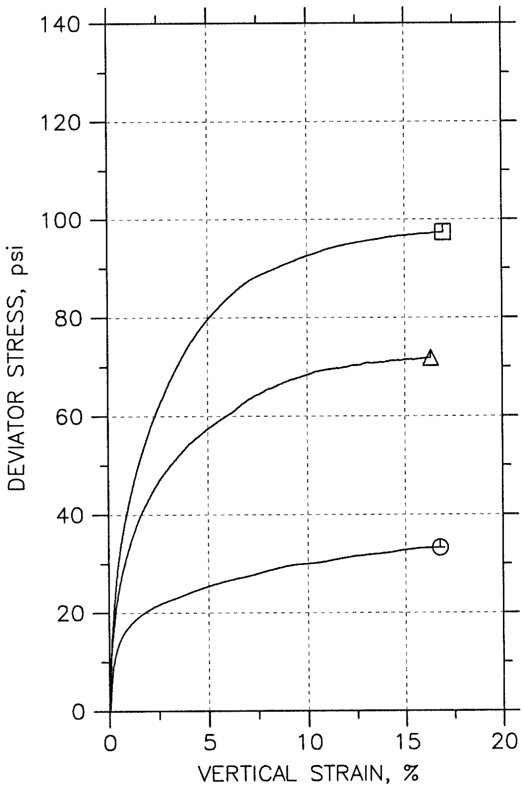
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
○	UD	10107.1	7-9 ft	JW	4/12/10			10107.1_2583.dat
△	UD	10107.2	7-9 ft	JW	4/12/10			10107.2_2582.dat

MACTEC	Project: KIF Dike East Seapage	Location: A-2	Project No.: 3043101017
	Boring No.: A-2	Sample Type: Undisturbed	
	Description: Gray Clay with Gravel		
	Remarks: ASTM D4767-04		

Tue, 20-APR-2010 13:10:54

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





		○	△	□	
Symbol		○	△	□	
Sample No.		UD	UD	UD	
Test No.		10114.1	10114.2	10114.3	
Depth		35-37 ft	35-37 ft	35-37 ft	
Initial	Diameter, in	2.855	2.835	2.824	
	Height, in	5.967	5.957	5.958	
	Water Content, %	26.3	23.2	23.0	
	Dry Density, pcf	100.3	103.	103.6	
	Saturation, %	104.3	98.3	99.1	
	Void Ratio	0.681	0.636	0.626	
Before Shear	Water Content, %	22.1	21.7	21.4	
	Dry Density, pcf	105.6	106.3	106.9	
	Saturation*, %	100.0	100.0	100.0	
	Void Ratio	0.597	0.585	0.577	
	Back Press., psi	30.	87.99	90.	
Ver. Eff. Cons. Stress, psi		28.	42.02	56.	
Shear Strength, psi		16.62	35.89	48.66	
Strain at Failure, %		16.8	16.3	17	
Strain Rate, %/min		0.01	0.01	0.01	
B-Value		1.14	0.96	0.97	
Estimated Specific Gravity		2.7	2.7	2.7	
Liquid Limit		---	---	---	
Plastic Limit		---	---	---	

MACTEC

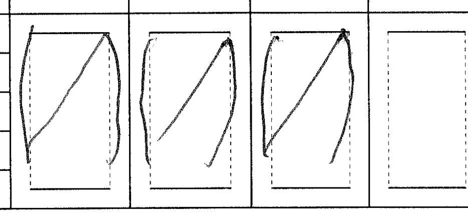
Project: KIF Dike East Seapage

Location: A-2

Project No.: 3043101017

Boring No.: A-2

Sample Type: Undisturbed



Description: Gray Clay

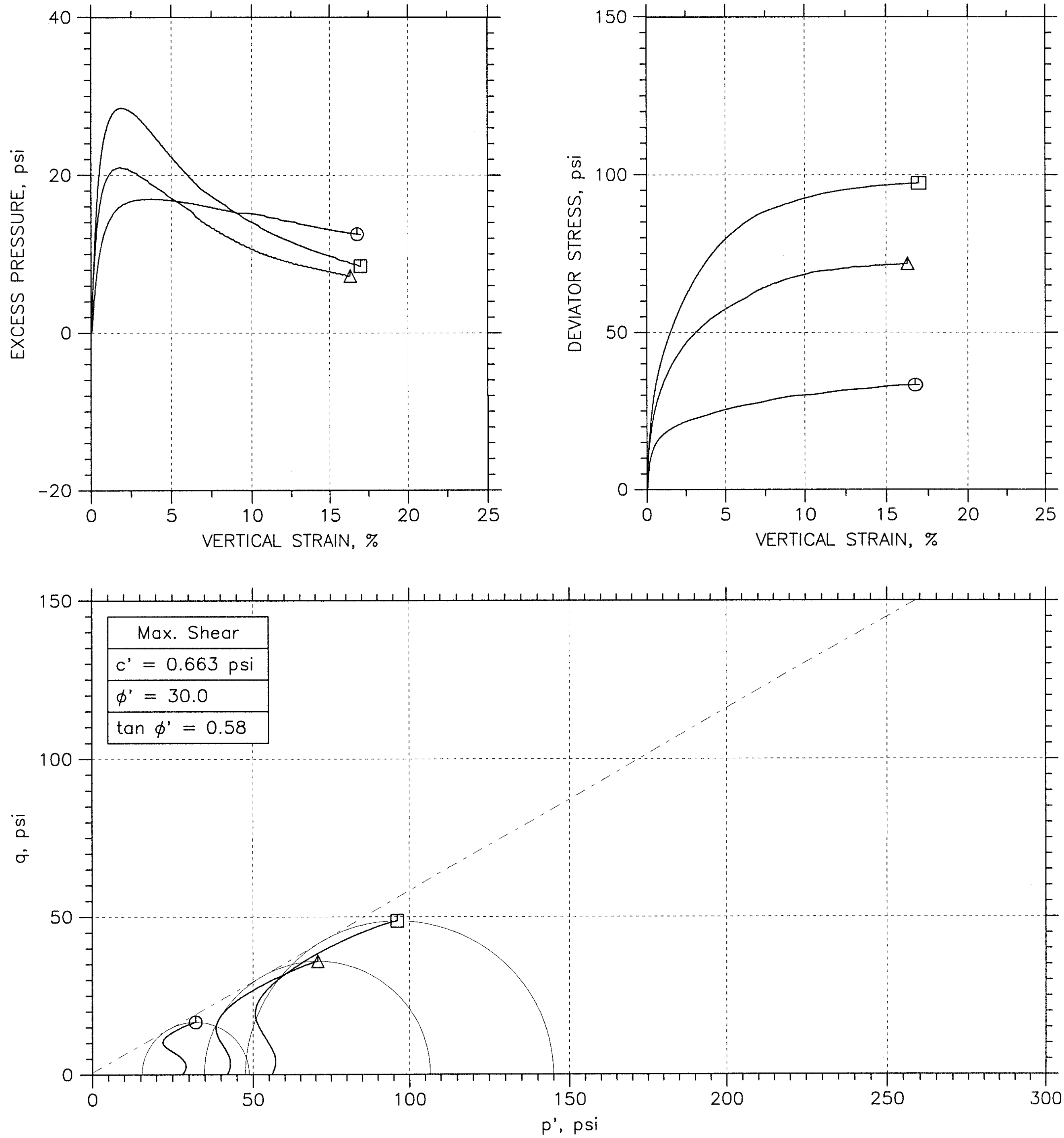
Remarks: ASTM D4767-04

Phase calculations based on start and end of test.

* Saturation is set to 100% for phase calculations.

Wed, 21-APR-2010 08:51:20

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767



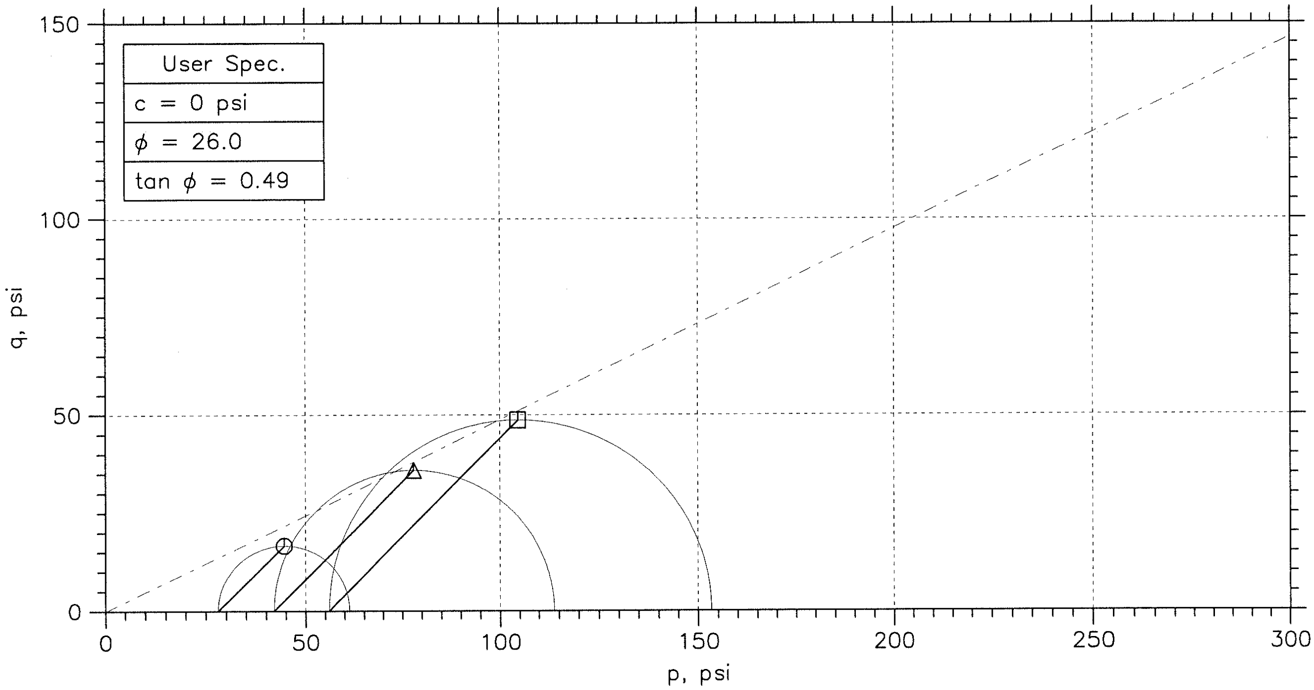
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⦶	UD	10114.1	35-37 ft	JW	4/14/10			10114.1_2583.dat
△	UD	10114.2	35-37 ft	JW	4/14/10			10114.2a_2581.dat
◫	UD	10114.3	35-37 ft	JW	4/14/10			10114.3_2582.dat

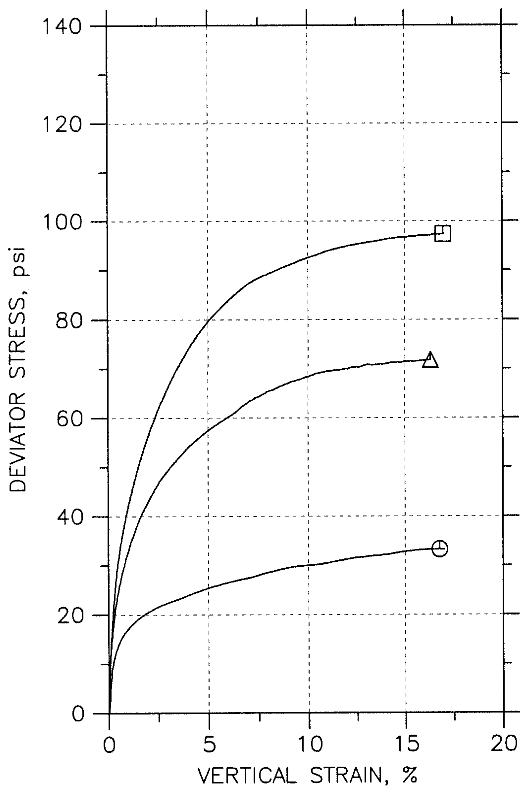
MACTEC

Project: KIF Dike East Seapage	Location: A-2	Project No.: 3043101017
Boring No.: A-2	Sample Type: Undisturbed	
Description: Gray Clay		
Remarks: ASTM D4767-04		

Wed, 21-APR-2010 08:51:21

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

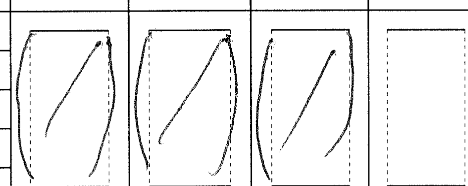




	Symbol	⦶	△	⊡	
	Sample No.	UD	UD	UD	
	Test No.	10114.1	10114.2	10114.3	
	Depth	35-37 ft	35-37 ft	35-37 ft	
Initial	Diameter, in	2.855	2.835	2.824	
	Height, in	5.967	5.957	5.958	
	Water Content, %	26.3	23.2	23.0	
	Dry Density, pcf	100.3	103.	103.6	
	Saturation, %	104.3	98.3	99.1	
	Void Ratio	0.681	0.636	0.626	
Before Shear	Water Content, %	22.1	21.7	21.4	
	Dry Density, pcf	105.6	106.3	106.9	
	Saturation*, %	100.0	100.0	100.0	
	Void Ratio	0.597	0.585	0.577	
	Back Press., psi	30.	87.99	90.	
	Ver. Eff. Cons. Stress, psi	28.	42.02	56.	
	Shear Strength, psi	16.62	35.89	48.66	
	Strain at Failure, %	16.8	16.3	17	
	Strain Rate, %/min	0.01	0.01	0.01	
	B-Value	1.14	0.96	0.97	
	Estimated Specific Gravity	2.7	2.7	2.7	
	Liquid Limit	---	---	---	
	Plastic Limit	---	---	---	

MACTEC

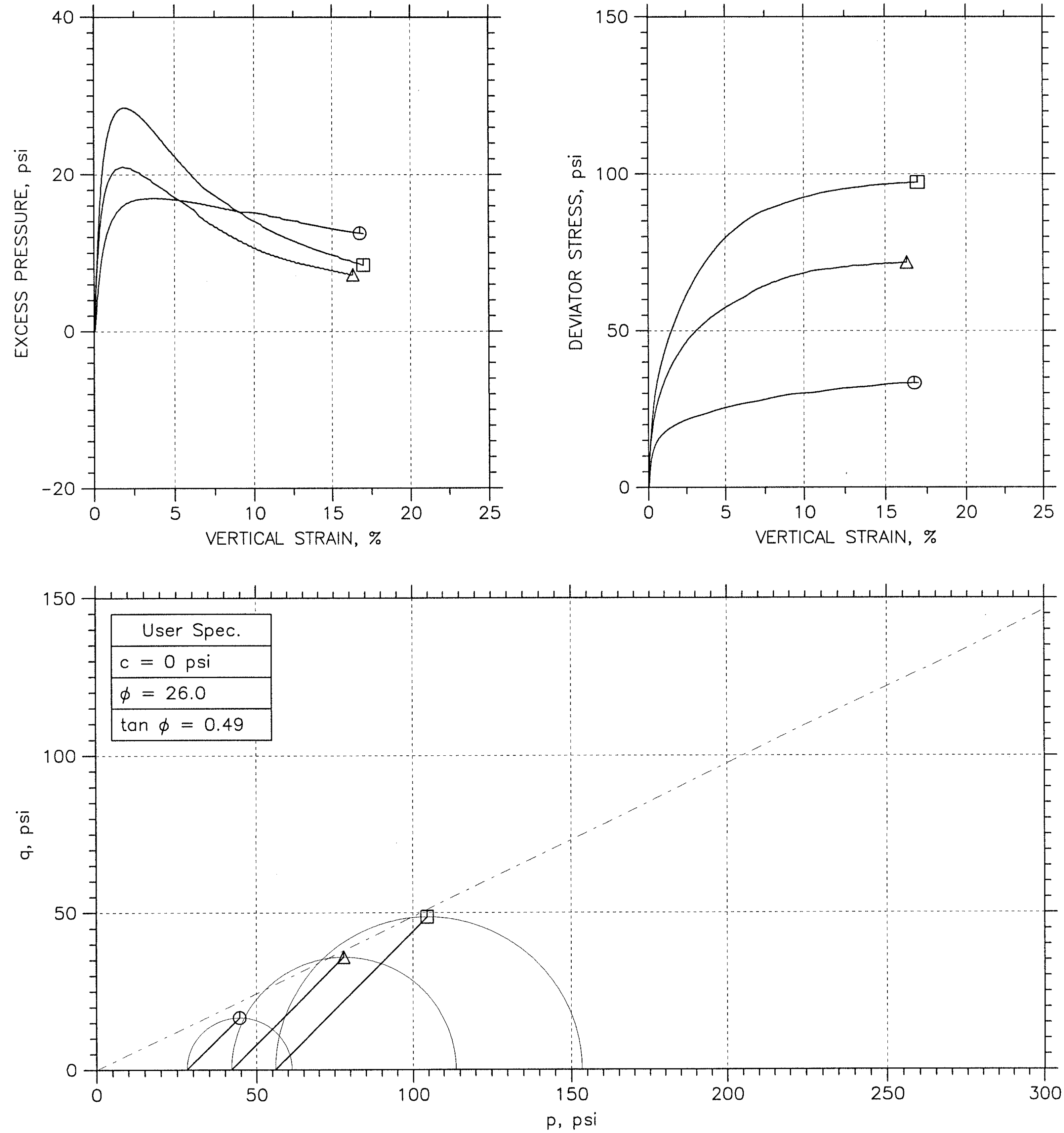
Project: KIF Dike East Seapage
Location: A-2
Project No.: 3043101017
Boring No.: A-2
Sample Type: Undisturbed
Description: Gray Clay
Remarks: ASTM D4767-04



Phase calculations based on start and end of test.
* Saturation is set to 100% for phase calculations.

Wed, 21-APR-2010 08:52:01

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767



	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⦶	UD	10114.1	35-37 ft	JW	4/14/10			10114.1_2583.dat
△	UD	10114.2	35-37 ft	JW	4/14/10			10114.2a_2581.dat
⊡	UD	10114.3	35-37 ft	JW	4/14/10			10114.3_2582.dat

MACTEC			
	Project: KIF Dike East Seapage	Location: A-2	Project No.: 3043101017
	Boring No.: A-2	Sample Type: Undisturbed	
	Description: Gray Clay		
	Remarks: ASTM D4767-04		

Wed, 21-APR-2010 08:52:02

MACTEC

HYDRAULIC CONDUCTIVITY

Project No.	*3043-10-1017*	Tested By	*JW*
Project Name	*KIF East Dike Seapage*	Test Date	*4/15/2010*
Boring No.	*A-2*	Reviewed By	
Sample No.	*UD*	Review Date	
Sample Depth	*33-35 ft*	Lab No.	*10113*
Sample Description	*Gray Clay*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*UD*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*26.5*
Wet Unit Weight, pcf:	*127.4*
Dry Unit Weight, pcf:	*100.7*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***4.4E-08***

Remarks: ____________________

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

MACTEC

Project Number 3043-10-1017
Project Name KIF East Dike Seapage
Boring No. A-2
Sample No. UD
Sample Depth 33-35 ft
Sample Description Gray Clay

Tested By JW
Test Date 04/15/10
Reviewed By
Review Date
Lab No. 10113

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	AB-9
Location 1	5.554	Location 1	2.876	Wet Soil+Pan, grams	1236.76
Location 2	5.500	Location 2	2.842	Dry Soil + Pan, grams	1025.90
Location3	5.522	Location 3	2.864	Pan Weight, grams	87.16
Average	5.525	Average	2.861	Moisture Content, %	22.5
Volume, in^3	35.51	Wet Soil + Tare, grams	1187.45	Dry Unit Weight, pcf	107.6
SG Assumed	2.70	Tare Weight, grams	0.00	Saturation, %	107.3
Soil Sample Wt., g	1187.45	Dry Soil +Tare, grams	938.74	Diameter, in.	N/A
Dry UW, pcf	100.7	Moisture Content, %	26.5	Length, in.	N/A
Saturation, %	106.3			Volume, in^3	N/A

Consolidation

Chamber Pressure, psi	49
Back Pressure, psi	21
Confining Pressure, psi	28
Initial Burett Reading	37.44
Final Burett Reading	0
Volume Change, cc	37.44

Permeant used water

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
1530	1.40	28.00	25.55	2.45	23.3	23.8	21.5	5.35E-08	4.95E-08
2760	1.40	28.00	24.20	3.80	23.3	23.8	20.3	4.74E-08	4.38E-08
3720	1.40	28.00	23.20	4.80	23.3	23.8	19.3	4.54E-08	4.20E-08
990	1.40	27.30	25.75	1.55	22.8	23.2	21.8	5.28E-08	4.94E-08
2020	1.40	27.30	24.55	2.75	22.8	23.2	20.6	4.71E-08	4.41E-08
2700	1.40	27.30	23.90	3.40	22.8	23.2	20.0	4.42E-08	4.14E-08
4740	1.40	27.30	22.05	5.25	22.8	23.2	18.3	4.06E-08	3.80E-08

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	UD	N/A	N/A	Vertical

Avg. k at 20 °C 4.4E-08 cm/sec

a_a = 0.76712 cm²
A = 41.47 cm²
L = 14.03 cm
S=L/A= 0.33845 1/cm

a_p= 0.031416 cm²
M_1= 0.03018
M_2= 1.04095
$C = M_1S/(G_{Hg}-1)$= 0.0008126 for 15° to 25°

Remarks:

MACTEC

HYDRAULIC CONDUCTIVITY

Project No.	*3043-10-1017*	Tested By	*JW*
Project Name	*KIF East Dike Seapage*	Test Date	*4/12/2010*
Boring No.	*A-1*	Reviewed By	
Sample No.	*UD*	Review Date	
Sample Depth	*33-35 ft*	Lab No.	*10115*
Sample Description	*Greenish Gray Clay*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*UD*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*23.5*
Wet Unit Weight, pcf:	*131.1*
Dry Unit Weight, pcf:	*106.1*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***5.3E-08***

Remarks: ____________________

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

MACTEC

Project Number	3043-10-1017	Tested By	JW
Project Name	KIF East Dike Seapage	Test Date	04/12/10
Boring No.	A-1	Reviewed By	
Sample No.	UD	Review Date	
Sample Depth	33-35 ft	Lab No.	10115
Sample Description	Greenish Gray Clay		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	T-2
Location 1	5.541	Location 1	2.827	Wet Soil+Pan, grams	1147.07
Location 2	5.524	Location 2	2.826	Dry Soil + Pan, grams	977.85
Location3	5.532	Location 3	2.837	Pan Weight, grams	8.41
Average	5.532	Average	2.830	Moisture Content, %	17.5
Volume, in^3	34.80	Wet Soil + Tare, grams	1197.72	Dry Unit Weight, pcf	119.1
SG Assumed	2.70	Tare Weight, grams	0.00	Saturation, %	113.7
Soil Sample Wt., g	1197.72	Dry Soil +Tare, grams	969.44	Diameter, in.	N/A
Dry UW, pcf	106.1	Moisture Content, %	23.5	Length, in.	N/A
Saturation, %	108.2			Volume, in^3	N/A

Consolidation

Chamber Pressure, psi	32
Back Pressure, psi	4
Confining Pressure, psi	28
Initial Burett Reading	65.44
Final Burett Reading	3.25
Volume Change, cc	62.19

Permeant used water

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
4830	1.40	19.00	13.25	5.75	23.9	15.7	10.4	7.15E-08	6.52E-08
1555	1.40	19.05	17.35	1.70	23.9	15.8	14.2	5.65E-08	5.15E-08
3420	1.40	19.05	15.55	3.50	23.9	15.8	12.5	5.62E-08	5.13E-08
4620	1.40	19.05	14.45	4.60	23.9	15.8	11.5	5.70E-08	5.19E-08
1590	1.40	18.45	16.75	1.70	23.9	15.3	13.7	5.73E-08	5.23E-08
4320	1.40	18.45	14.40	4.05	23.9	15.3	11.5	5.5E-08	4.98E-08
1819	1.40	17.90	16.10	1.80	23.9	14.8	13.1	5.5E-08	5.02E-08

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	UD	N/A	N/A	Vertical

Avg. k at 20 °C **5.3E-08 cm/sec**

$a_a =$ 0.76712 cm²
A = 40.58 cm²
L = 14.05 cm
S=L/A= 0.34627 1/cm

$a_p =$ 0.031416 cm²
$M_1 =$ 0.03018
$M_2 =$ 1.04095
$C = M_1 S/(G_{Hg}-1) =$ 0.0008314 for 15° to 25°

Remarks:

MACTEC

HYDRAULIC CONDUCTIVITY

Project No.	*3043-10-1017*	Tested By	*JW*
Project Name	*KIF East Dike Seapage*	Test Date	*4/12/2010*
Boring No.	*A-3*	Reviewed By	
Sample No.	*UD*	Review Date	
Sample Depth	*10.5-12.5 ft*	Lab No.	*10116*
Sample Description	*Tan Clay with Gravel*		

ASTM D5084 - Method F (CVFH)

Sample Type:	*UD*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*30.7*
Wet Unit Weight, pcf:	*124.4*
Dry Unit Weight, pcf:	*95.1*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***8.4E-08***

Remarks: ______________________________

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

MACTEC

Project Number	3043-10-1017	Tested By	JW
Project Name	KIF East Dike Seapage	Test Date	04/12/10
Boring No.	A-3	Reviewed By	
Sample No.	UD	Review Date	
Sample Depth	10.5-12.5 ft	Lab No.	10116
Sample Description	Tan Clay with Gravel		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	H-7
Location 1	5.425	Location 1	2.848	Wet Soil+Pan, grams	1112.33
Location 2	5.371	Location 2	2.851	Dry Soil + Pan, grams	874.00
Location3	5.432	Location 3	2.871	Pan Weight, grams	8.17
Average	5.409	Average	2.857	Moisture Content, %	27.5
Volume, in^3	34.67	Wet Soil + Tare, grams	1131.87	Dry Unit Weight, pcf	98.4
SG Assumed	2.70	Tare Weight, grams	0.00	Saturation, %	104.3
Soil Sample Wt., g	1131.87	Dry Soil +Tare, grams	865.83	Diameter, in.	
Dry UW, pcf	95.1	Moisture Content, %	30.7	Length, in.	
Saturation, %	107.6			Volume, in^3	

Consolidation

Chamber Pressure, psi	39
Back Pressure, psi	29
Confining Pressure, psi	10
Initial Burett Reading	21.2
Final Burett Reading	2.5
Volume Change, cc	18.7

Permeant used water

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
785	1.60	20.50	19.00	1.50	22.2	17.3	15.9	8.76E-08	8.31E-08
2057	1.60	20.50	16.70	3.80	22.2	17.3	13.7	9.11E-08	8.64E-08
2661	1.60	20.50	16.00	4.50	22.2	17.3	13.0	8.54E-08	8.10E-08
3600	1.60	20.50	14.70	5.80	22.2	17.3	11.8	8.53E-08	8.09E-08
710	1.60	22.00	20.40	1.60	22.2	18.7	17.1	9.57E-08	9.08E-08
1216	1.60	22.00	19.50	2.50	22.2	18.7	16.3	8.95E-08	8.50E-08
2520	1.60	22.00	17.30	4.70	22.2	18.7	14.2	8.68E-08	8.24E-08

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	UD	N/A	N/A	Vertical

Avg. k at 20 °C 8.4E-08 cm/sec

a_a = 0.76712 cm²
A = 41.35 cm²
L = 13.74 cm
S=L/A= 0.33228 1/cm

a_p= 0.031416 cm²
M_1= 0.03018
M_2= 1.04095
$C = M_1 S/(G_{Hg}-1)$= 0.0007978 for 15° to 25°

Remarks:

MACTEC

HYDRAULIC CONDUCTIVITY

Project No.	*3043-10-1017*	Tested By	*JW*
Project Name	*KIF East Dike Seapage*	Test Date	*4/13/2010*
Boring No.	*A-2*	Reviewed By	
Sample No.	*UD*	Review Date	
Sample Depth	*25-27 ft*	Lab No.	*10110*
Sample Description	***Brown Sandy Clay with Gravel***		

ASTM D5084 - Method F (CVFH)

Sample Type:	*UD*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*30.6*
Wet Unit Weight, pcf:	*119.6*
Dry Unit Weight, pcf:	*91.6*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***1.7E-07***

Remarks: ______________________________

PERMEABILITY TEST
(ASTM D5084 - 03) (Method F, Constant Volume Falling Head)

MACTEC

Project Number	3043-10-1017	Tested By	JW
Project Name	KIF East Dike Seapage	Test Date	04/13/10
Boring No.	A-2	Reviewed By	
Sample No.	UD	Review Date	
Sample Depth	25-27 ft	Lab No.	10110

Sample Description: Brown Sandy Clay with Gravel

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	T-9
Location 1	3.197	Location 1	2.844	Wet Soil+Pan, grams	605.44
Location 2	3.110	Location 2	2.819	Dry Soil + Pan, grams	475.81
Location3	3.114	Location 3	2.838	Pan Weight, grams	8.39
Average	3.140	Average	2.834	Moisture Content, %	27.7
Volume, in^3	19.80	Wet Soil + Tare, grams	622.01	Dry Unit Weight, pcf	97.3
SG Assumed	2.70	Tare Weight, grams	0.00	Saturation, %	102.5
Soil Sample Wt., g	622.01	Dry Soil +Tare, grams	476.42	Diameter, in.	N/A
Dry UW, pcf	91.6	Moisture Content, %	30.6	Length, in.	N/A
Saturation, %	98.4			Volume, in^3	N/A

Consolidation

Chamber Pressure, psi	55
Back Pressure, psi	34
Confining Pressure, psi	21
Initial Burett Reading	16.8
Final Burett Reading	-2.2
Volume Change, cc	19

Permeant used water

Elapsed Time (sec)	z_o (cm)	za (cm)	zb (cm)	Δz_p (cm)	Temp (°C)	Intial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
600	1.40	25.30	20.55	4.75	23.3	37.7	29.9	1.82E-07	1.68E-07
1230	1.40	25.30	16.50	8.80	23.3	37.7	23.2	1.85E-07	1.71E-07
600	1.40	19.40	15.75	3.65	23.3	28.4	22.4	1.86E-07	1.72E-07
1155	1.40	19.50	13.15	6.35	23.3	28.5	18.1	1.85E-07	1.71E-07
540	1.40	19.45	16.05	3.40	23.3	28.4	22.9	1.90E-07	1.76E-07
420	1.40	18.80	16.15	2.65	23.3	27.4	23.1	1.93E-07	1.79E-07

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
6	UD	N/A	N/A	Vertical

Avg. k at 20 °C 1.7E-07 cm/sec

a_a = 0.76712 cm^2

A = 40.69 cm^2

L = 7.98 cm

S=L/A= 0.19604 1/cm

a_p= 0.031416 cm^2

M_1= 0.03018

M_2= 1.04095

$C = M_1 S/(G_{Hg}-1)$= 0.0004707 for 15° to 25°

Remarks:

MACTEC

HYDRAULIC CONDUCTIVITY

Project No.	*3043-10-1017*	Tested By	*JW*
Project Name	*KIF East Dike Seapage*	Test Date	*4/12/2010*
Boring No.	*A-2*	Reviewed By	
Sample No.	*UD*	Review Date	
Sample Depth	*9-11 ft*	Lab No.	*10108*
Sample Description	*Gray Clay with Gravel*		

ASTM D5084-03 - (Method C Falling Head RisingTail)

Sample Type:	*UD*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*12.3*
Wet Unit Weight, pcf:	*137.2*
Dry Unit Weight, pcf:	*122.1*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***5.9E-06***

Remarks: ______________________________

PERMEABILITY TEST
(ASTM D5084 - 03) (Method C, Increasing Tailwater Level)

MACTEC

Project Number	3043-10-1017	Tested By	JW
Project Name	KIF East Dike Seapage	Test Date	04/12/10
Boring No.	A-2	Reviewed By	
Sample No.	UD	Review Date	
Sample Depth	9-11 ft	Lab No.	10108
Sample Description	Gray Clay with Gravel		

Initial Sample Data				Final Sample Data	
Length, in		Diameter, in		Pan No.	DB-5
Location 1	3.322	Location 1	2.832	Wet Soil+Pan, g	768.29
Location 2	3.316	Location 2	2.799	Dry Soil + Pan, g	675.74
Location3	3.401	Location 3	2.813	Pan Weight, g	8.27
Average	3.346	Average	2.815	Moisture Content, %	13.9
Volume, in^3	20.82	Wet Soil + Tare, g	749.65	Dry Unit Weight, pcf	124.8
SG Assumed	2.7	Tare Weight, g	0.00	Saturation, %	106.9
Soil Sample Wt., g	749.65	Dry Soil + Tare, g	667.47	Diameter, in.	N/A
Dry UW, pcf	122.1	Moisture Content, %	12.3	Length, in.	N/A
Saturation, %	87.6			Volume, in^3	N/A

Consolidation	
Chamber Pressure, psi	45.7
Back Pressure, psi	38.7
Confining Pressure, psi	7
Initial Burette Reading	16.5
Finial Burette Reading	9.3
Volume Change, cc	7.2
Permeant used	Water

Time (sec)	H_a (cm)	H_1 (cm)	H_b (cm)	H_2 (cm)	Temp (°C)	Initial Hydraulic Gradient	Final Hydraulic Gradient	k cm/sec	k cm/sec at 20 °C
1920	12.3	102.5	38.5	77.6	23.9	10.6	4.6	7.37E-06	6.73E-06
945	13.5	102.4	27.9	88.7	23.9	10.5	7.2	6.81E-06	6.21E-06
700	12.1	101.4	23.0	91.6	23.9	10.5	8.1	6.37E-06	5.81E-06
480	12.7	101.9	19.9	95.2	23.9	10.5	8.9	5.98E-06	5.45E-06
738	13.1	101.7	24.1	91.7	23.9	10.4	8.0	6.21E-06	5.66E-06
580	11.6	101.9	20.6	93.5	23.9	10.6	8.6	6.25E-06	5.70E-06
578	10.9	102.0	19.9	93.7	23.9	10.7	8.7	6.17E-06	5.63E-06

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
7	UD	N/A	N/A	Vertical

Avg. k at 20 °C **5.88E-06 cm/sec**

a = area of burette in cm²
L = length of sample in cm
A = area of sample in cm²

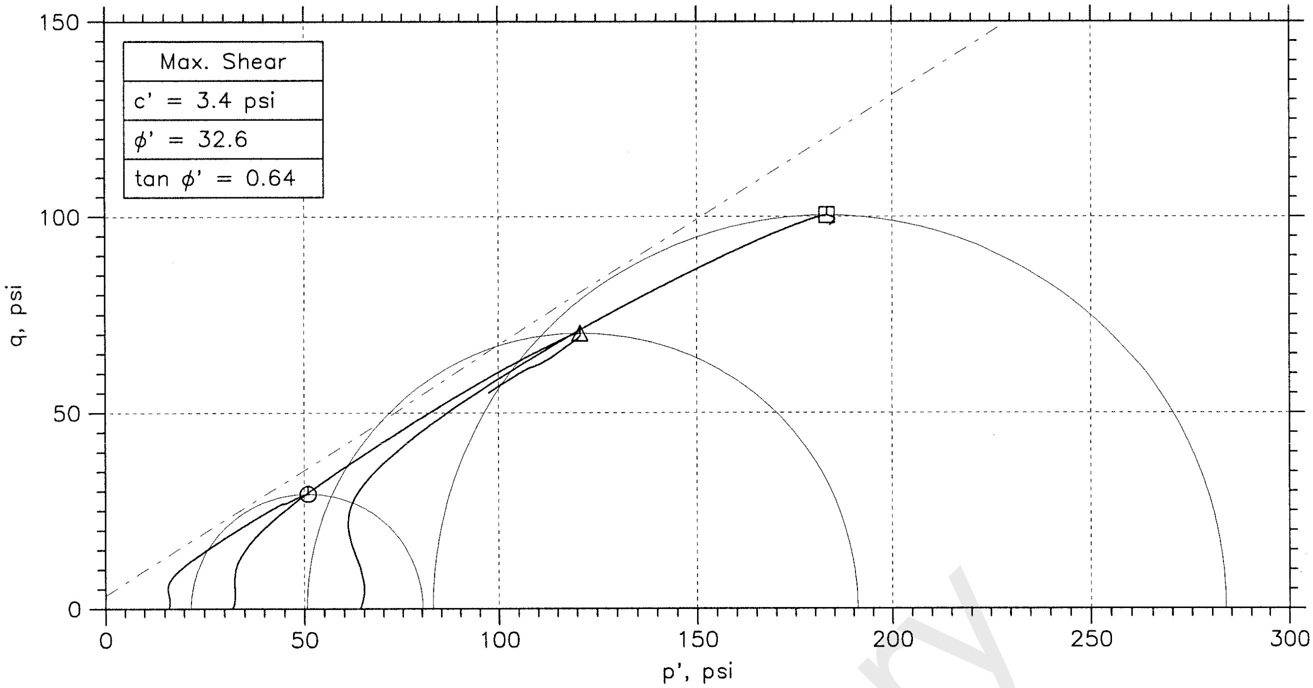
Ha = initial inlet head in cm
H_1 = initial outlet head in cm
t = time in seconds

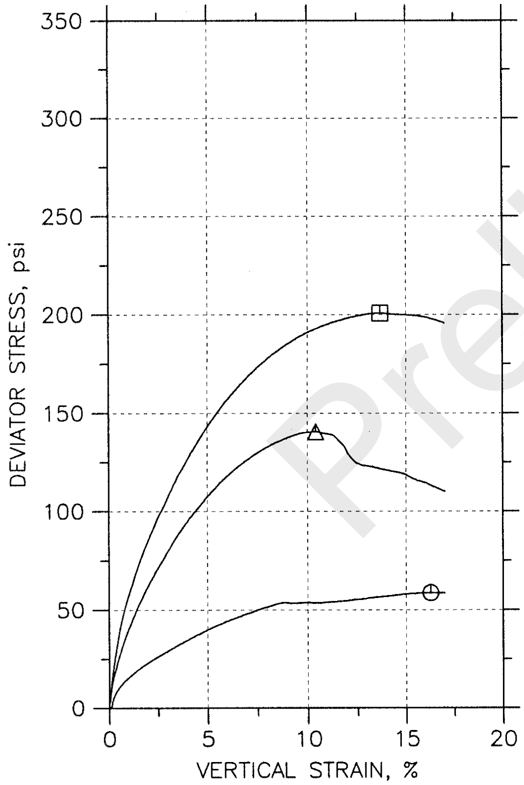
H_b = final inlet head in cm
H_2 = final outlet head in cm

a = 0.16 cm²
A = 40.14 cm²
L = 8.50 cm

Remarks:

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

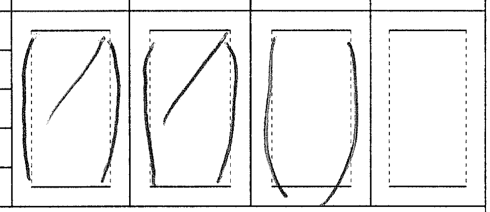




	Symbol	○	△	□	
	Sample No.	UD-1	UD-1	UD-1	
	Test No.	10161.1	10161.2	10161.3	
	Depth	18-20 ft	18-20 ft	18-20 ft	
Initial	Diameter, in	2.816	2.848	2.845	
	Height, in	5.958	6	5.965	
	Water Content, %	57.1	55.1	45.6	
	Dry Density, pcf	60.73	63.07	71.92	
	Saturation, %	91.0	93.5	97.4	
	Void Ratio	1.57	1.47	1.17	
Before Shear	Water Content, %	57.1	53.4	45.1	
	Dry Density, pcf	64.29	66.83	73.33	
	Saturation*, %	100.0	100.0	100.0	
	Void Ratio	1.43	1.34	1.13	
	Back Press., psi	76.	78.	51.99	
	Ver. Eff. Cons. Stress, psi	16.	31.99	64.01	
	Shear Strength, psi	29.26	70.18	100.3	
	Strain at Failure, %	16.3	10.4	13.7	
	Strain Rate, %/min	0.05	0.05	0.05	
	B-Value	0.96	0.97	0.95	
	Estimated Specific Gravity	2.5	2.5	2.5	
	Liquid Limit	---	---	---	
	Plastic Limit	---	---	---	

MACTEC

Project: KIF Dike East Seapage
Location: B-1
Project No.: 3043101017
Boring No.: B-1
Sample Type: Undisturbed

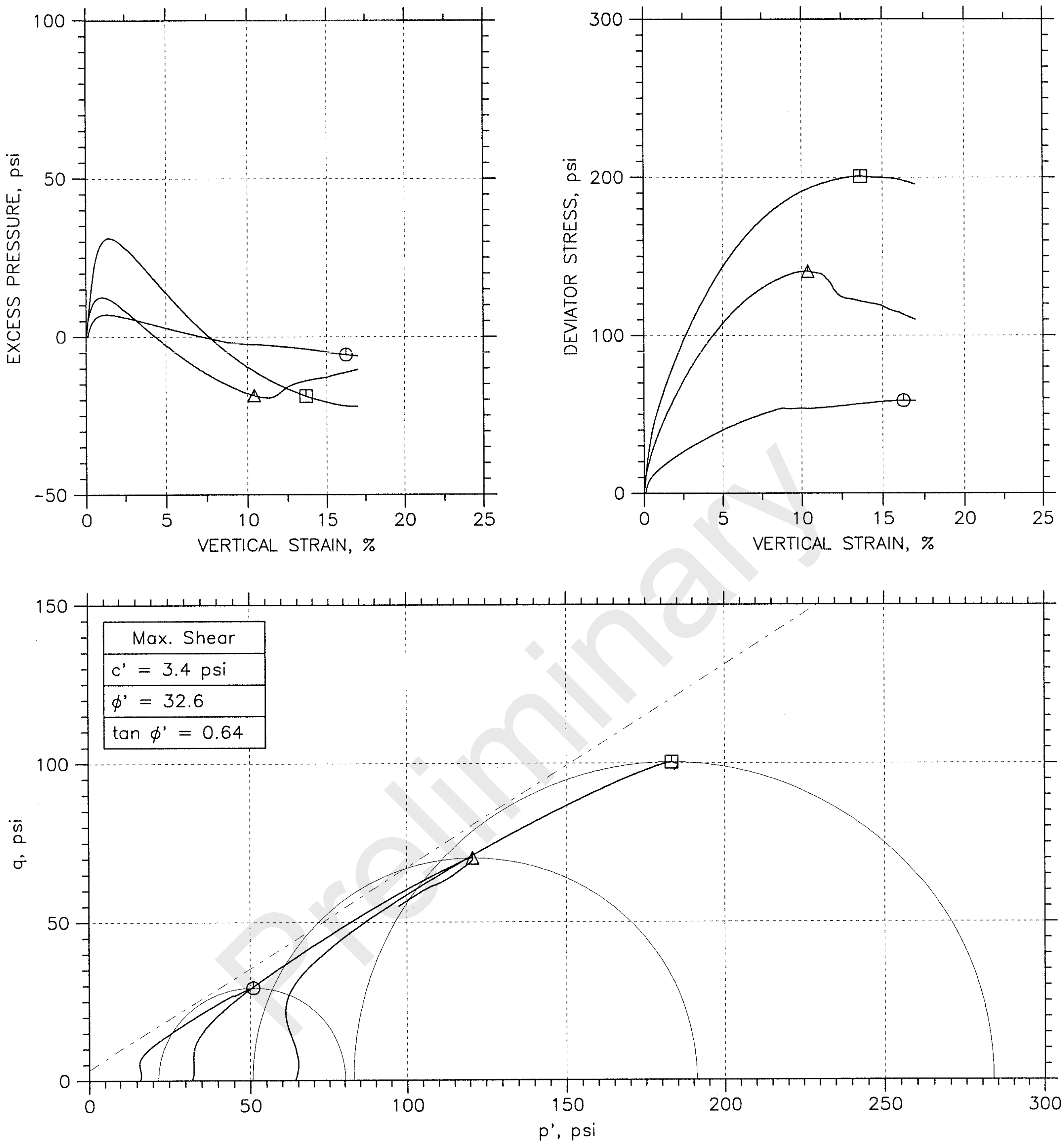


Description: Dark Gray Silt (Fly Ash)
Remarks: ASTM D4767-04

Fri, 07-MAY-2010 08:44:21

Phase calculations based on start and end of test.
* Saturation is set to 100% for phase calculations.

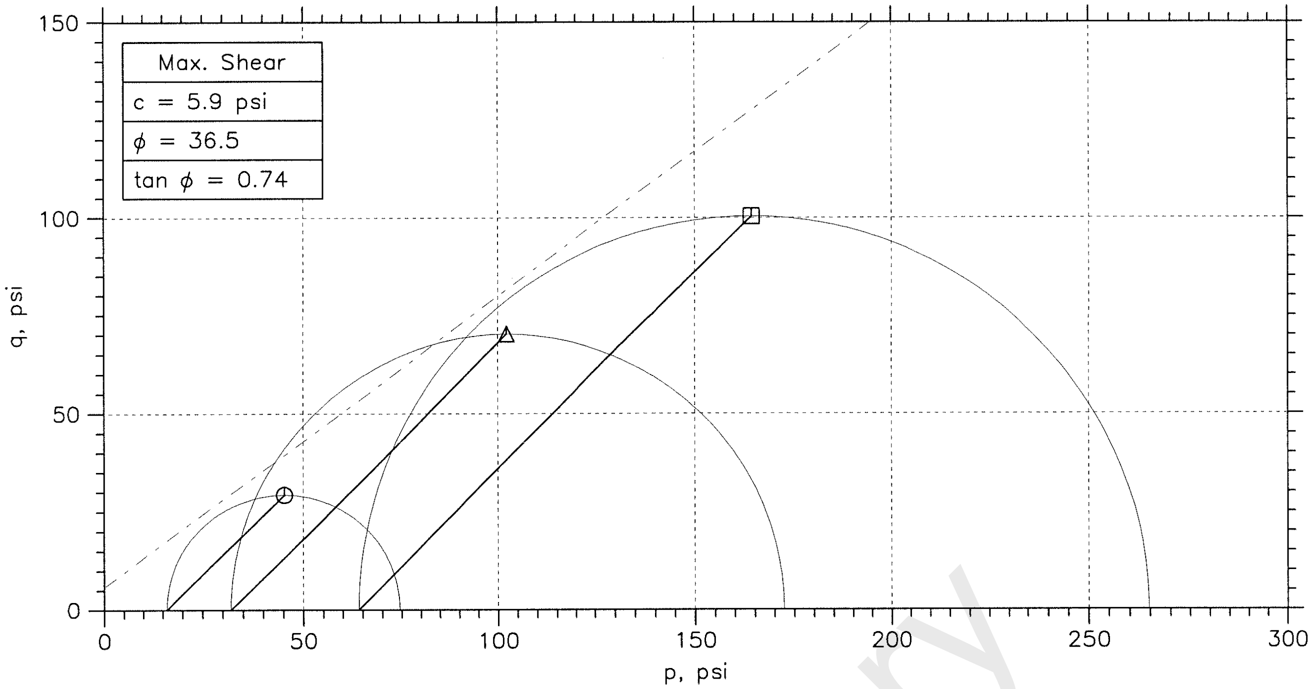
CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

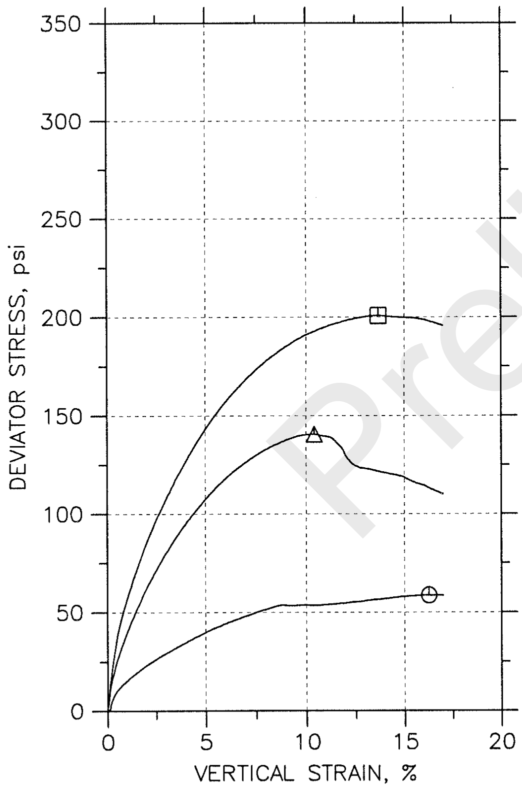


	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
○	UD-1	10161.1	18-20 ft	JW	5/4/10			10161.1_2583.dat
△	UD-1	10161.2	18-20 ft	JW	5/4/10			10161.2_2582.dat
□	UD-1	10161.3	18-20 ft	JW	5/4/10			10161.3_2581.dat

MACTEC			
	Project: KIF Dike East Seapage	Location: B-1	Project No.: 3043101017
	Boring No.: B-1	Sample Type: Undisturbed	
	Description: Dark Gray Silt (Fly Ash)		
	Remarks: ASTM D4767-04		

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





		○	△	□	
Sample No.		UD-1	UD-1	UD-1	
Test No.		10161.1	10161.2	10161.3	
Depth		18-20 ft	18-20 ft	18-20 ft	
Initial	Diameter, in	2.816	2.848	2.845	
	Height, in	5.958	6	5.965	
	Water Content, %	57.1	55.1	45.6	
	Dry Density, pcf	60.73	63.07	71.92	
	Saturation, %	91.0	93.5	97.4	
	Void Ratio	1.57	1.47	1.17	
Before Shear	Water Content, %	57.1	53.4	45.1	
	Dry Density, pcf	64.29	66.83	73.33	
	Saturation*, %	100.0	100.0	100.0	
	Void Ratio	1.43	1.34	1.13	
	Back Press., psi	76.	78.	51.99	
Ver. Eff. Cons. Stress, psi		16.	31.99	64.01	
Shear Strength, psi		29.26	70.18	100.3	
Strain at Failure, %		16.3	10.4	13.7	
Strain Rate, %/min		0.05	0.05	0.05	
B-Value		0.96	0.97	0.95	
Estimated Specific Gravity		2.5	2.5	2.5	
Liquid Limit		---	---	---	
Plastic Limit		---	---	---	

MACTEC

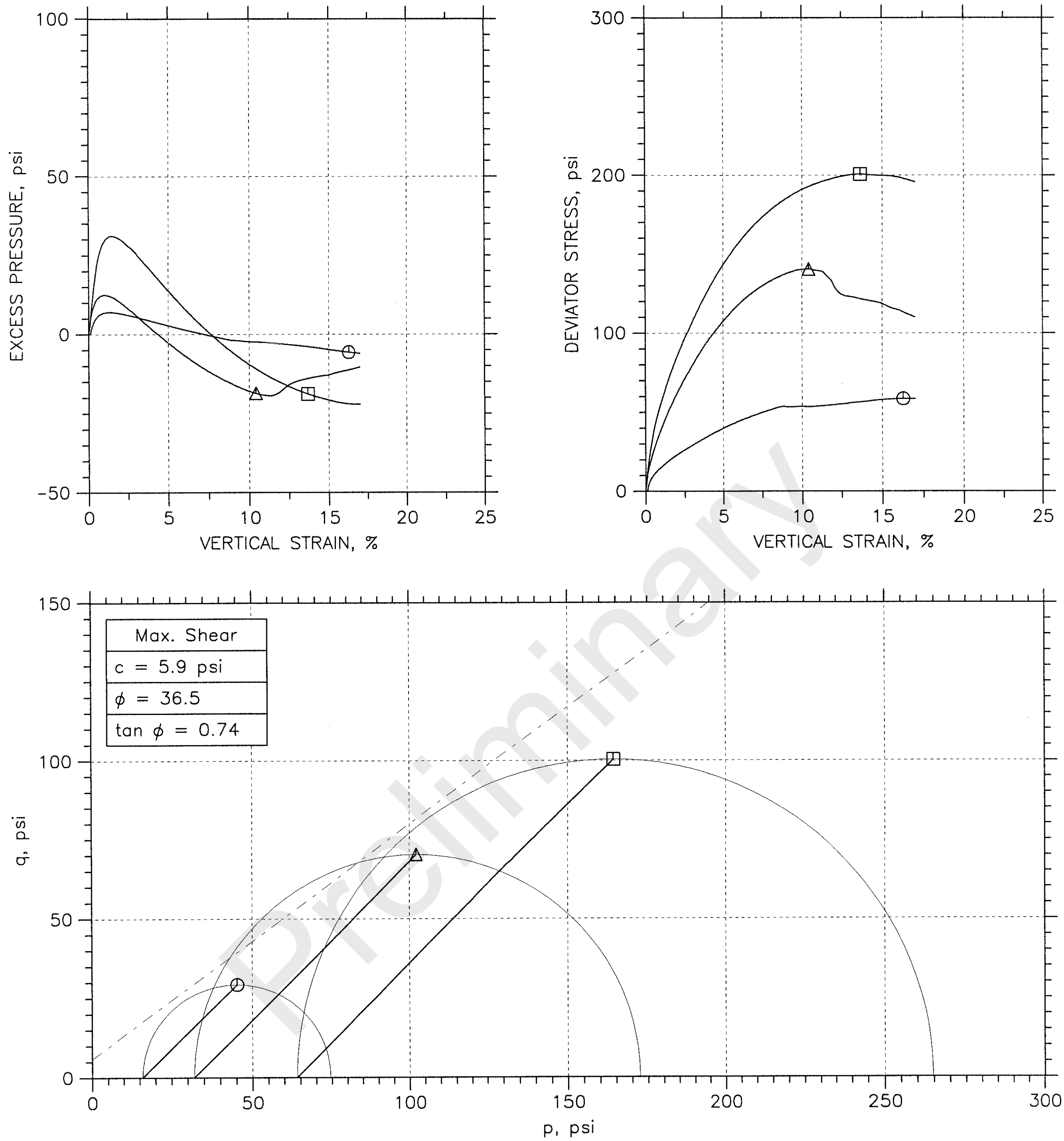
Project: KIF Dike East Seapage	
Location: B-1	
Project No.: 3043101017	
Boring No.: B-1	
Sample Type: Undisturbed	
Description: Dark Gray Silt (Fly Ash)	
Remarks: ASTM D4767-04	

Fri, 07-MAY-2010 08:44:37

Phase calculations based on start and end of test.

* Saturation is set to 100% for phase calculations.

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767



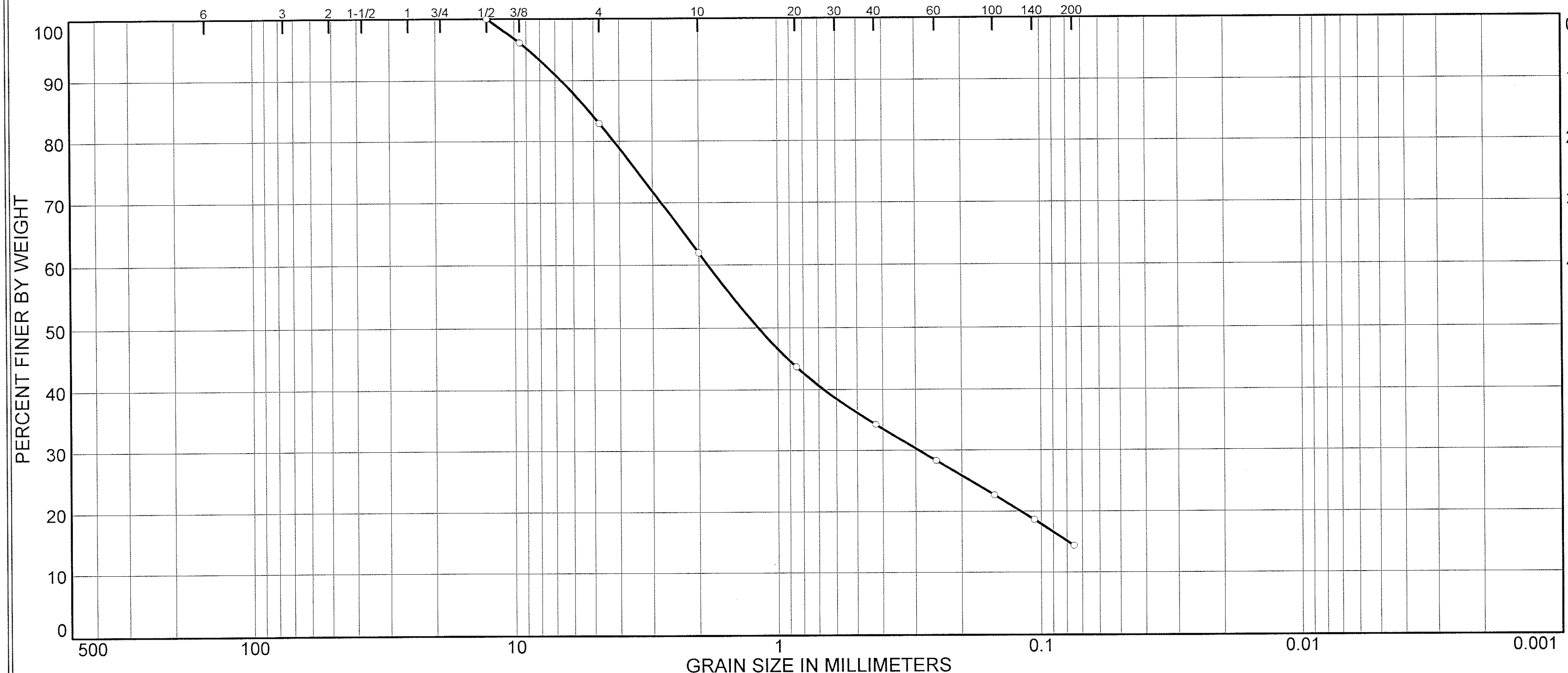
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
○	UD-1	10161.1	18-20 ft	JW	5/4/10			10161.1_2583.dat
△	UD-1	10161.2	18-20 ft	JW	5/4/10			10161.2_2582.dat
□	UD-1	10161.3	18-20 ft	JW	5/4/10			10161.3_2581.dat

MACTEC

Project: KIF Dike East Seapage	Location: B-1	Project No.: 3043101017
Boring No.: B-1	Sample Type: Undisturbed	
Description: Dark Gray Silt (Fly Ash)		
Remarks: ASTM D4767-04		

Fri, 07-MAY-2010 08:44:37

Partical Size Distribution ASTM D422-63 (2007)



% COBBLES	% GRAVEL COARSE	% GRAVEL FINE	% SAND COARSE	% SAND MEDIUM	% SAND FINE	% FINES SILT	% FINES CLAY
0.0	0.0	17.1	21.0	27.6	19.9	14.4	

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
A-1	SS-8	10.5-12 ft	5/3/10		Black Silty Sand with Gravel (Visual)	17.6		

Client

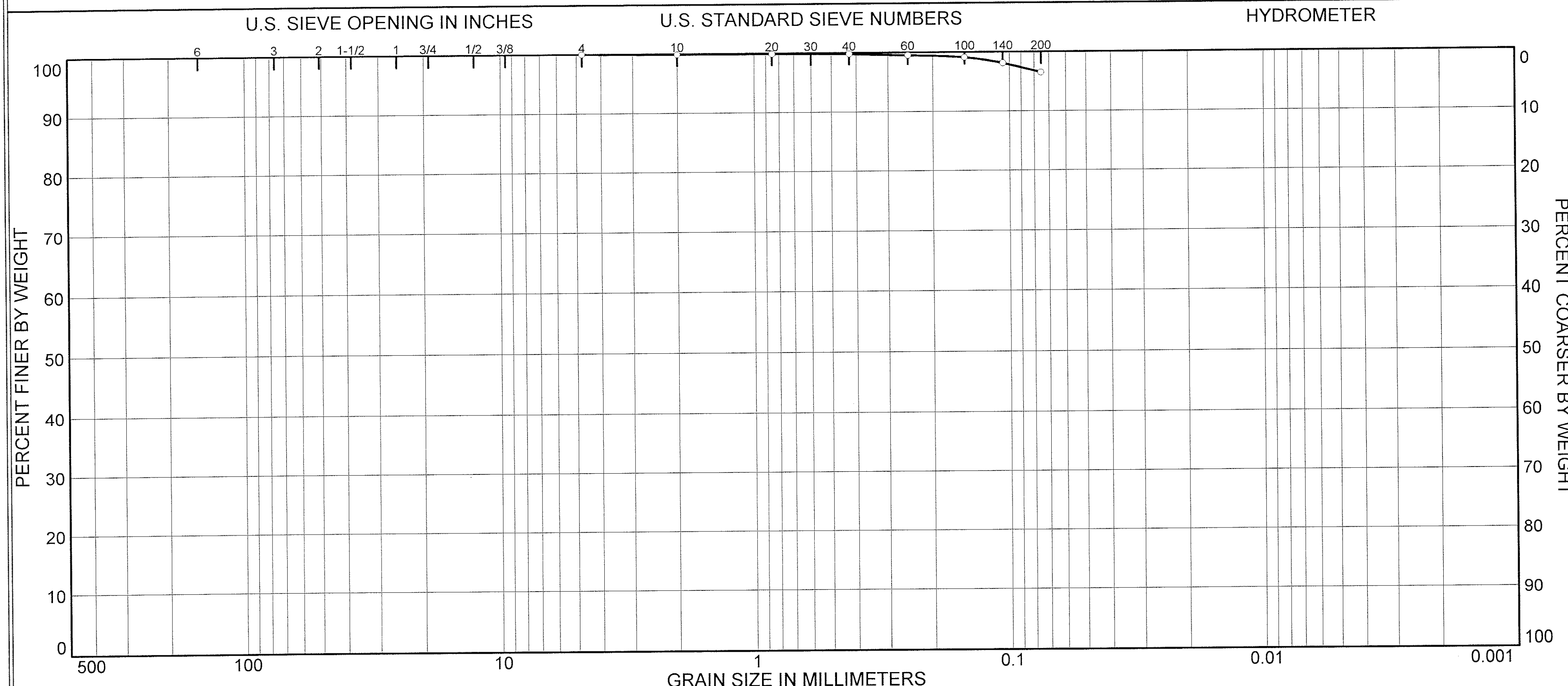
Project KIF East Dike Seepage

Project No. 3043-10-1017 10150

MACTEC ENGINEERING AND CONSULTING, INC.

Tested By: EH Reviewed By: JW

Partical Size Distribution ASTM D422-63 (2007)



% COBBLES	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
○ 0.0	0.0	0.0	0.1	0.1	3.3	96.5	

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
○ A-1	SS-13	28.5-30 ft	5/3/10		Gray Silt (Fly Ash)	33.3		

Client

Project KIF East Dike Seepage

Project No. 3043-10-1017 10151

MACTEC ENGINEERING AND CONSULTING, INC.

○ Tested By: EH Reviewed By: JW

Partical Size Distribution ASTM D422-63 (2007)

	% COBBLES	% GRAVEL		% SAND			% FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	0.0	0.2	14.4	47.3	38.1

	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
○	A-1	SS-19	39.5-41 ft	5/3/10	CL	Brown Lean Clay	24.2	39	20

Client		MACTEC ENGINEERING AND CONSULTING, INC.	○ Tested By: EH Reviewed By: JW
Project KIF East Dike Seepage			
Project No. 3043-10-1017	10152		

Partical Size Distribution ASTM D422-63 (2007)

% COBBLES	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.2	56.1	43.7	

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
A-1	SS-23	45.5-47 ft	5/4/10		Gray Clayey Sand	24.0		

Client

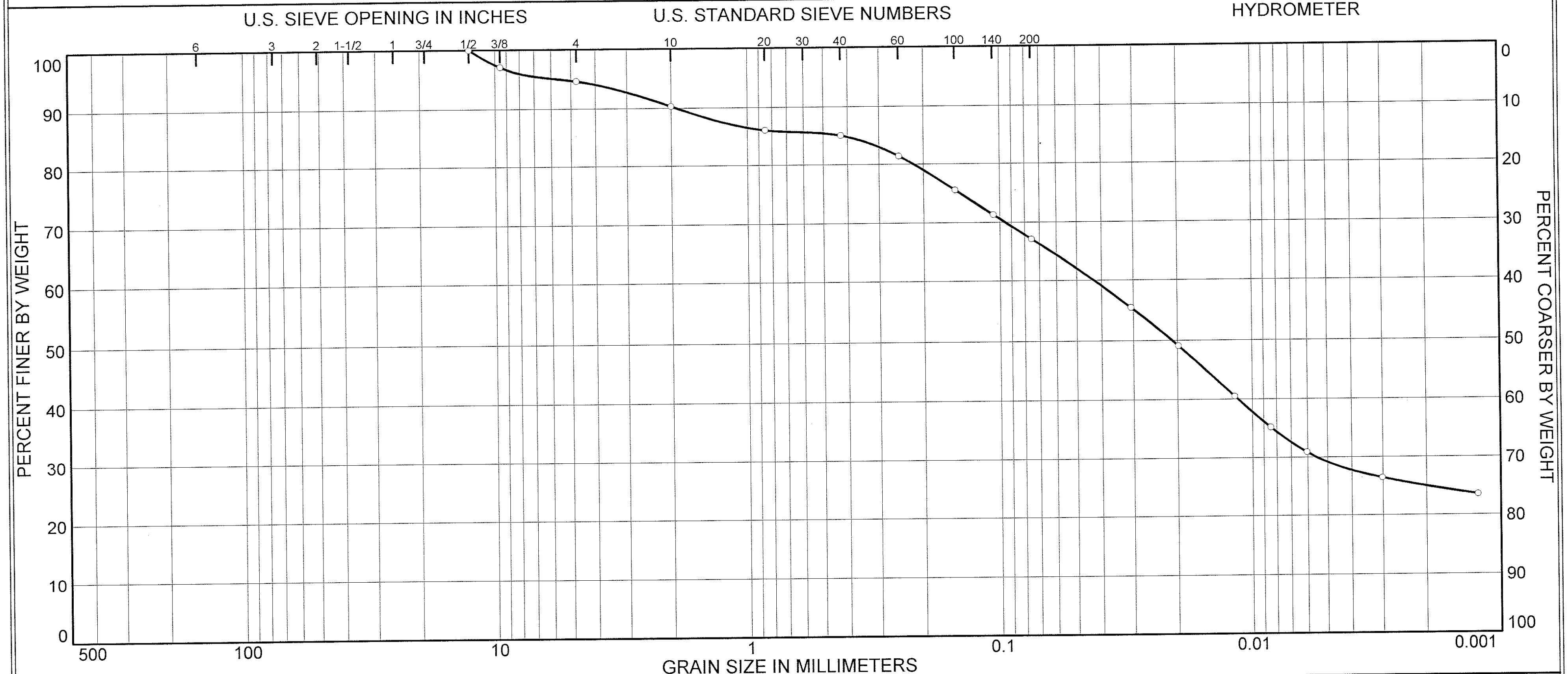
Project KIF East Dike Seepage

Project No. 3043-10-1017 10153

MACTEC ENGINEERING AND CONSULTING, INC.

Tested By: EH Reviewed By: JW

Partical Size Distribution ASTM D422-63 (2007)



% COBBLES	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.0	0.0	5.3	4.4	5.3	17.9	37.9	29.2

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
A-2	SS-14	19.5-21 ft	5/3/10	MH	Brown Sandy Elastic Silt	34.3	56	32

Client

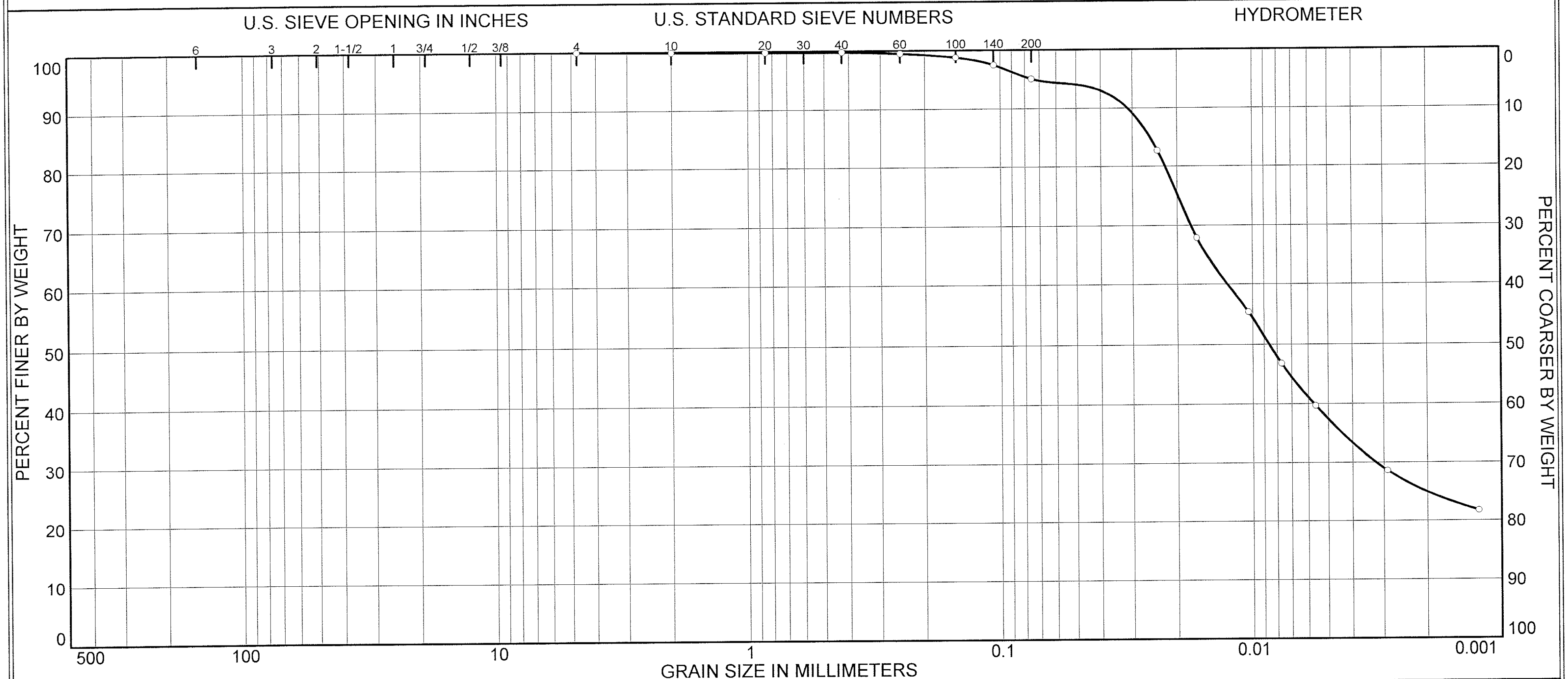
Project KIF East Dike Seepage

Project No. 3043-10-1017 10154

MACTEC ENGINEERING AND CONSULTING, INC.

Tested By: EH Reviewed By: JW

Partical Size Distribution ASTM D422-63 (2007)



% COBBLES	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.1	0.1	4.7	57.7	37.4

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
A-2	SS-23	33-34.5 ft	5/3/10	CL	Gray Lean Clay	27.8	35	19

Client

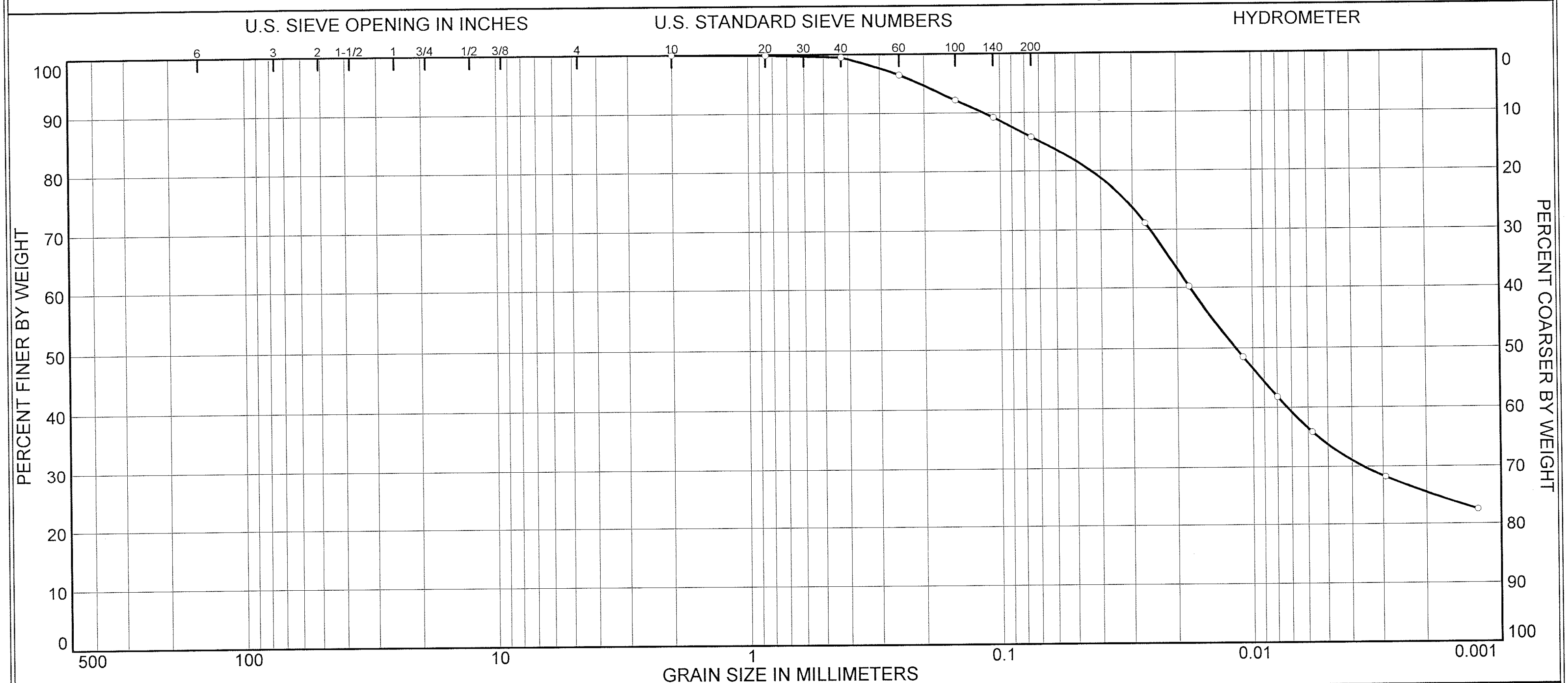
Project KIF East Dike Seepage

Project No. 3043-10-1017 10155

MACTEC ENGINEERING AND CONSULTING, INC.

Tested By: EH Reviewed By: JW

Partical Size Distribution ASTM D422-63 (2007)



	% COBBLES	% GRAVEL		% SAND			% FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	0.0	0.5	13.7	52.0	33.8

	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
○	A-2	SS-28	40.5-42 ft	5/3/10	ML	Brownish Gray Silt	23.6	34	25

Client

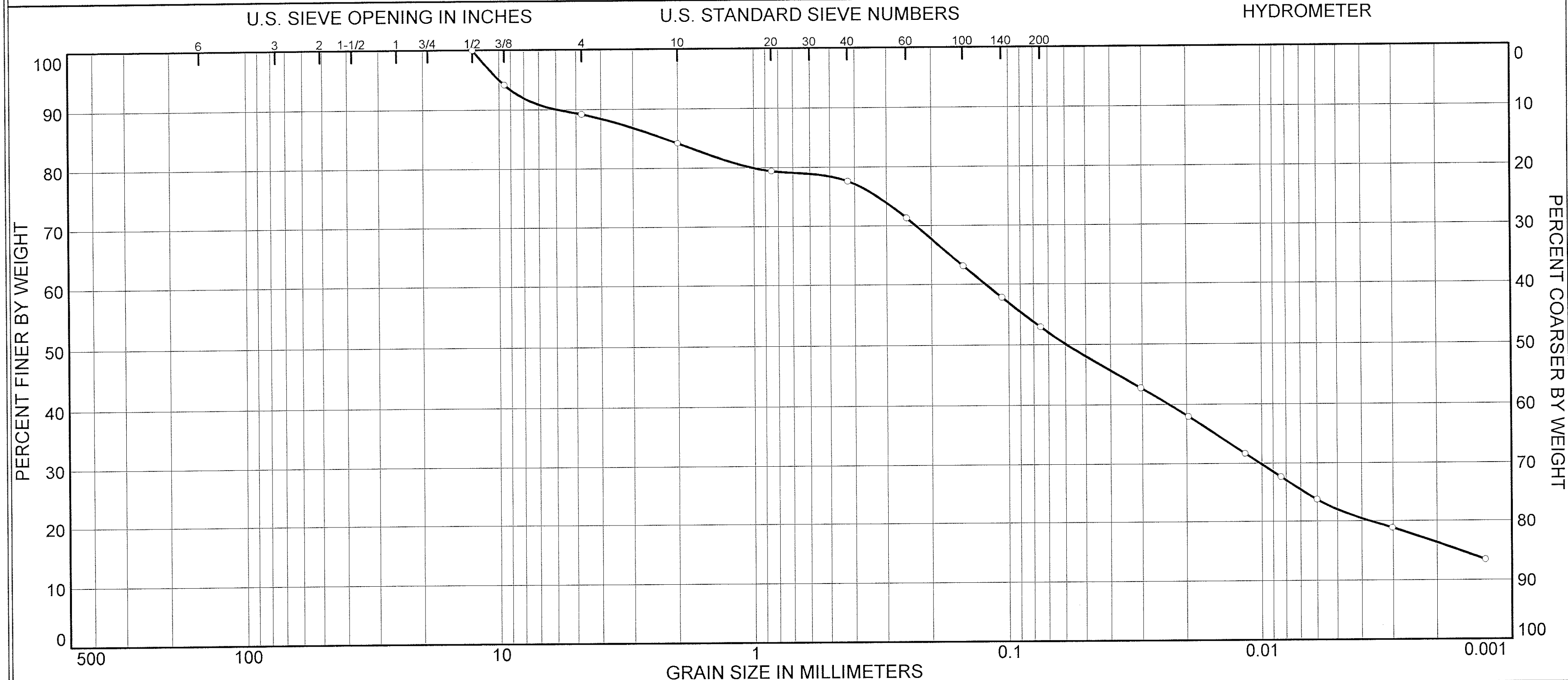
Project KIF East Dike Seepage

Project No. 3043-10-1017 10156

MACTEC ENGINEERING AND CONSULTING, INC.

○ Tested By: EH Reviewed By: JW

Partical Size Distribution ASTM D422-63 (2007)



% COBBLES	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.0	0.0	10.8	5.0	6.6	24.7	30.9	22.0

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
A-3	SS-11	17-18.5 ft	5/3/10	CL	Brown Sandy Lean Clay	24.5	47	23

Client

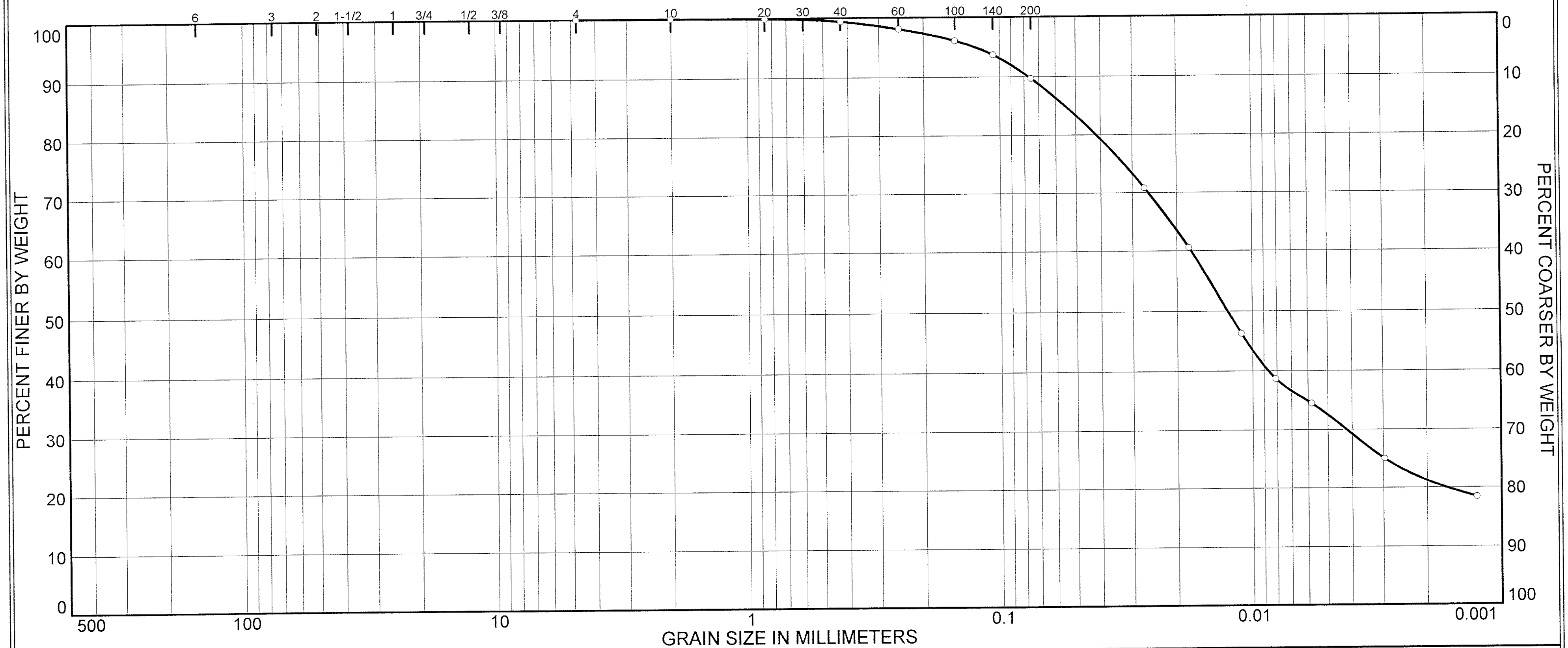
Project KIF East Dike Seepage

Project No. 3043-10-1017 10157

MACTEC ENGINEERING AND CONSULTING, INC.

Tested By: EH Reviewed By: JW

Partical Size Distribution ASTM D422-63 (2007)



% COBBLES	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.6	9.7	57.1	32.6

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
A-3	A-3SS-18	27.5-29 ft	5/3/10	CL	Gray Lean Clay	21.8	33	20

Client

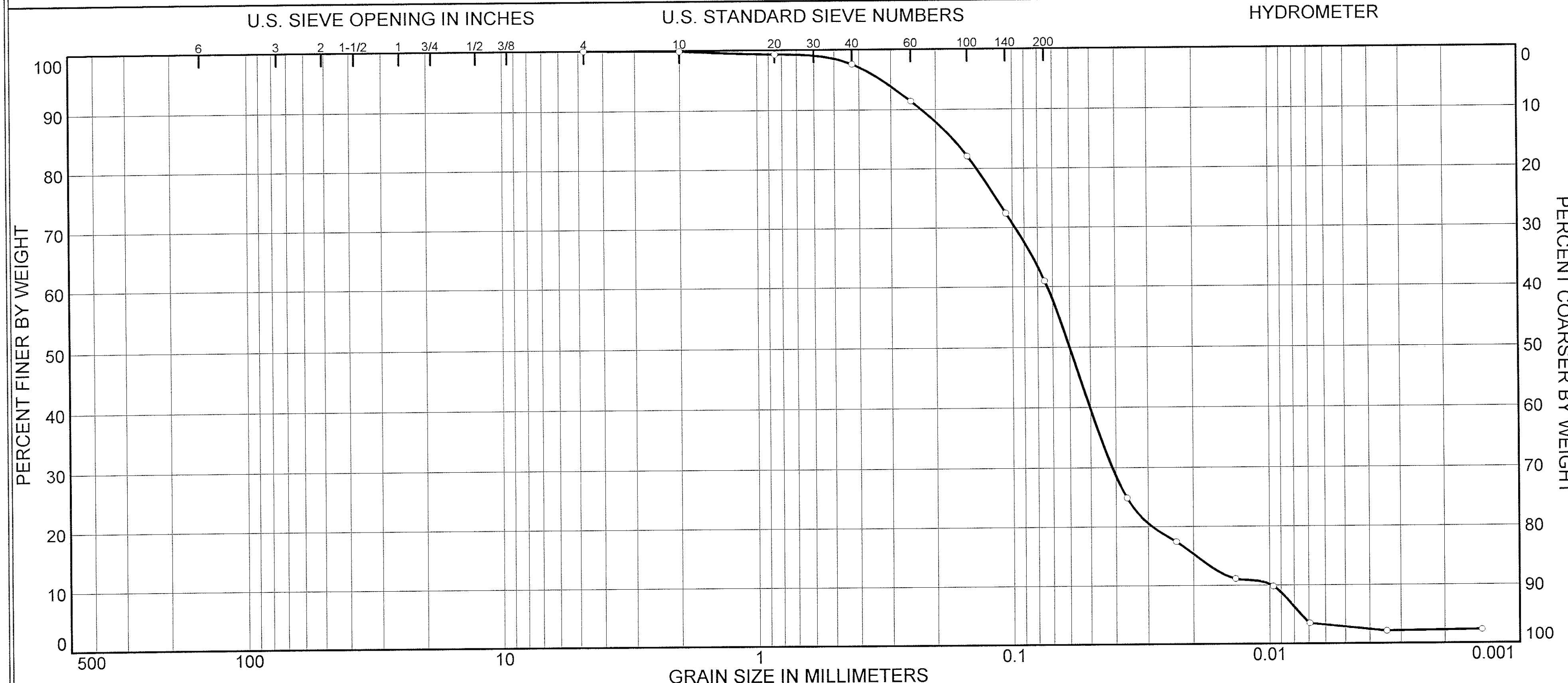
Project KIF East Dike Seepage

Project No. 3043-10-1017 10158

MACTEC ENGINEERING AND CONSULTING, INC.

Tested By: EH Reviewed By: JW

Partical Size Distribution ASTM D422-63 (2007)



% COBBLES	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.1	2.3	36.6	58.1	2.9

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
B-1	SS-12	16.5-18 ft	5/3/10	ML	Black Sandy Silt (Fly Ash)	59.6	NV	NP

Client

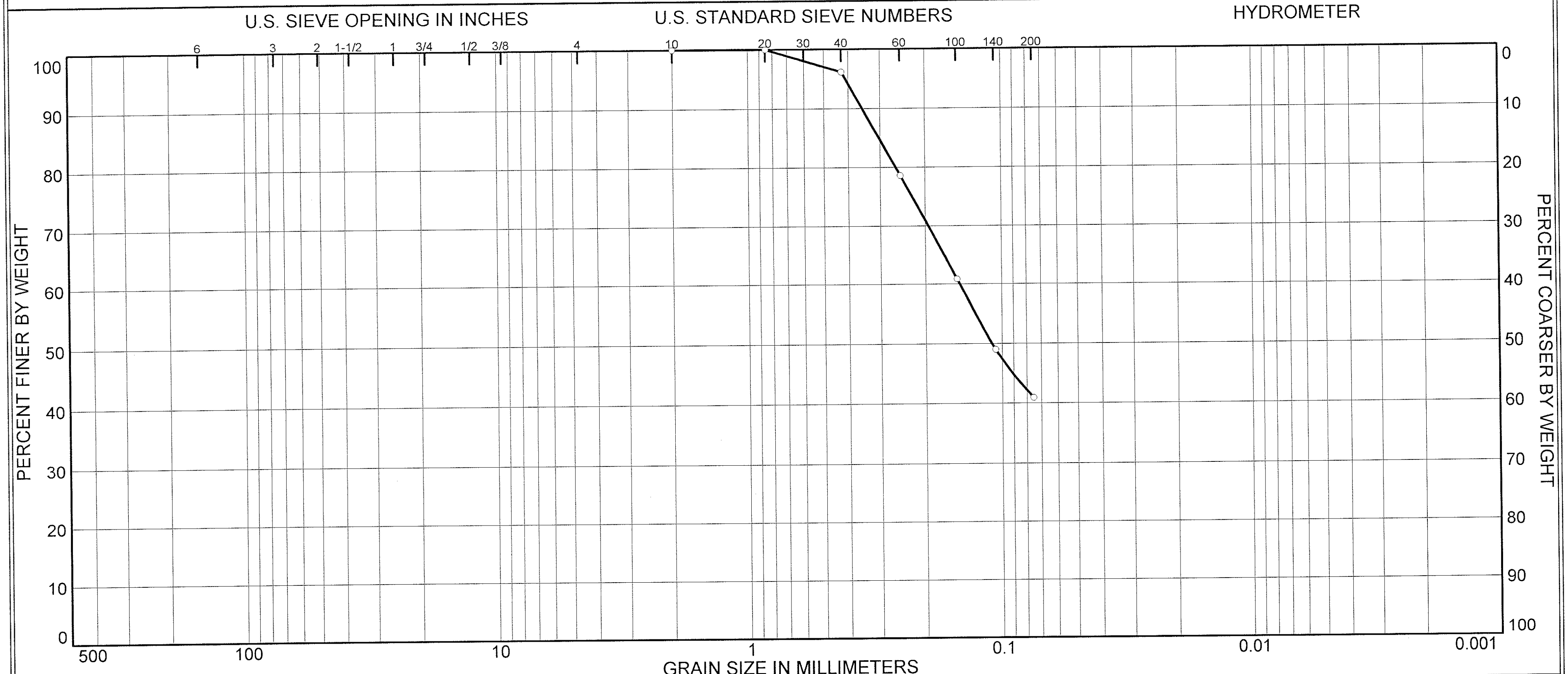
Project KIF East Dike Seepage

Project No. 3043-10-1017 10159

MACTEC ENGINEERING AND CONSULTING, INC.

Tested By: EH Reviewed By: JW

Partical Size Distribution ASTM D422-63 (2007)



% COBBLES	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	3.8	55.3	40.9	

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
B-1	SS-17	30-31.5 ft	5/3/10		Brown Silty Sand (Visual)	20.2		

Client

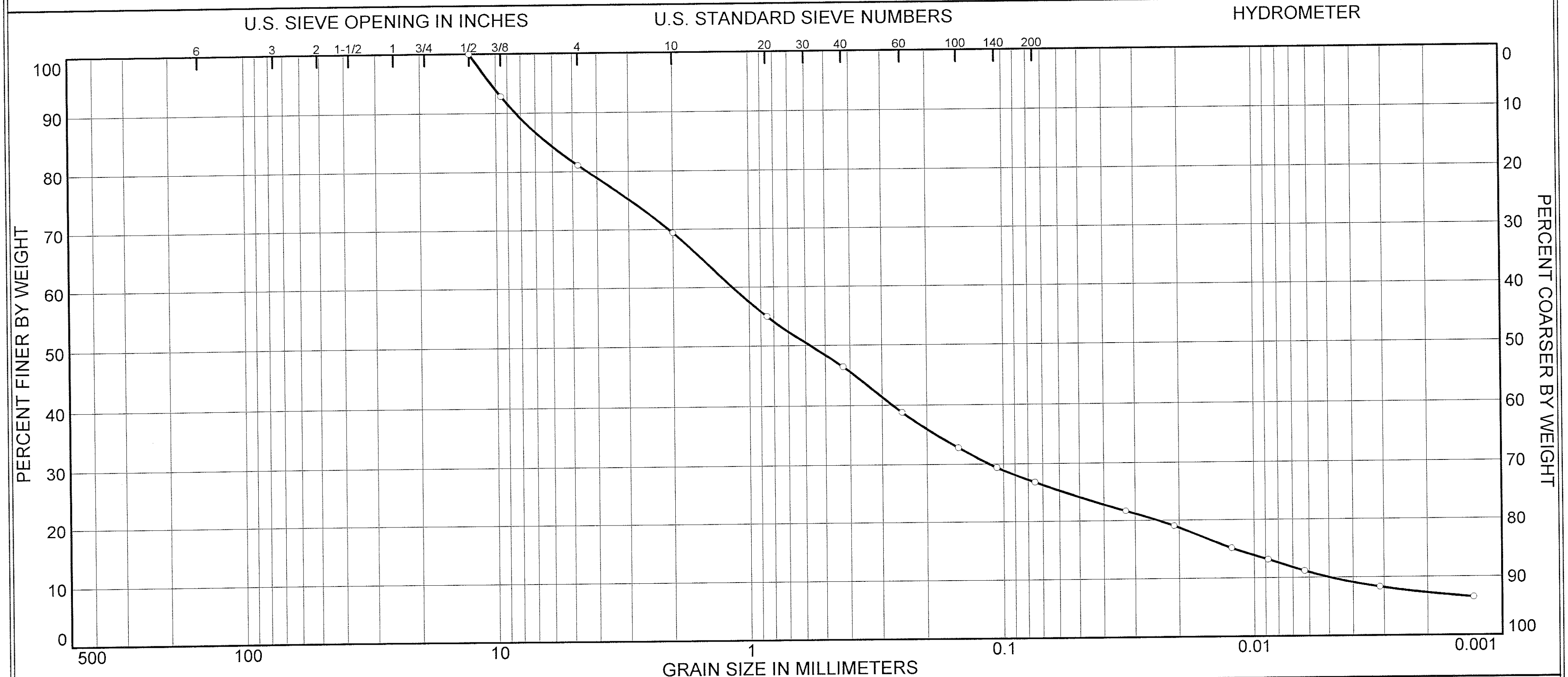
Project KIF East Dike Seepage

Project No. 3043-10-1017 10160

MACTEC ENGINEERING AND CONSULTING, INC.

Tested By: EH REviewed By: JW

Partical Size Distribution ASTM D422-63 (2007)



	% COBBLES	% GRAVEL		% SAND			% FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	18.9	11.7	23.0	19.6	16.8	10.0

	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
○	B-2	SS-7	9-10.5 ft	5/3/10	SC	Gray Clayey Sand with Gravel	14.8	35	22

Client

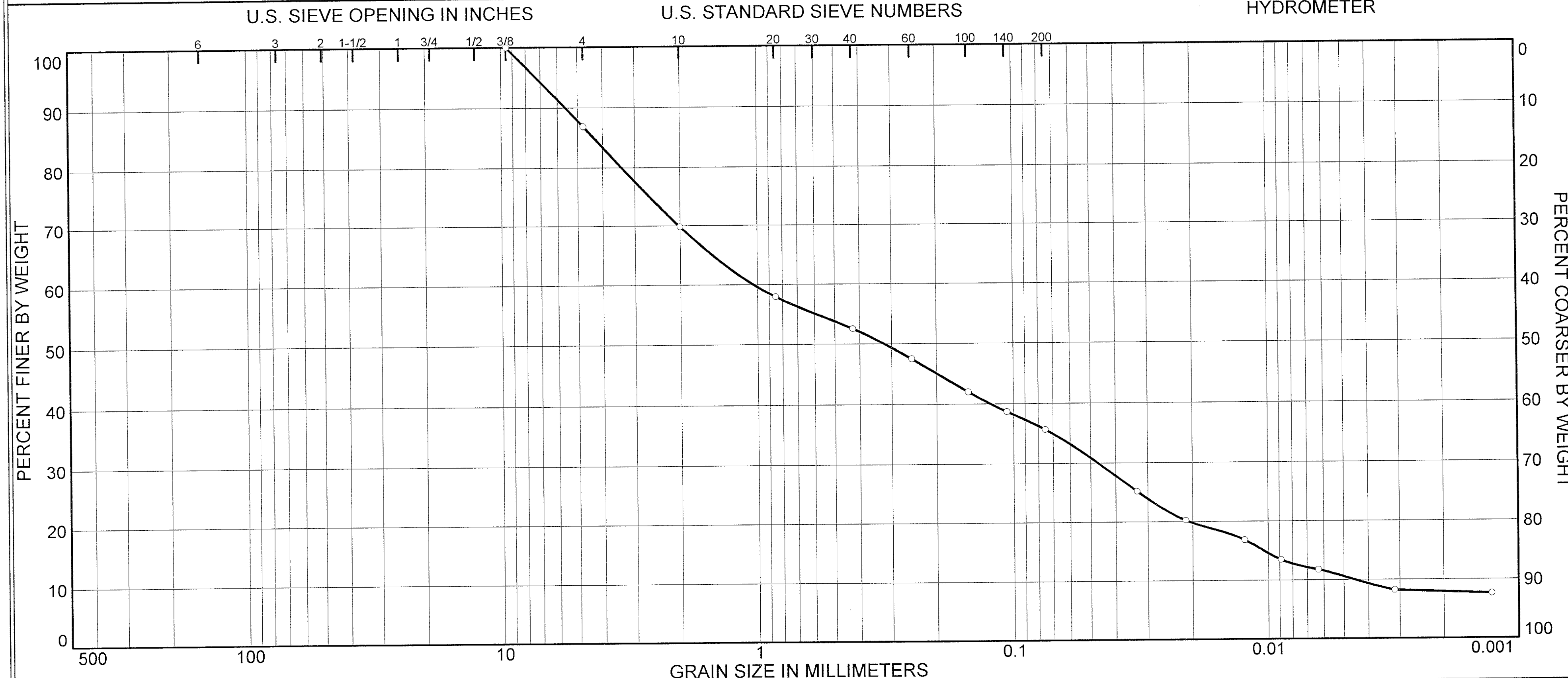
Project KIF East Dike Seepage

Project No. 3043-10-1017 10164

MACTEC ENGINEERING AND CONSULTING, INC.

○ Tested By: EH Reviewed By: JW

Partical Size Distribution ASTM D422-63 (2007)



	% COBBLES	% GRAVEL		% SAND			% FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	13.1	17.1	17.3	16.8	25.2	10.5

	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
○	B-3	SS-14	19.5-21 ft	5/3/10	SM	Gray Silty Sand	25.1	37	26

Client

Project KIF East Dike Seepage

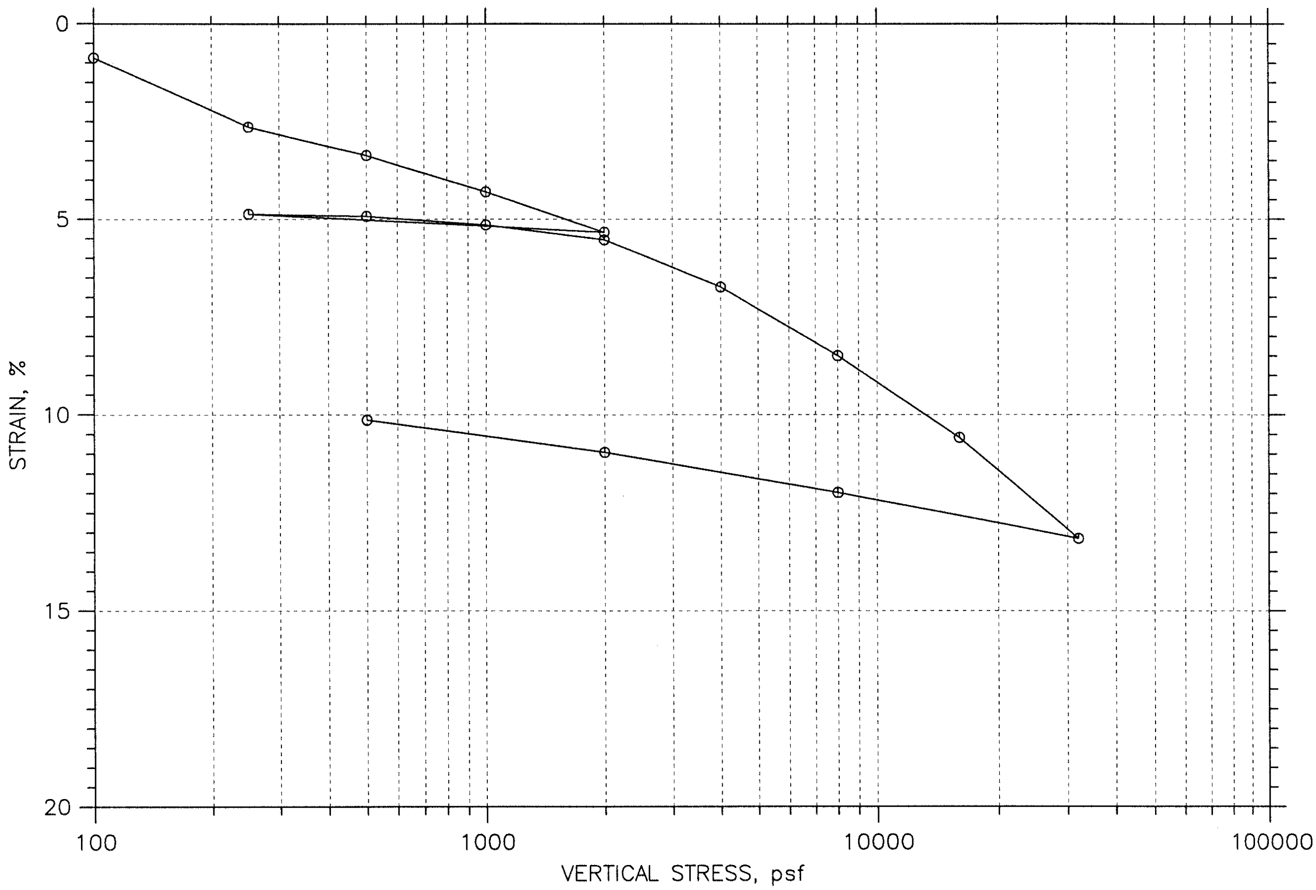
Project No. 3043-10-1017 | 10165

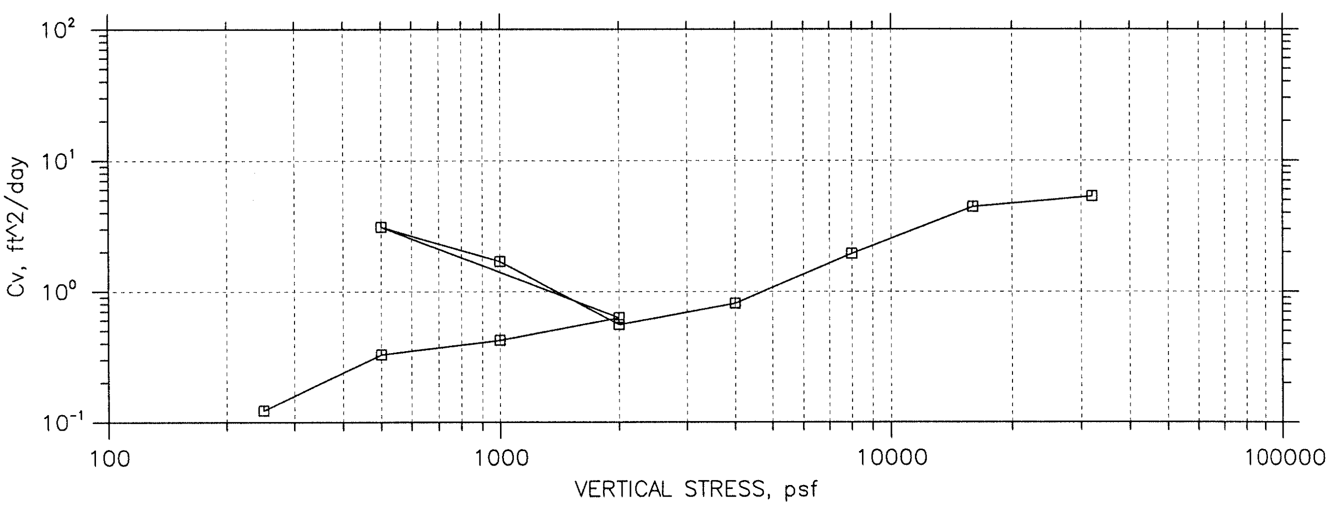
MACTEC ENGINEERING AND CONSULTING, INC.

○ Tested By: EH Reviewed By: JW

CONSOLIDATION TEST DATA

SUMMARY REPORT



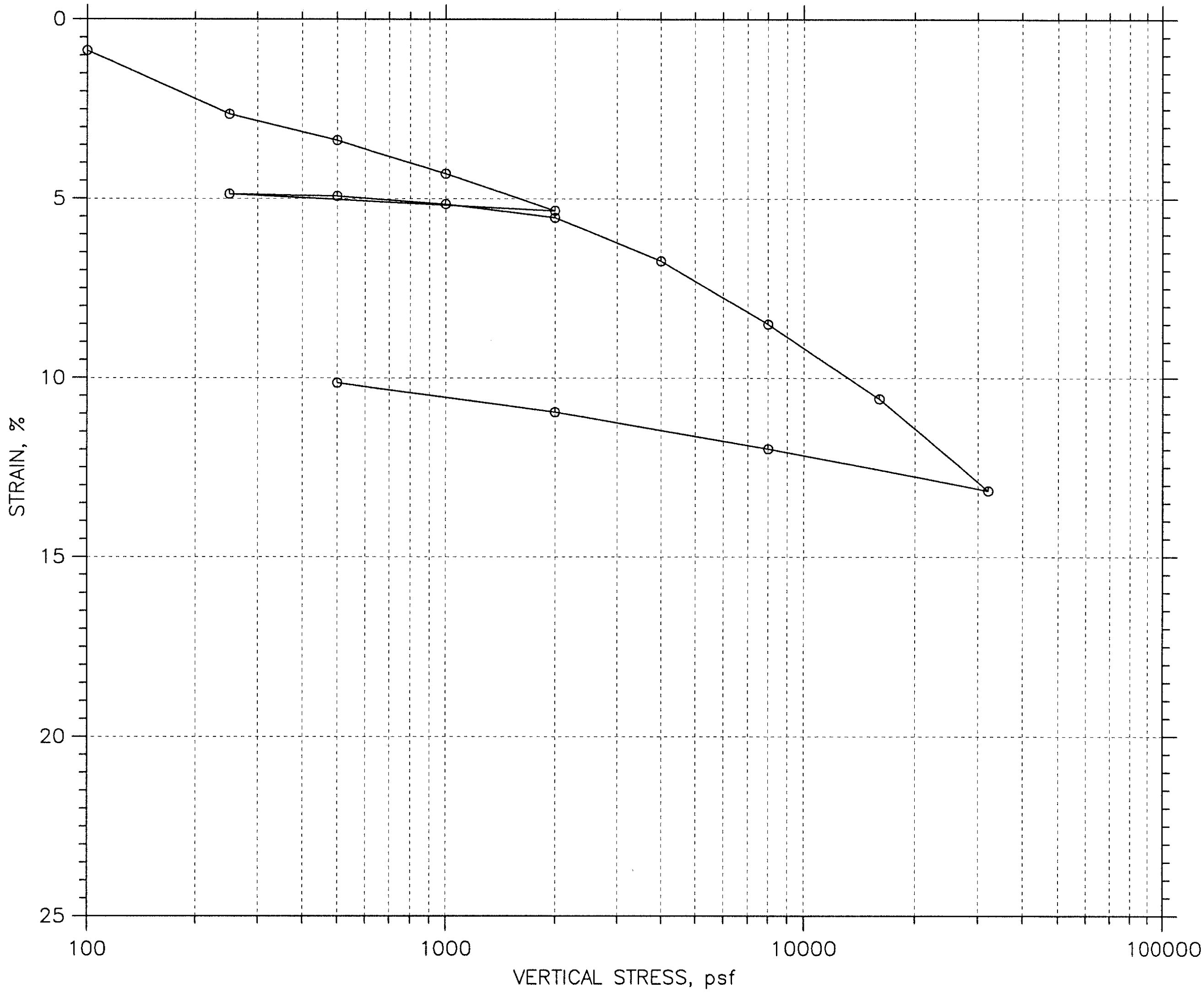


MACTEC	Project: KIF East Dike Seepage	Location: B-3	Project No.: 3043101017
	Boring No.: B-3	Tested By: JW	Checked By:
	Sample No.: UD-1	Test Date: 5/4/10	Depth: 24-26 ft
	Test No.: 10166	Sample Type: Undisturbed	Elevation: N/A
	Description: Gray Sandy Clayey		
	Remarks: ASTM D2435-04		

Wed, 12-MAY-2010 09:59:25

CONSOLIDATION TEST DATA

SUMMARY REPORT



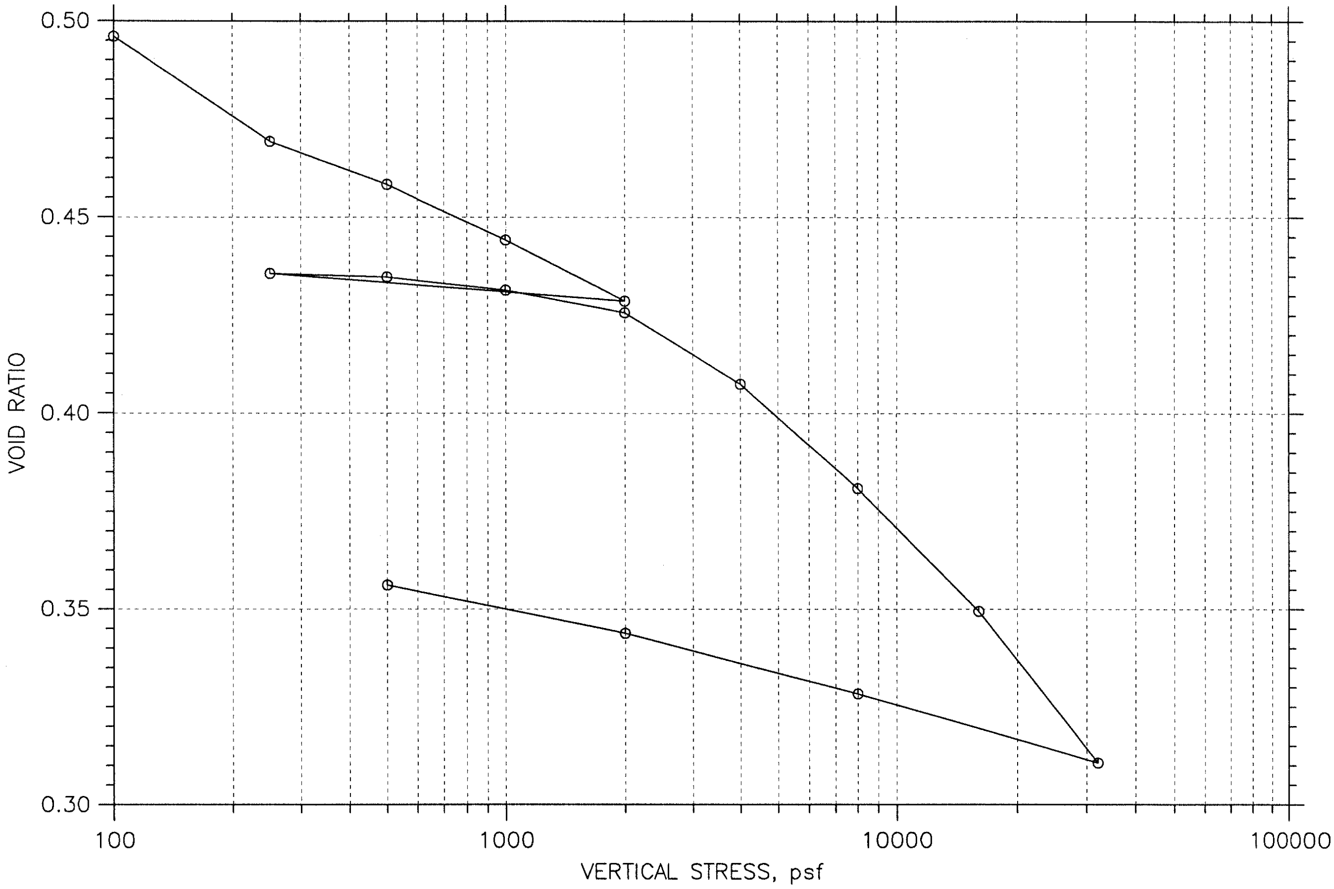
					Before Test	After Test
Overburden Pressure: 0 psf				Water Content, %	22.14	16.42
Preconsolidation Pressure: 0 psf				Dry Unit Weight, pcf	110.	122.5
Compression Index: 0				Saturation, %	115.66	122.66
Diameter: 2.499 in		Height: 0.999 in		Void Ratio	0.51	0.36
LL: ---	PL: ---	PI: ---	GS: 2.66			

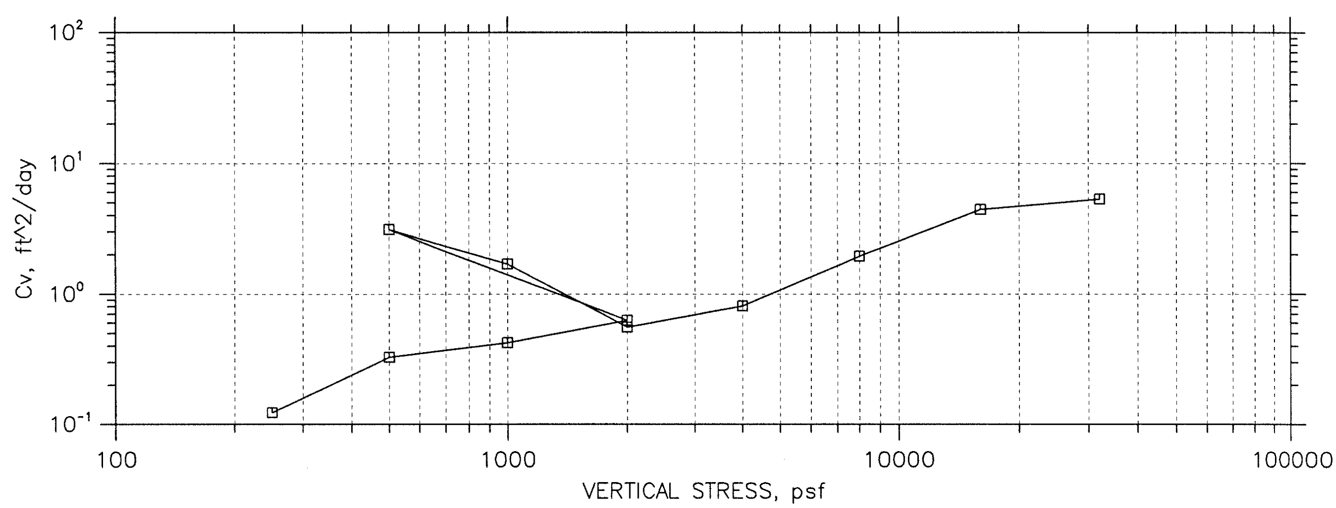
MACTEC	Project: KIF East Dike Seepage	Location: B-3	Project No.: 3043101017
	Boring No.: B-3	Tested By: JW	Checked By:
	Sample No.: UD-1	Test Date: 5/4/10	Depth: 24-26 ft
	Test No.: 10166	Sample Type: Undisturbed	Elevation: N/A
	Description: Gray Sandy Clayey		
	Remarks: ASTM D2435-04		

Wed, 12-MAY-2010 09:59:26

CONSOLIDATION TEST DATA

SUMMARY REPORT



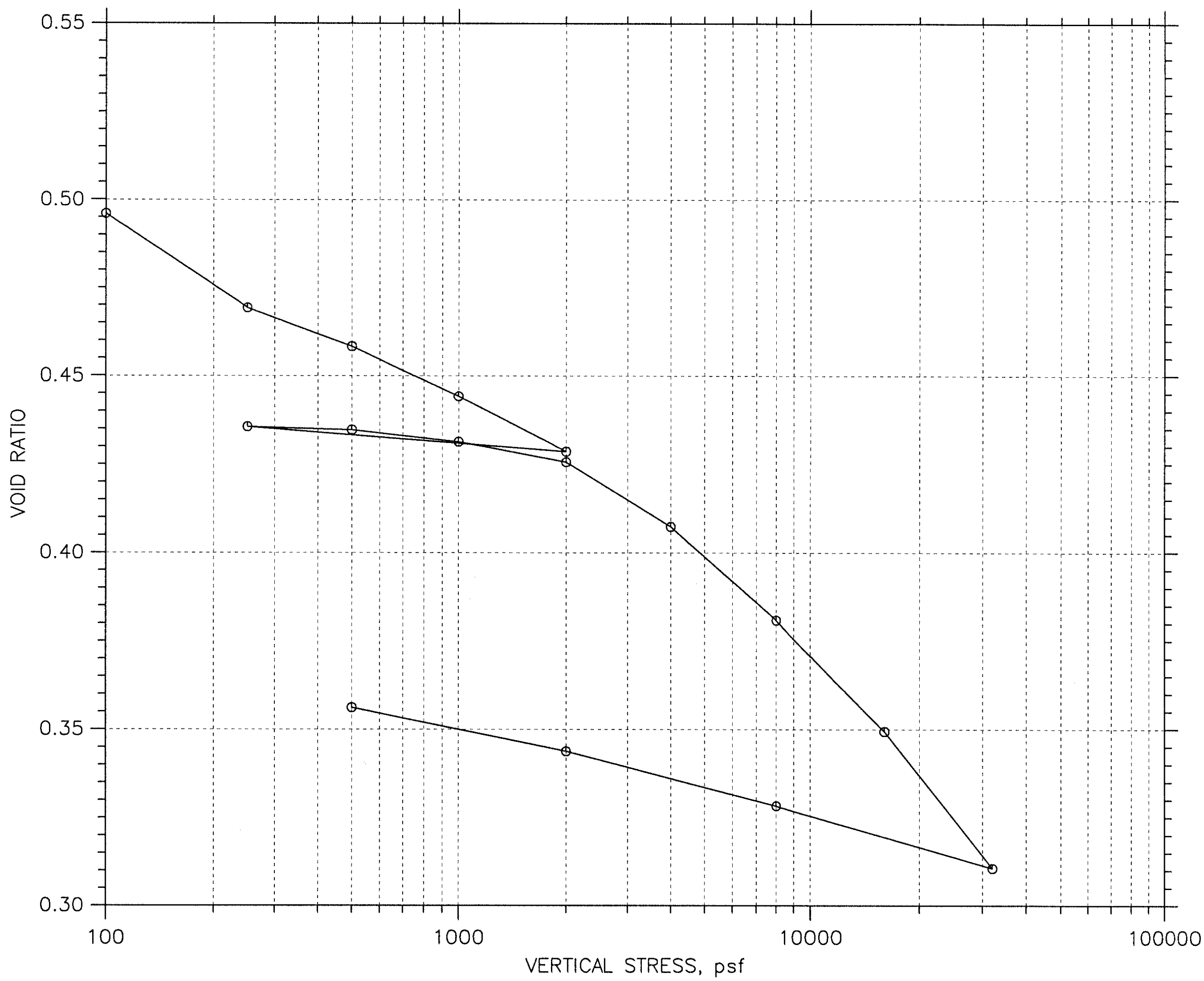


MACTEC			
	Project: KIF East Dike Seepage	Location: B-3	Project No.: 3043101017
	Boring No.: B-3	Tested By: JW	Checked By:
	Sample No.: UD-1	Test Date: 5/4/10	Depth: 24-26 ft
	Test No.: 10166	Sample Type: Undisturbed	Elevation: N/A
	Description: Gray Sandy Clayey		
	Remarks: ASTM D2435-04		

Wed, 12-MAY-2010 09:59:44

CONSOLIDATION TEST DATA

SUMMARY REPORT



					Before Test	After Test
Overburden Pressure: 0 psf				Water Content, %	22.14	16.42
Preconsolidation Pressure: 0 psf				Dry Unit Weight, pcf	110.	122.5
Compression Index: 0				Saturation, %	115.66	122.66
Diameter: 2.499 in		Height: 0.999 in		Void Ratio	0.51	0.36
LL: ---	PL: ---	PI: ---	GS: 2.66			

MACTEC	Project: KIF East Dike Seepage	Location: B-3	Project No.: 3043101017
	Boring No.: B-3	Tested By: JW	Checked By:
	Sample No.: UD-1	Test Date: 5/4/10	Depth: 24-26 ft
	Test No.: 10166	Sample Type: Undisturbed	Elevation: N/A
	Description: Gray Sandy Clayey		
	Remarks: ASTM D2435-04		

Wed, 12-MAY-2010 09:59:45

MACTEC

SPECIFIC GRAVITY OF SOILS

ASTM D854-06

Project No.	3034-10-1017	**Tested By**	EH
Project Name	KIF East Dike Seepage	**Test Date**	5/4/2010
Boring No.	B-3	**Reviewed By**	
Sample No.	UD-1	**Review Date**	
Sample Depth	24-26 ft	**Lab No.**	10166
Sample Description	Gray Sandy Clay		

Pan No. C-37

Tare No.	BB-12
Tare Mass, gram	279.5
Dry Soil + Tare Mass, grams	317.32
Mass of oven-dried soil, grams, M_s	37.82
Mass of pycnometer with water at test temperature (T), grams, $M_{pw,t}$	339.25
Mass of pycnometer, water and soil, grams, $M_{pws,t}$	362.88
Test Temperature, °C , T_t	23.4
Specific Gravity at test temperature, M_s / [$M_{pw,t}$ - ($M_{pws,t}$ - M_s)], G_t	2.665
Temperature Coefficient, K	0.99924
SPECIFIC GRAVITY @ 20°C: $G_{20\,^oC} = K*G_t$	**2.66**

PREPARATION METHOD: [ ] Method A, Wet [x] Method B, Dry

EQUIPMENT USED	LID	Calibrated Mass, g	Measured Mass, g	Difference, g
SCALE	418			
OVEN	144			
THERMOMETER	2866			
PYCNOMETER	2053	90.28	90.28	**0**

Difference should be less than 0.06 g, or use a different pycnometer.

REMARKS: