AECOM

AECOM
750 Corporate Woods Parkway, Vernon Hills, Illinois 60061
T 847.279.2500 F 847.279.2510 www.aecom.com

August 5, 2009

Mr. Ralph Rodgers
Assistant General Counsel
400 West Summit Hill Drive
Knoxville, TN 37902-1401

Re: Technical Updates to AECOM Root Cause Analysis Report, TVA Dredge Pond Failure, Harriman, TN – AECOM Project No. 60095742,

Dear Mr. Rodgers,

After AECOM's preparation of responses to Mr. Barry Thacker's comments on June 26, 2009, we decided to include additional TVA data and update some of the tables and analyses presented in our June 25, 2009 Root Cause Analysis (RCA) Report. Even though the inclusion of this data causes negligible changes to the results our analyses, and consequently, no changes to our opinions expressed in the RCA Report; we consider that this update may help improve our report in clarity and completeness.

Updated Flyash Void Ratio Statistical Analysis

As material properties may change over time as a result of different loading conditions, the results from the most recent explorations was initially given more importance as they were considered to better reflect the subsurface conditions at the time of failure.

As our studies showed that the void ratio of the fly ash is rather insensitive to changes in pressure or depth (i.e., no significant densification with increased loading), the measurements of void ratio made in old explorations should show values similar to the ones measured in the newer explorations. We have included the void ratios for undisturbed sluiced ash measured by Singleton in 1994 in test borings SS-3, SS-6 and US-7 to show that this relatively old data is consistent with the data presented in our report (from newer explorations) and confirms the relative incompressibility and potential for undrained behavior of the fly ash. The results and statistical analysis performed on all the data show that the void ratio of failed and unfailed ash with the dredge cells are both 0.84.

The measurement of the void ratio of the sluiced ash, in the RCA Report, is discussed in Sections 1.4.2 and 1.5.1. A summary of the measured void ratios is listed in Table 1.5.1_T1 and the actual measurements are presented in Figures 1.5.1_1 and 1.5.1_2. The text, summary tables and figures have been revised to include this added data and the revised documentation has been included as Appendix A.

Updated Hydraulic Conductivity of Rolled Ash Dikes (above Elev. 770ft)

The seepage model of dredge cells showed in our June 25, 2009 RCA report, utilized a hydraulic conductivity derived from the CPT_u piezocone dissipation tests. Upon further review of the collected data, we consider that the hydraulic conductivity measured during laboratory triaxial permeability tests on AECOM tube samples may represent the actual permeability of rolled ash dikes more accurately. Ten horizontal and ten vertical laboratory permeability tests were performed on relatively undisturbed tube samples of rolled ash dike fill from the intact Cell 1 Test Trench No. 3.

Averages of these tests are presented on attached Table 1.4.6_T3 and explained in updated text for RCA Report Sections 1.4.4 and 1.5.2.1.

The laboratory test values show higher hydraulic conductivities for rolled ash than what was used in our published RCA analyses, derived from the CPT_u dissipation tests. In additional, these laboratory test results showed a K_h/K_v value of 1.3:1, as opposed to 2:1, assumed in our report.

The results of thisse hydraulic conductivity tests are described in RCA Sections 1.4.4 and 1.5.2.1 and the results are summarized in Table 1.4.6_T3. The tables and text included in the RCA Report have been revised and the revised versions have been attached as Appendix B.

It should be noted that these updated conductivity values (higher than the ones presented in our original RCA Report) are lower than the values chosen by Mr. Thacker for his analysis. It should also be noted that Mr. Thacker's assumed in his models that the upstream dikes above El. 770 feet were built with rolled bottom ash. Test Trench No. 3 at Cell No. 1 showed that the Dikes B up to the D2 level were constructed of rolled flyash and not bottom ash. This updated information is presented in attached Appendix B.

Updated Seepage and Stability Analyses for Cell 2 Northwest

As part of AECOM's July 17, 2009 responses to Mr. Thacker's comments presented on June 26, 2009, we performed some adjustments to our model and performed several parametric stability and seepage analyses utilizing the commercial computer programs, SLOPE/W and SEEP/W. A summary of the adjustments made and the results obtained is presented below:

1. The left boundary of the seepage model was setback from 50 to 500 feet upstream of Dike D2. This updated setback was selected to represent the average radius of the dredge pond in Cell 2.
2. As suggested by Mr. Thacker, we performed a parametric seepage study for hydraulic conductivity K_h/K_v ratios in the sluiced flyash using 1, 2, 10 and 100. These analyses showed that a K_h/K_v ratio for the sluiced ash between 1 and 2 would lead to water pressures at the location of monitoring well MW 15 consistent with the actual measurements. Therefore, this study reaffirmed that our selection of K_h/K_v of 1.0 for sluiced ash within the Kingston Dredge Cell analyses is adequate.

We have further updated the results of our analysis presented on July 17, 2009 by changing the hydraulic conductivity of the Rolled Ash Dikes, as discussed in the previous section.

A summary of the results of the updated analyses for Cell 2 Northwest is presented in attached Table 1.6.3_9. The results show negligible changes in computed stability factors of safety against sliding (FS). The updated stability analyses show a computed FS at Cell 2 slightly less than the values published in our original RCA report.

A summary of the results of this updated analyses and the results published in the original RCA Report are shown in the table below:

Cell 2 Northwest Stability Section (Shear Strength in Sluiced Ash)	FS – 6/25/09 RCA Reported 50-foot Pond Setback, Rolled Ash Conductivities based on CPT_u tests, and K_h/K_v of 1.0 in Sluiced Ash	FS - Updated Analyses using 500-foot Pond Setback, Updated Rolled Ash Conductivities, and K_h/K_v of 1.0 in Sluiced Ash
Stage 1, Case 1 (Φ=30˚, c=0 psf)	1.32 (1.3)	1.32 (1.3)
Stage 1, Case 2 (Φ=30˚, c=0 psf)	1.24 (1.2)	1.23 (1.2)
Stage 2, Case 1 (S_{up}/σ = 0.3)	1.03 (1.0)	1.02 (1.0)
Stage 2, Case 2 (S_{up}/σ = 0.3)	0.97 (1.0)	0.97 (1.0)

The results of the individual slope stability runs are attached in Appendix C.

As mentioned before, the change in the computed FS is negligible and these results do not change our opinion on the failure mechanism presented in the original RCA Report. However, we considered it important to present this updated analysis, as it includes more accurate material parameters and analytical model geometry.

Considering the negligible change in the computed FS of Cell 2 Northwest, we consider that the computed safety factors for the Southwest Cell 2 and the East Phase 1 Emergency Cell will also be negligible if the same changes to the models were to be applied. Therefore, we consider that it is not necessary to reanalyze Phase 1 Cell and Southwest Cell 2.

We felt compelled to supplement the June 25. 2009 RCA with this letter to provide a more accurate representation of pond geometry in our analytical model and use hydraulic conductivity test data on rolled flyash from our Test Trench No. 3 program at Cell 1.

We hope to publish this study in a peer reviewed geotechnical technical journal once we get approval from the TVA to do so, and after we receive written opinion from TDEC on AECOM's RCA work.

Please call us if you have any questions.

Very truly yours,

William H. Walton, P.E., S.E.
Vice President, Senior Principal Engineer

Bill Butler, P.E.
Senior Geotechnical Engineer

Attachments – Appendices A, B & C

Cc: G. Castro - Consultant

WILLIAM H. WALTON
REGISTERED ENGINEER
NO. 00110328
STATE OF TENNESSEE

Appendix A. Updated Fly Ash Void Ratio

Section 1.4.2: Geotechnical Index Text, Gradations and Classification

Section 1.5.1 Summary of Parameters Used for Analysis (Sluiced Ash)
(includes Table 1.5.1_T1 Summary of Void Ratios in Ash))

Figure 1.5._1: Void Ratio versus Elevation (Unfailed Ash)

Figure 1.5._2: Void Ratio versus Elevation (Failed Ash)

1.4.2 Geotechnical Index Tests, Gradations and Classification

The index testing completed for this project included grain size distribution, liquid limit, plastic limit, plasticity index, specific gravity and density determinations. Specific details related to the testing procedures implemented for this series of tests are presented in Volume III of this report. Individual test results are included in the appendix of Volume III.

In total, the grain size distributions of approximately 180 samples were determined. The ash consisted primarily of silt size particles with trace to little sand and clay. The slime layer tended to be finer grained silt than the ash. The alluvial silts and clays were primarily fine grained with trace to some sand content. The alluvial sand were composed of primarily fine to coarse sand size particles with trace to some silt sized particles and trace amounts of gravel and clay.

The liquid limit, plastic limit and plasticity index of approximately 230 samples were determined. The ash was determined to be non plastic. The slime was generally determined to have a relatively low plasticity, the plasticity index ranged from approximately 10 to 25. Liquid limits on the order of 30 to 60 were measured in the slimes. The alluvial clays were generally low plasticity clays and silts. The alluvial sands were of low plasticity to non-plastic. The results of the Atterberg limit testing is summarized in Table 1.4_T1 at the end of this report. Individual tests plots are included in Volume III of this report. The Atterberg limits are also presented on the soil boring logs in Volume II of this report. The Atterberg limits for soils and ash which were determined to be non-plastic have not been presented on the soil boring logs.

The specific gravity of approximately 145 samples was measured. Thirty-three samples of the ash were tested. The specific gravity of the ash varied from 2.2 to 2.6 with an average of approximately 2.37. The specific gravity of the slime ranged from 2.2 to 2.3. The specific gravity of 108 samples of the alluvial deposits was measured. The specific gravity ranged from 2.6 to 2.8 with an average of 2.7. The results of the specific gravity testing are summarized in Table 1.4.2_T1

The wet density, dry density and void ratio of the ash were also evaluated as part of the index testing. In total, the wet and dry density of 73 samples of the fly ash was determined. The wet density of the ash varied from 90 to 130 pounds per cubic foot (pcf) with an average of 106 pcf. The dry unit weight was calculated to range from 50 to 116 pcf with an average of 76 pcf. The void ratios were calculated to range from 0.3 to 1.3 with an average of 0.~~97~~ **0.84 for failed and unfailed ash.**

1.5 Summary of Parameters Used For Analysis

1.5.1 Sluiced Ash

In Situ Void Ratio

The in-situ void ratio was measured based on the density and moisture content of samples that were collected from the borings across the site. A more complete discussion of the analysis methods employed are presented in Volume III of this report. The void ratio was an important property when evaluating how the ash would behave under loading. The results of the void ratio calculations have been presented in a series of tables and figures. Table 1.5.1_T1 summarizes the results of the void ration determinations.

Table 1.5.1_T1 Summary of Void Ratios in Ash

Material Type	Void Ratio						
	Arithmetic Mean	Median	Mode	Standard Deviation	% Void Ratios > 0.8	Maximum	Minimum
Failed Ash	~~0.83~~ **0.84**	0.81	0.73	0.23	48.4	1.78	0.25
Unfailed Ash	~~0.88~~ **0.84**	~~0.84~~ **0.81**	0.79	~~0.24~~ **0.26**	58.1	2.19	0.39

Notes: 1) Void ratios were calculated from water contents and Gs = 2.37
2) Unfailed Ash in 300- and 600- Series, MACTEC 2004 data, ~~and~~ 09-400 and 09-402 borings of the 400-Series**, and Singleton (1994)**
3) Failed Ash in 100-, 200-, and 500-Series, and 09-404, 09-406, and 09-408 borings of the 400-Series

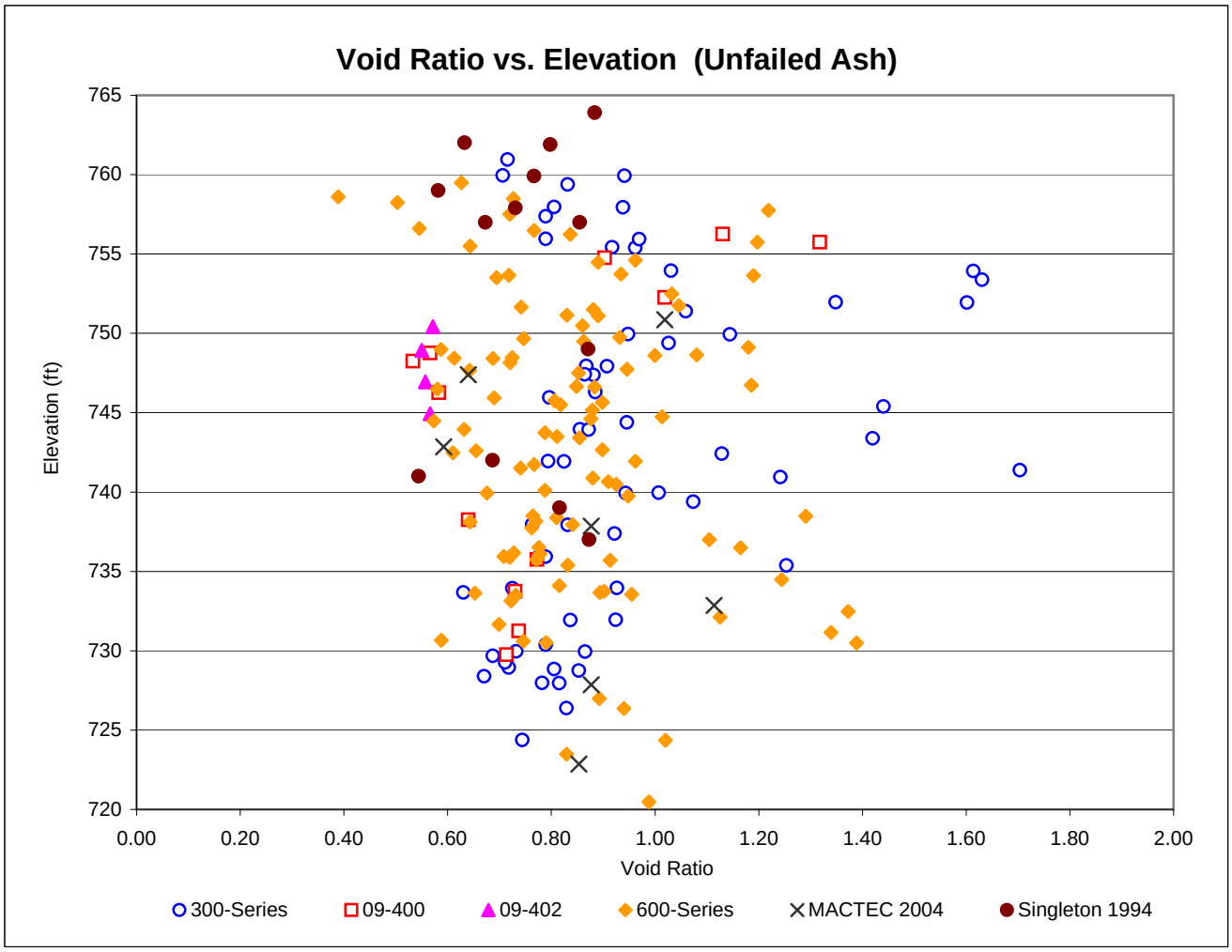
The results are graphically depicted in Figure 1.5.1_ 1 and 1.5.1_2. Figure 1.5.1_1 presents the variation of void ratio with elevation for samples of the unfailed ash. In general, there is no trend relating void ratio and elevation. Similarly, Figure 1.5.1_2 presents the variation in void ratio with elevation for the samples collected in the failed ash. Again, no trend is apparent. An average void ratio of 0.8 was selected for use in AECOM's analysis. Additional tables and figures presenting the data in various groupings are presented in Volume III of this report.

Hydraulic Conductivity

Soil or a similar particulate media, such as the ash, are composed of a skeleton of soil particles and a void space (pore space) occupied by air and/or water. The voids form channels for air or water to flow through the soil mass. The size (or approximate diameter) of these channels determines the rate at which the water can travel through the soil mass. Therefore, the size of the grains controls the hydraulic conductivity of the soils. Fine-grained materials such as fly ash, similar to natural silts, have lower permeability when compared to coarse soils such as clean sands or gravel, and higher hydraulic conductivity than clayey soils.

1.5.1_1

(July 30, 2009)

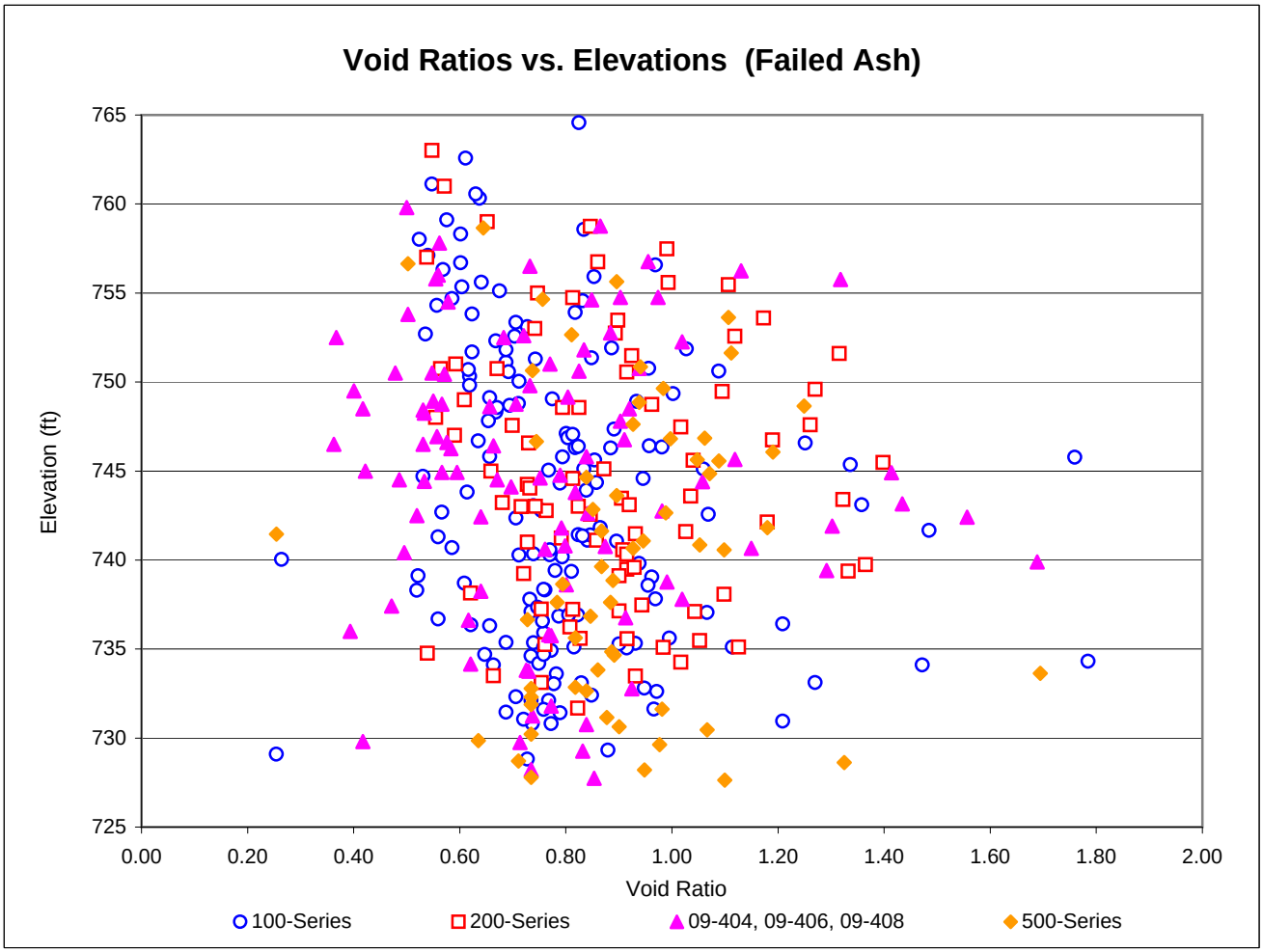


Unfailed Ash	**Arithmatic Mean:**	**0.84**
	Geometric Mean	**0.81**
	Mode:	**0.79**
	Median	**0.82**
	Variance	**0.07**
	Standard Deviation	**0.26**

Note: 1. Only ash below Elev. 765 ft.
2. Assuming G_s=2.37 and 100% saturation
3. Unfailed Ash in 300-, and 600-Series, MACTEC 2004 data, and 09-400 and 09-402 borings of the 400-Series
4. Void Ratio in Singleton 1994 (US-3, US-6, US-7, US-8 and US-9) were reported by Singleton

1.5.1_2

(July 30, 2009)



Failed Ash	**Arithmatic Mean:**	**0.84**
	Geometric Mean	**0.81**
	Mode:	**0.73**
	Median	**0.82**
	Variance	**0.05**
	Standard Deviation	**0.23**

Note: 1. Only ash below Elev. 765 ft. In 100- and 200-Series, ash below water table
2. Assuming G_s=2.37 and 100% saturation
3. Failed Ash in 100-, 200-, and 500-Series, and 09-404, 09-406, and 09-408 borings of the 400-Series

Appendix B. Updated Hydraulic Conductivity of Rolled Ash Dikes

Section 1.4.4: Hydraulic Conductivity Testing

Section 1.5.2.1 Ash Dikes (Compacted Ash)

Table 1.4.6_T3: Summary of Hydraulic Conductivity Used in SEEP/W and SLOPE/W Analyses

Summary of Laboratory Hydraulic Conductivity Tests on Rolled Fly Ash

1.4.3 Proctor Density Tests

Laboratory moisture density testing was performed on bulk samples of the ash collected from the test trench which was excavated at the site. The intent of the testing was to evaluate the degree of compaction of the ash dikes which were constructed at the site. Please refer to Section 1.3.5.2 for a comparison of the laboratory determined maximum dry densities to the densities determined from field sand cone testing.

1.4.4 Hydraulic Conductivity Testing

Horizontal and vertical triaxial hydraulic conductivity testing was completed on thin walled tube samples collected from the test trench excavation. The testing was performed to determine the hydraulic conductivity of the ~~ash~~ **sluiced and rolled fly ash** at the site so seepage through the impoundment could be modeled. The ~~average~~ **measured** horizontal and vertical hydraulic conductivities of the **sluiced** ash were determined to be ~~1.3E-04~~ **6.3E-05 and 5.3E-05** cm/sec**, respectively. The average horizontal and vertical hydraulic conductivity for the rolled ash in the Cell 1 dikes was 6.2E-05 and 4.6E-05, respectively.**

1.4.5 Direct Shear Testing

Direct shear testing was performed at the Vernon Hills laboratory on the alluvial clay soils and reconstituted samples of the fly ash. A more comprehensive discussion on testing procedures is included in the Volume III of this report. These tests were performed in a drained condition at a very slow rate of shear. On average, the internal angle of friction for the reconstituted ash was determined to be approximately 34 degrees. However, at low confining stress the friction angle of the ash was measured between 38 to 42 degrees. For analysis purposes, AECOM chose 37 degrees for ash at low confinement. The alluvial clays were determined to have an average drained friction angle of 32 degrees. The direct shear tests closely represent the horizontal mode of shear that would be experienced by the soils along the base of the failure wedge.

1.4.6 Triaxial Shear Strength Testing

An extensive program of triaxial shear strength testing was performed for this project. Two modes of shear were tested as part of the analysis. Triaxial compression testing was the predominant mode of shear. The compression test is most applicable to the driving portion of the failure wedge (active zone); however, the strengths derived from this test can reasonably used to analyze most modes of shear. The basic principal of the test is a constant confining stress is applied while the axial stress is increased.

The second mode of shear analyzed was triaxial lateral compression. This mode of shear is most applicable to the passive zone of the failure surface. This mode was tested using reduced triaxial extension testing which is equivalent to lateral compression for undrained testing of saturated soils. In reduced triaxial extension testing, a constant confining stress is applied while an upward axial force is applied.

Besides the variation in the loading type, the drainage conditions were also modified for various triaxial tests. The majority of the tests were performed in an undrained condition. During shear, no water was permitted to enter or leave the sample making the sample volume constant. The water pressure within the sample is measured so that the behavior of the soil can be determined.

volume change. A lower friction angle is observed during undrained shearing because the dilation is suppressed, since no volume change is allowed. At constant volume conditions, the friction angle developed during undrained shearing of dilative materials is similar to the one observed for contractive samples. Therefore, the results from undrained tests performed on dilative samples were also utilized to estimate the drained friction angles for the contractive sluiced fly ash in AECOM's analyses.

The table below lists the mobilized friction angles from both drained and undrained tests on contractive samples and the mobilized friction angles in the undrained tests for the dilative samples. An average friction angle of 30 degrees for sluiced ash was selected for the analysis. It should be noted that several tests showed values below 30 degrees. However, in most of these cases the peak friction angle could not be fully mobilized since the tests had to be stopped before the peak was reached. This premature stopping of the test was caused by inherent limitations of the triaxial equipment.

1.5.2 Dikes

1.5.2.1 Ash Dikes (Compacted Ash)

Hydraulic Conductivity

Using AECOM CPT_u dissipation test data, K_h was estimated at 1.4 E-05 cm/sec. K_v values were not measured by this test method. A horizontal to vertical hydraulic conductivity ratio (K_h/K_v) of 2 was chosen for the **June 25, 2009 RCA** seepage analysis, which matches the value agreed to by Parsons E&C and GeoSyntec for their 2005 analyses. **Based on horizontal and vertical hydraulic conductivity testing on tube samples of rolled ash, AECOM measured 6.2E-05 and 4.6E-05, respectively in the rolled ash dike material that yields a K_h/K_v of 1.35.**

Drained Strength

The ash used to build the dikes (mostly fly ash with some bottom ash, depending on the vintage of construction) was compacted to a minimum of 95% of Standard Proctor maximum dry unit weight. The low void ratios of the fly ash and the low confining stresses (near the surface) in these dikes plot below the Steady State line. Therefore, strong dilation is anticipated during shearing. As discussed before, materials that have such a strong tendency to dilate will develop very high undrained shear stresses; higher than the drained shear strength. Therefore, these materials were accounted in AECOM's models used for analysis as purely frictional materials since one should not rely on negative pore pressures associated with dilation.

For the slope stability analysis of the west side of the dredge cells, AECOM adopted shear strength parameters for Dike B from Parsons (2004) and TVA Drawing No. 10N400, Rev. 6 dated February 16, 1977 for the type and physical properties of this fill. A unit weight of 114 psf, a friction angle of 37 degrees and a cohesion intercept of 0 psf were assigned. This fill was placed in the mid 1970's as part of the vertical expansion of the ash pond to prevent inundation of Swan Pond Road and the railroad tracks serving the plant. Much of this fill was disturbed by the failure.

		Hydraulic Conductivity							
		Kh			Kv			Kh/Kv	Notes
		(cm/sec)	(ft/sec)	(ft/min)	(cm/sec)	(ft/sec)	(ft/min)		
Dike Ash	**Case 1**	1.4E-05	4.6E-07	2.8E-05	7.0E-06	2.3E-07	1.4E-05	2:1	From AECOM Field CPT_u Dissipation Tests and Presented in AECOM Report dated June 25, 2009
	Case 2	6.2E-05	2.0E-06	1.2E-04	4.6E-05	1.5E-06	9.1E-05	1.35:1	Updated K for Rolled Ash from AECOM Horizontal and Vertical Tube Triaxial Tests
Sluiced Ash	**Case 1**	6.3E-05	2.1E-06	1.2E-04	6.3E-05	2.1E-06	1.2E-04	1:1	From AECOM Laboratory Permeability Tests and Presented in AECOM Report dated June 25, 2009
	Case 2	1.3E-04	4.1E-06	2.5E-04	6.3E-05	2.1E-06	1.2E-04	2:1	AECOM July 17, 2009 Response to Mr. Barry Thacker
	Case 3	6.3E-04	2.1E-05	1.2E-03	6.3E-05	2.1E-06	1.2E-04	10:1	AECOM July 17, 2009 Response to Mr. Barry Thacker
	Case 4	6.3E-03	2.1E-04	1.2E-02	6.3E-05	2.1E-06	1.2E-04	100:1	AECOM July 17, 2009 Response to Mr. Barry Thacker
Compacted Clay Fill (Dike C)		5.0E-06	1.6E-07	9.8E-06	2.5E-06	8.2E-08	4.9E-06	2:1	From Parsons E&C/Geosyntec (2005) and Presented in AECOM Report dated June 25, 2009
Alluvium - Silty Sands and Silts		9.1E-06	3.0E-07	1.8E-05	4.6E-06	1.5E-07	9.0E-06	2:1	From AECOM Field CPTu Dissipation Tests and Presented in AECOM Report dated June 25, 2009
Alluvium - Clays and Silts		1.5E-06	4.9E-08	3.0E-06	1.5E-06	4.9E-08	3.0E-06	1:1	From AECOM Field CPTu Dissipation Tests and Presented in AECOM Report dated June 25, 2009
Laminated Sensitive Silts and Ash Slimes		2.4E-07	7.9E-09	4.7E-07	1.2E-07	3.9E-09	2.4E-07	2:1	From AECOM Field CPTu Dissipation Tests and Presented in AECOM Report dated June 25, 2009
Soft Clay		1.5E-06	4.9E-08	3.0E-06	1.5E-06	4.9E-08	3.0E-06	1:1	Presented in AECOM Report dated June 25, 2009

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SUMMARY OF LABORATORY HYDRAULIC CONDUCTIVITY TESTS
ROLLED FLY ASH

Horizontal Permeability

Test No.	**kh, cm/s**
1	7.96E-05
2	7.52E-05
3	1.58E-04
4	1.07E-04
5	6.20E-05
6	1.16E-04
7	4.57E-05
8	4.40E-05
9	1.87E-05
10	3.29E-05

Vertical Permeability

Test No.	**kv, cm/s**	
1	7.52E-05	
2	5.00E-05	
3	8.02E-04	**
4	1.52E-05	
5	1.94E-05	
6	7.23E-04	**
7	4.75E-05	
8	1.28E-04	
9	7.75E-05	
10	9.13E-05	
11	3.07E-05	
12	2.79E-05	

Average	kh, cm/s
Arithmetic	7.4E-05
Geometric	6.2E-05

Average	kv, cm/s
Arithmetic	5.6E-05
Geometric	4.6E-05

Note**: Test omitted when computing average, since it is one other of magnitude higher and it was considered an outlier. Considering this data point would scew the computed averages.

Revised AECOM's Analysis:

kv, cm/s:	6.2E-05
kh, cm/s:	4.6E-05
kh/kv:	1.35

Thacker's Analysis:

kv, cm/s:	2.0E-04
kh, cm/s:	1.0E-04
kh/kv:	2

Appendix C. Updated Seepage and Stability Analysis for Cell 2 Northwest

Table 16.3._9 Summary of Supplementary Slope Stability Analyses at Cell 2 Northwest Section

Actual Slope Stability Analyses (16 Cases) summarized in Table 16.3._9

Table 1.6.3_9 Summary of Supplementary Slope Stability Analyses at Cell 2 Northwest Section

60095742 - TVA

Slope Stability Analyses

Analysis ID	File Name	Material 1				Material 2			Material 4			Material 5			Material 6			Material 7			Material 8			Material 9			Material 10			Material 11			Material 14			Material 15			FOS
		Dike - Ash (& Dike B2)				Ash - Sluiced			Laminated Sensitive Silts and Ash Slimes 1			Laminated Sensitive Silts and Ash Slimes 2			Laminated Sensitive Silts and Ash Slimes 3			Laminated Sensitive Silts and Ash Slimes 4			Laminated Sensitive Silts and Ash Slimes 5			Laminated Sensitive Silts and Ash Slimes 6			Soft Clay			Dike - Compacted Clay Fill			Alluvium - Clays and Silts			Alluvium - Silty Sands and Silts			
		γ_s	γ_m	ϕ	c	γ_s	ϕ	S_{up}/σ_v	γ_s	ϕ	c	γ_s	ϕ	c	γ_s	ϕ	c	γ_s	ϕ	c	γ_s	ϕ	c	γ_s	ϕ	c	γ_s	ϕ	c	γ_s	ϕ	c	γ	ϕ	p	γ	ϕ	p	M&P
	Cell 2 Northwest Section																																							
	Stage 1 (Phi = 30 deg in sluiced ash)																																							
1.1	**Stage 1 Case 1 Original Model**	**107**	**102**	**37**	**-**	**107**	**30**	**-**	**90**	**-**	**700**	**90**	**-**	**800**	**90**	**-**	**900**	**90**	**-**	**1100**	**90**	**-**	**1300**	**90**	**-**	**1500**	**110**	**-**	**600**	**120**	**15**	**600**	**110**	**0.0**	**1200**	**130**	**30**	**600**	**1.32**
1.1.A	Stage 1 Case 1 Original Model with Updated K for Rolled Ash	107	102	37	-	107	30	-	90	-	700	90	-	800	90	-	900	90	-	1100	90	-	1300	90	-	1500	110	-	600	120	15	600	110	0.0	1200	130	30	600	1.32
1.1.B	Stage 1 Case 1 Original Model with 500 ft Extension Seepage Analysis and Old K for Rolled Ash	107	102	37	-	107	30	-	90	-	700	90	-	800	90	-	900	90	-	1100	90	-	1300	90	-	1500	110	-	600	120	15	600	110	0.0	1200	130	30	600	1.28
1.1.C	Stage 1 Case 1 Original Model with 500 ft Extension Seepage Analysis and Updated K for Rolled Ash	107	102	37	-	107	30	-	90	-	700	90	-	800	90	-	900	90	-	1100	90	-	1300	90	-	1500	110	-	600	120	15	600	110	0.0	1200	130	30	600	1.32
1.2	**Stage 1 Case 2 Original Model**	**107**	**102**	**37**	**-**	**107**	**30**	**-**	**90**	**-**	**600**	**90**	**-**	**700**	**90**	**-**	**800**	**90**	**-**	**1000**	**90**	**-**	**1250**	**90**	**-**	**1400**	**110**	**-**	**600**	**120**	**15**	**600**	**110**	**0.0**	**1200**	**130**	**30**	**600**	**1.24**
1.2.A	Stage 1 Case 2 Original Model with Updated K for Rolled Ash	107	102	37	-	107	30	-	90	-	600	90	-	700	90	-	800	90	-	1000	90	-	1250	90	-	1400	110	-	600	120	15	600	110	0.0	1200	130	30	600	1.25
1.2.B	Stage 1 Case 2 Original Model with 500 ft Extension Seepage Analysis and Old K for Rolled Ash	107	102	37	-	107	30	-	90	-	600	90	-	700	90	-	800	90	-	1000	90	-	1250	90	-	1400	110	-	600	120	15	600	110	0.0	1200	130	30	600	1.22
1.2.C	Stage 1 Case 2 Original Model with 500 ft Extension Seepage Analysis and Updated K for Rolled Ash	107	102	37	-	107	30	-	90	-	600	90	-	700	90	-	800	90	-	1000	90	-	1250	90	-	1400	110	-	600	120	15	600	110	0.0	1200	130	30	600	1.23
	Stage 2 (S_{up}/σ = 0.30 in sluiced ash)																																							
2.1	**Stage 2 Case 1 Original Model**	**107**	**102**	**37**	**-**	**107**	**-**	**0.30**	**90**	**-**	**700**	**90**	**-**	**800**	**90**	**-**	**900**	**90**	**-**	**1100**	**90**	**-**	**1300**	**90**	**-**	**1500**	**110**	**-**	**600**	**120**	**15**	**600**	**110**	**0.0**	**1200**	**130**	**30**	**600**	**1.03**
2.1.A	Stage 2 Case 1 Original Model with Updated K for Rolled Ash	107	102	37	-	107	-	0.30	90	-	700	90	-	800	90	-	900	90	-	1100	90	-	1300	90	-	1500	110	-	600	120	15	600	110	0.0	1200	130	30	600	1.03
2.1.B	Stage 2 Case 1 Original Model with 500 ft Extension Seepage Analysis and Old K for Rolled Ash	107	102	37	-	107	-	0.30	90	-	700	90	-	800	90	-	900	90	-	1100	90	-	1300	90	-	1500	110	-	600	120	15	600	110	0.0	1200	130	30	600	0.99
2.1.C	Stage 2 Case 1 Original Model with 500 ft Extension Seepage Analysis and Updated K for Rolled Ash	107	102	37	-	107	-	0.30	90	-	700	90	-	800	90	-	900	90	-	1100	90	-	1300	90	-	1500	110	-	600	120	15	600	110	0.0	1200	130	30	600	1.02
2.2	**Stage 2 Case 2 Original Model**	**107**	**102**	**37**	**-**	**107**	**-**	**0.30**	**90**	**-**	**600**	**90**	**-**	**700**	**90**	**-**	**800**	**90**	**-**	**1000**	**90**	**-**	**1250**	**90**	**-**	**1400**	**110**	**-**	**600**	**120**	**15**	**600**	**110**	**0.0**	**1200**	**130**	**30**	**600**	**0.97**
2.2.A	Stage 2 Case 2 Original Model with Updated K for Rolled Ash	107	102	37	-	107	-	0.30	90	-	600	90	-	700	90	-	800	90	-	1000	90	-	1250	90	-	1400	110	-	600	120	15	600	110	0.0	1200	130	30	600	0.98
2.2.B	Stage 2 Case 2 Original Model with 500 ft Extension Seepage Analysis and Old K for Rolled Ash	107	102	37	-	107	-	0.30	90	-	600	90	-	700	90	-	800	90	-	1000	90	-	1250	90	-	1400	110	-	600	120	15	600	110	0.0	1200	130	30	600	0.94
2.2.C	Stage 2 Case 2 Original Model with 500 ft Extension Seepage Analysis and Updated K for Rolled Ash	107	102	37	-	107	-	0.30	90	-	600	90	-	700	90	-	800	90	-	1000	90	-	1250	90	-	1400	110	-	600	120	15	600	110	0.0	1200	130	30	600	0.97

Note: Orginal Models are presented in AECOM Report dated June 25, 2009

Analysis ID: 1.1

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 1 Case 1 (Average Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Drained Condition
Block Specified Failure Surface

Original Model (Presented in AECOM Report Dated June 25, 2009)

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

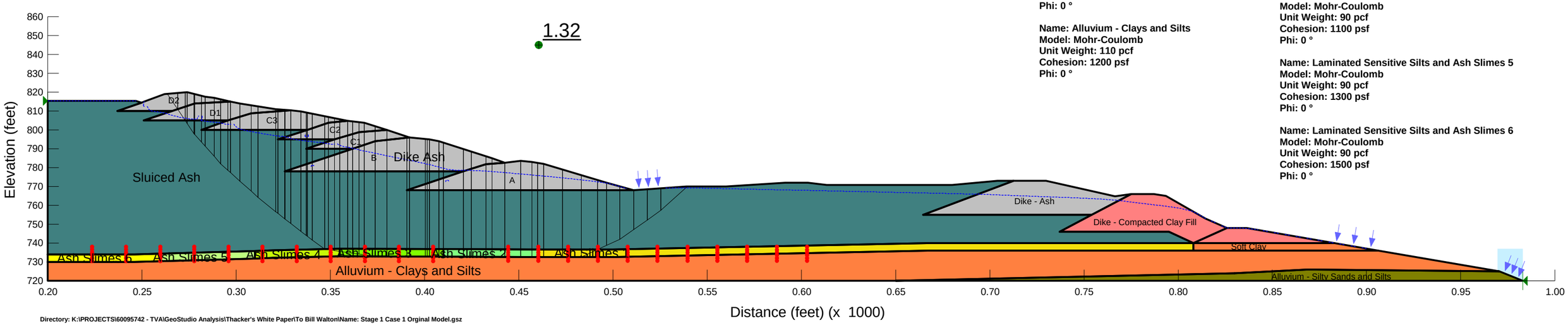
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 900 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1100 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1300 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1500 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 1 Case 1 Orginal Model.gsz

Analysis ID: 1.1.A

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 1 Case 1 (Average Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Drained Condition
Block Specified Failure Surface

Original Model with Updated K Parameter for Rolled Ash (Dike Ash)

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

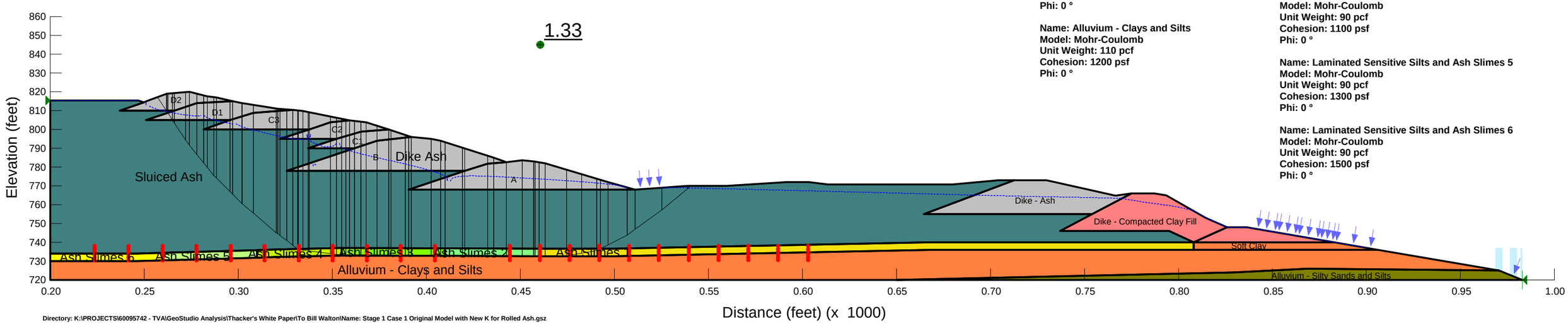
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 900 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1100 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1300 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1500 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 1 Case 1 Original Model with New K for Rolled Ash.gsz

Analysis ID: 1.1.B

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 1 Case 1 (Average Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Drained Condition
Block Specified Failure Surface

Original Model with 500 ft Extension Seepage Analysis and Old K for Rolled Ash

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

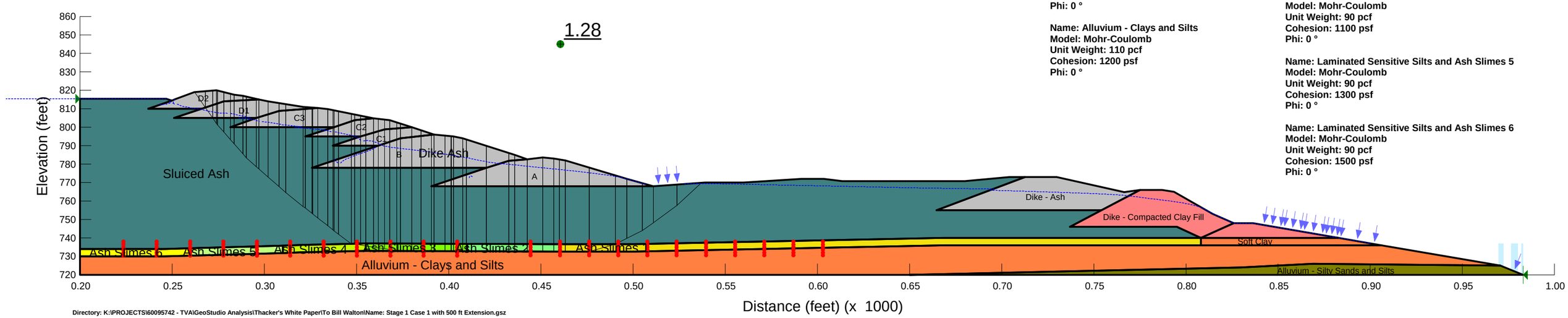
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 900 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1100 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1300 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1500 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 1 Case 1 with 500 ft Extension.gsz

Analysis ID: 1.1.C

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 1 Case 1 (Average Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Drained Condition
Block Specified Failure Surface

Original Model with 500 ft Extension Seepage Analysis and Updated K for Rolled Ash

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

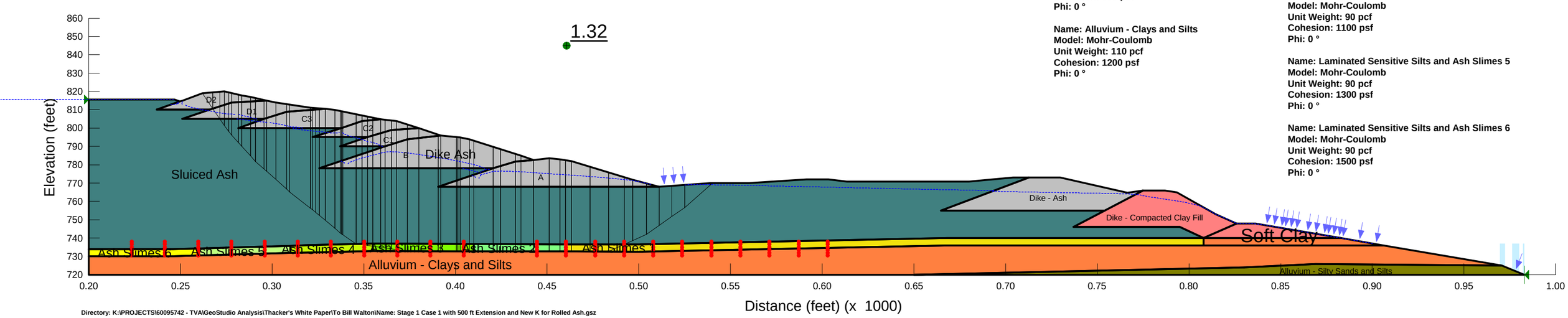
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 900 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1100 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1300 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1500 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 1 Case 1 with 500 ft Extension and New K for Rolled Ash.gsz

Analysis ID: 1.2

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 1 Case 2 (Low Bound Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Drained Condition
Block Specified Failure Surface

Original Model (Presented in AECOM Report Dated June 25, 2009)

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 600 psf
Phi: 0 °

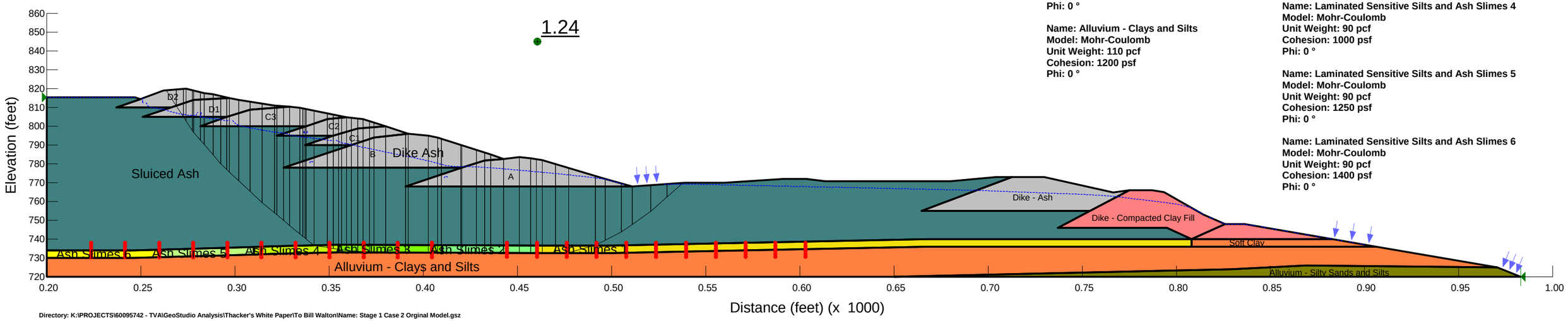
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1000 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1250 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1400 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 1 Case 2 Orginal Model.gsz

Analysis ID: 1.2.A

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 1 Case 2 (Low Bound Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Drained Condition
Block Specified Failure Surface

Original Model with Updated K Parameter for Rolled Ash (Dike Ash)

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 600 psf
Phi: 0 °

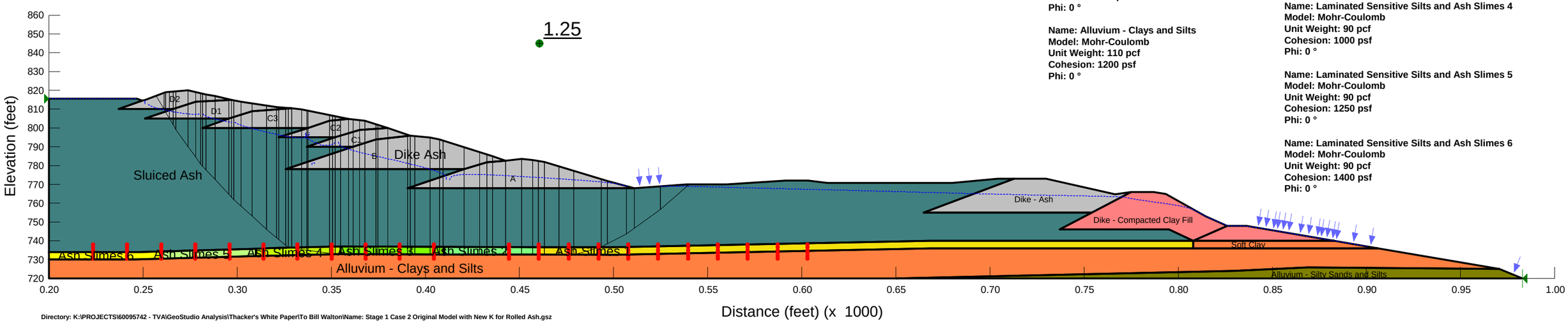
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1000 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1250 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1400 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 1 Case 2 Original Model with New K for Rolled Ash.gsz

Analysis ID: 1.2.B

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 1 Case 2 (Low Bound Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Drained Condition
Block Specified Failure Surface

Original Model with 500 ft Extension Seepage Analysis and Old K for Rolled Ash

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 600 psf
Phi: 0 °

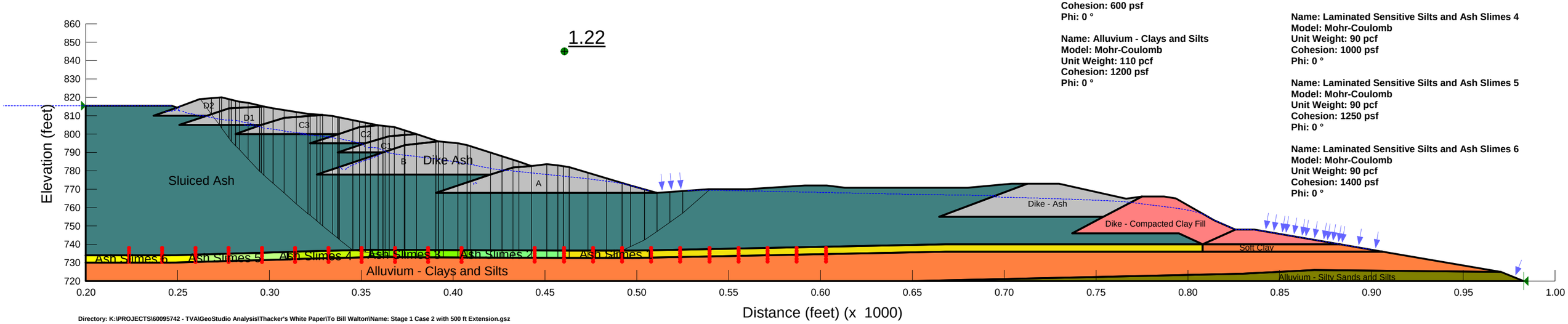
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1000 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1250 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1400 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 1 Case 2 with 500 ft Extension.gsz

Analysis ID: 1.2.C

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 1 Case 2 (Low Bound Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Drained Condition
Block Specified Failure Surface

Original Model with 500 ft Extension Seepage Analysis and Updated K for Rolled Ash

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Cohesion: 0 psf
Phi: 30 °
Phi-B: 0 °

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 600 psf
Phi: 0 °

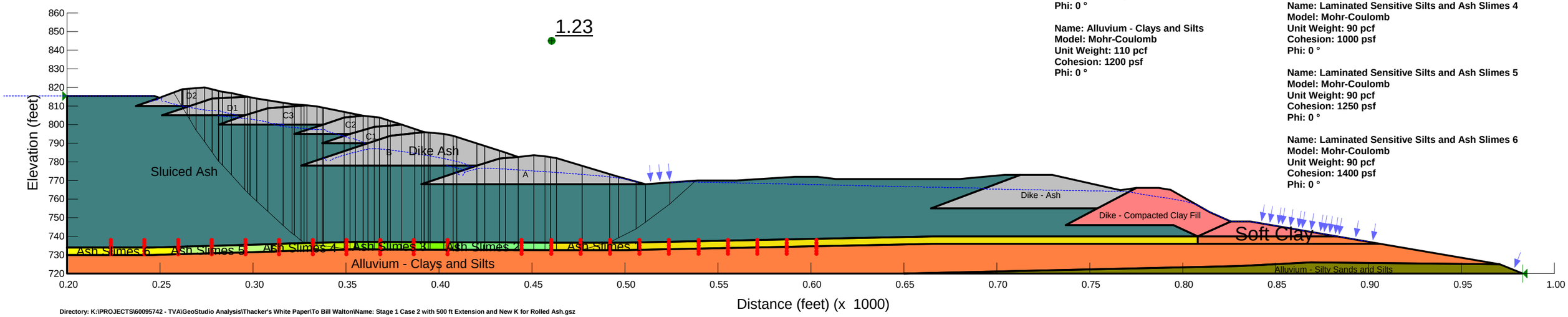
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1000 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1250 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1400 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 1 Case 2 with 500 ft Extension and New K for Rolled Ash.gsz

Analysis ID: 2.1

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 2 Case 1 (Average Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Undrained Condition
Block Specified Failure Surface

Original Model (Presented in AECOM Report Dated June 25, 2009)

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: S=f(overburden)
Unit Weight: 107 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 0

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

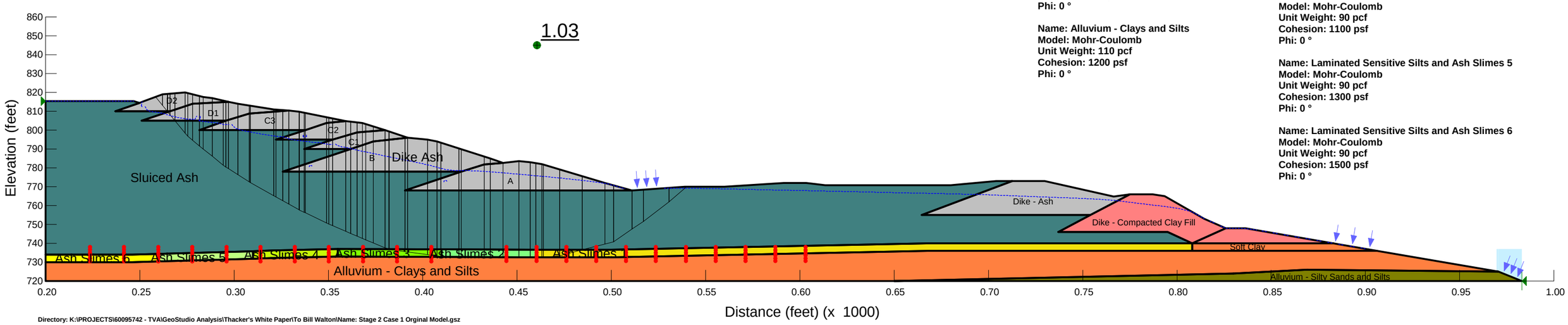
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 900 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1100 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1300 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1500 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 2 Case 1 Orginal Model.gsz

Analysis ID: 2.1.A

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 2 Case 1 (Average Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Undrained Condition
Block Specified Failure Surface

Original Model with Updated K Parameter for Rolled Ash (Dike Ash)

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: S=f(overburden)
Unit Weight: 107 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 0

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

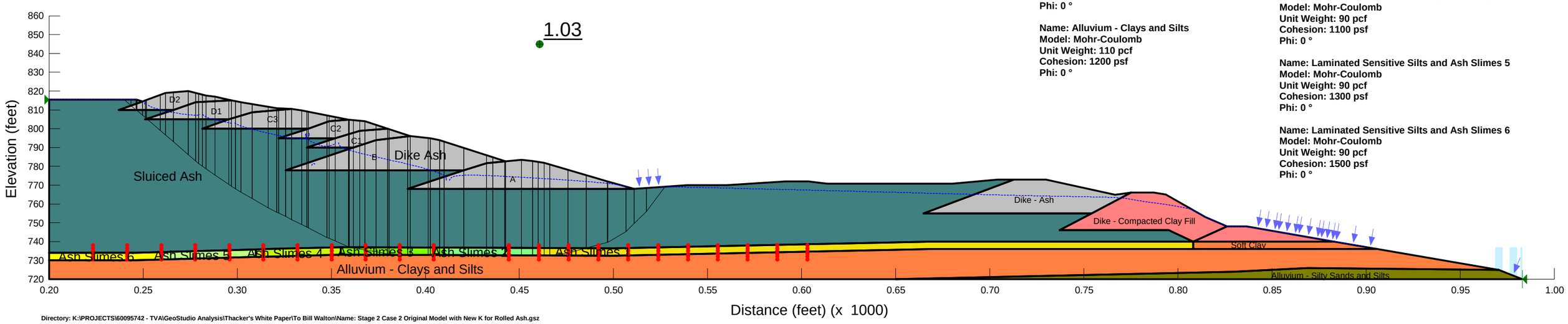
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 900 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1100 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1300 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1500 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 2 Case 2 Original Model with New K for Rolled Ash.gsz

Analysis ID: 2.1.B

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 2 Case 1 (Average Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Undrained Condition
Block Specified Failure Surface

Original Model with 500 ft Extension Seepage Analysis and Old K for Rolled Ash

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: S=f(overburden)
Unit Weight: 107 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 0

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

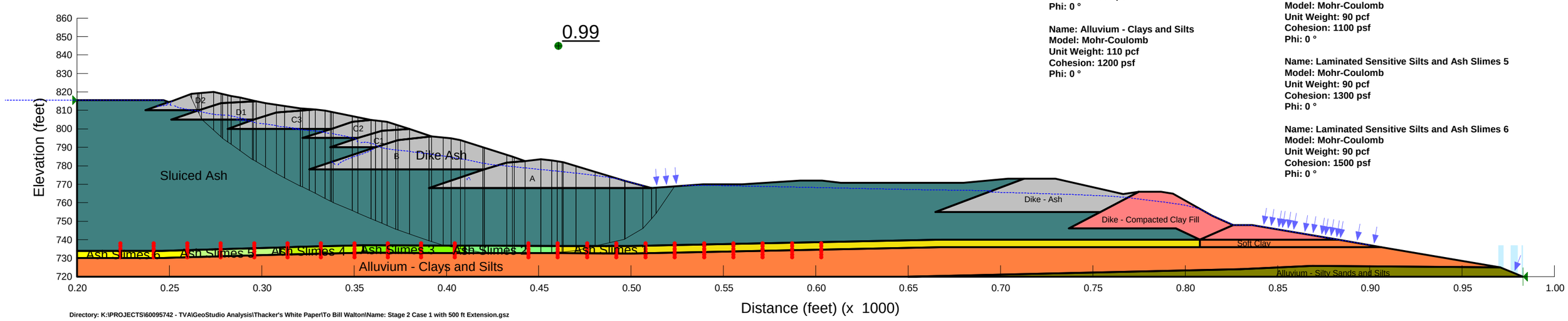
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 900 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1100 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1300 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1500 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 2 Case 1 with 500 ft Extension.gsz

Analysis ID: 2.1.C

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 2 Case 1 (Average Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Undrained Condition
Block Specified Failure Surface

Original Model with 500 ft Extension Seepage Analysis and Updated K for Rolled Ash

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: S=f(overburden)
Unit Weight: 107 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 0

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

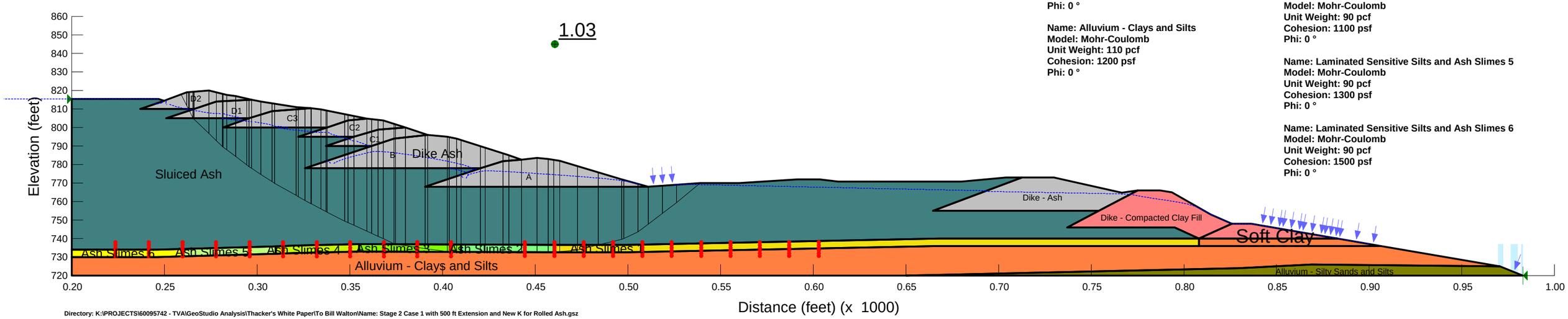
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 900 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1100 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1300 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1500 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 2 Case 1 with 500 ft Extension and New K for Rolled Ash.gsz

Analysis ID: 2.2

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 2 Case 2 (Low Bound Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Undrained Condition
Block Specified Failure Surface

Original Model (Presented in AECOM Report Dated June 25, 2009)

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: S=f(overburden)
Unit Weight: 107 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 0

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 600 psf
Phi: 0 °

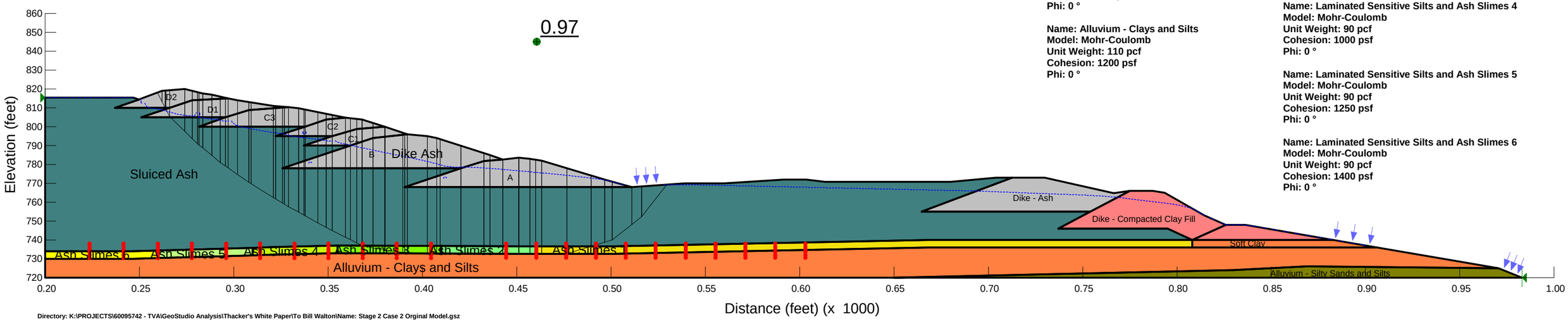
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1000 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1250 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1400 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 2 Case 2 Orginal Model.gsz

Analysis ID: 2.2.A

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 2 Case 2 (Low Bound Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Undrained Condition
Block Specified Failure Surface

Original Model with Updated K Parameter for Rolled Ash (Dike Ash)

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: S=f(overburden)
Unit Weight: 107 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 0

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 600 psf
Phi: 0 °

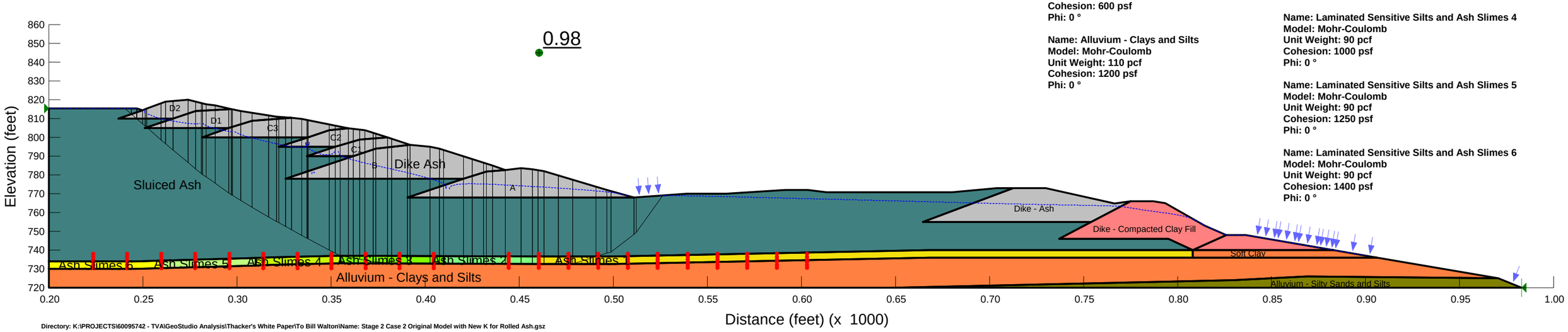
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1000 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1250 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1400 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 2 Case 2 Original Model with New K for Rolled Ash.gsz

Analysis ID: 2.2.B

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 2 Case 2 (Low Bound Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Undrained Condition
Block Specified Failure Surface

Original Model with 500 ft Extension Seepage Analysis and Old K for Rolled Ash

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: S=f(overburden)
Unit Weight: 107 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 0

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 600 psf
Phi: 0 °

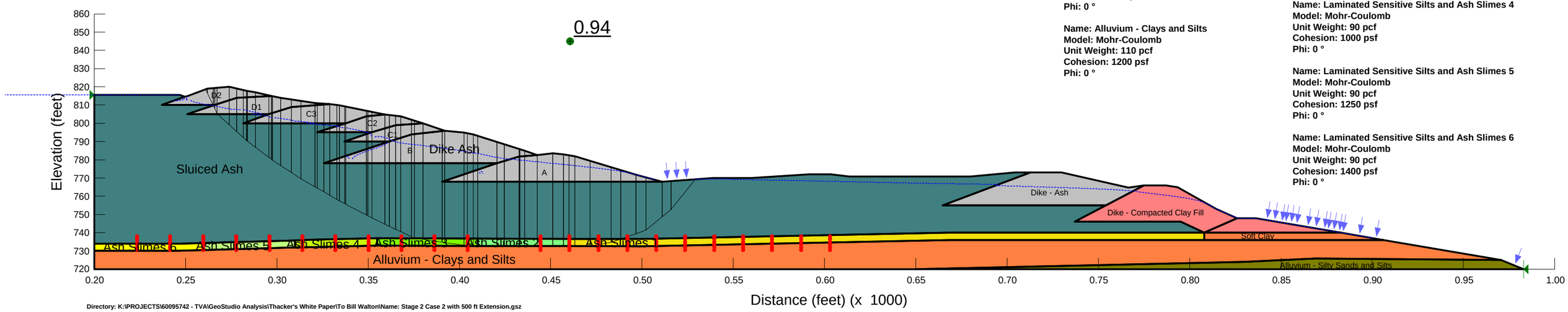
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1000 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1250 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1400 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 2 Case 2 with 500 ft Extension.gsz

Analysis ID: 2.2.C

Title: TVA - Kingston RCA
Comments: Slope Stability Analysis for Cell 2 Northwest Section Stage 2 Case 2 (Low Bound Strength of Ash Slimes)
Method: Morgenstern-Price
Analysis Sluiced Ash Undrained Condition
Block Specified Failure Surface

Original Model with 500 ft Extension Seepage Analysis and Updated K for Rolled Ash

Name: Ash - Dike
Model: Mohr-Coulomb
Unit Weight: 107 pcf
Unit Wt. Above Water Table: 102 pcf
Cohesion: 0 psf
Phi: 37 °

Name: Dike - Compacted Clay Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 600 psf
Phi: 15 °

Name: Ash - Sluiced
Model: S=f(overburden)
Unit Weight: 107 pcf
Tau/Sigma Ratio: 0.3
Minimum Strength: 0

Name: Soft Clay
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 600 psf
Phi: 0 °

Name: Alluvium - Clays and Silts
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion: 1200 psf
Phi: 0 °

Name: Alluvium - Silty Sands and Silts
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 600 psf
Phi: 30 °

Name: Laminated Sensitive Silts and Ash Slimes 1
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 600 psf
Phi: 0 °

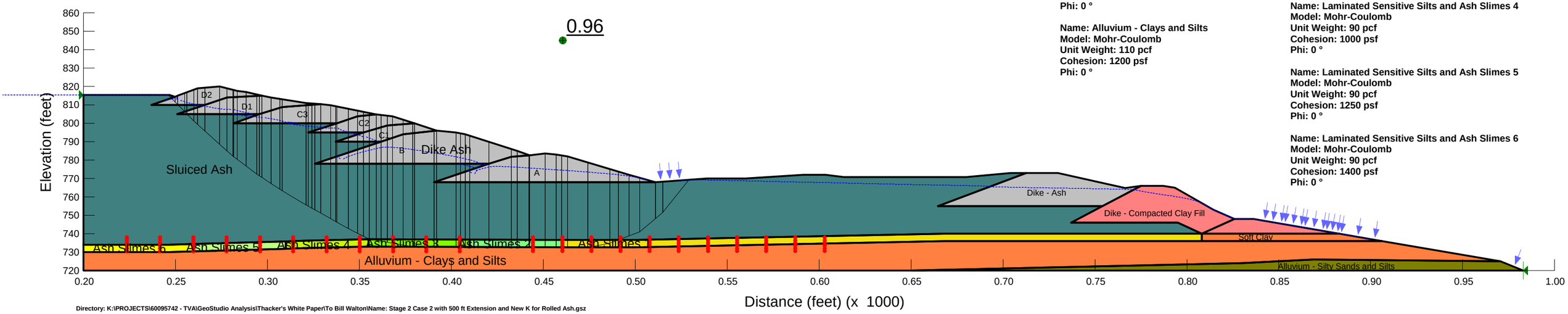
Name: Laminated Sensitive Silts and Ash Slimes 2
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 700 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 3
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 800 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 4
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1000 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 5
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1250 psf
Phi: 0 °

Name: Laminated Sensitive Silts and Ash Slimes 6
Model: Mohr-Coulomb
Unit Weight: 90 pcf
Cohesion: 1400 psf
Phi: 0 °



Directory: K:\PROJECTS\60095742 - TVA\GeoStudio Analysis\Thacker's White Paper\To Bill Walton\Name: Stage 2 Case 2 with 500 ft Extension and New K for Rolled Ash.gsz