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GEOTECHNICAL EXPLORATION SERVICES

SLOPE STABILITY AND LIQUEFACTION POTENTIAL ANALYSIS
CCR IMPOUNDMENT SYSTEM
DEERHAVEN GENERATING STATION (DGS)
10001 NW 13th STREET
GAINESVILLE, ALACHUA COUNTY, FLORIDA

PROJECT NO. 0230.1500077
REPORT NO. 1808777

Prepared For:

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November 11, 2020

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November 11, 2020

Innovative Waste Consulting Services, LLC
3720 NW 43rd Street, Suite 103
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Attention: Dr. Pradeep Jain, PhD., P.E.

Reference: **Report of Geotechnical Consulting Services**
Deerhaven Generating Station – CCR Impoundment Embankment
Slope Stability and Liquefaction Potential Analysis
10001 NW 13th Street
Gainesville, Alachua County, Florida
UES Project No. 0230.1500077 UES Report No. 1808777

Dear Dr. Jain:

Universal Engineering Sciences, LLC (UES) has completed the geotechnical engineering services for the subject project in Gainesville, Alachua County, Florida. This geotechnical Report is submitted in satisfaction of the contracted scope of services as summarized in UES Proposal No. 1705571, dated August 27, 2019.

UES completed the initial assessment of the slope stability and liquefaction analysis of the CCR Impoundment System and Pump Back Ponds embankments in November 2015. This assessment was completed per the requirements of 40 CFR 257.73(e). 40 CFR 257.73(f)(3) requires conducting these assessments every five years. The following report presents the results of our historical geotechnical exploration and slope stability and liquefaction analysis assessment of the CCR Impoundment System and Pump Back Ponds embankments at DGS to reflect the current site conditions. This plan was prepared under the supervision, direction and control of the undersigned registered professional engineer (PE). The undersigned PE is familiar with the requirements of 40 CFR 257.73(e). The undersigned PE certifies that this initial safety factor assessment meets the requirements of 40 CFR 257.73(e)(1). This certification was prepared per the requirement of 40 CFR 257.73(e)(2).

We appreciate the opportunity to have worked with you on this project and look forward to a continued association. Please contact us if you have any questions, or if we may further assist you as your plans proceed.

Sincerely,
UNIVERSAL ENGINEERING SCIENCES, LLC
Certificate of Authorization Number 549

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

EXECUTIVE SUMMARY

We have prepared this executive summary as a general overview. Please refer to, and rely on, the full report for information about findings, recommendations, and other considerations.

The Deerhaven Generating Station (site) has a coal combustion residuals (CCR) surface impoundment system that is comprised of two ash ponds (i.e., Ash Cell #1, Ash Cell #2) located within the same slurry wall containment system. The decant water from these ponds drain to Pump Back Cells located adjacent to these ash cells.

UES completed the initial assessment of the slope stability and liquefaction analysis of the CCR Impoundment System and Pump Back Ponds embankments in November 2015. This assessment was completed per the requirements of 40 CFR 257.73(e). 40 CFR 257.73(f)(3) requires conducting these assessments every five years. This report presents the results of our historical geotechnical exploration and an updated slope stability and liquefaction analysis assessment of the CCR Impoundment System and Pump Back Ponds embankments at DGS to reflect the current site conditions.

The general profile depicts horizons or layers that are in the stratigraphy sequence of descending lithology, as described below. The slope stability sections present these layers in a graphical manner. The site topography ranges from an elevation of +180 feet, NGVD to elevation +195 feet, NGVD. The soils consist of silty sand [SM] to approximate elevations of +186 to +184 feet and +180 to +175 feet, NGVD, and a clayey sand to sandy clay [SC/CH] liner to elevations to +184 to +180 feet, NGVD. Based on the SPT-N values and laboratory strength testing, the silty sands have relative densities of loose to medium dense to very dense, and the clayey soils have relative densities of medium dense to very stiff.

Groundwater levels were measured between 4 and 20.5 feet below existing site grades at the time of drilling (approximate elevations +182 to +193 feet, NGVD). Typically, fluctuations in groundwater levels should be anticipated throughout the year, primarily due to seasonal variations in rainfall, surface runoff, and other specific site factors that may vary from the time the soil test borings were conducted.

Based on our historical field exploration and laboratory testing program and site topography information, the factors of safety against slope failure for two loading conditions (long-term, maximum storage pool loading condition, and maximum surcharge pool loading condition) as well as the factor of safety against liquefaction potential exceed the requirements of 40 CFR 257.73(e). The site is not considered to be located in a seismic zone; therefore, a seismic factor of safety was not estimated for the surface impoundment.

1.0 INTRODUCTION

Universal Engineering Sciences, LLC (UES) conducted geotechnical exploration and completed the initial assessment of the slope stability and liquefaction analysis of the CCR Impoundment System and Pump Back Ponds embankments at the existing Deerhaven Generating Station (DGS) in Gainesville, Alachua County, Florida in November 2015. This assessment was completed per the requirements of 40 CFR 257.73(e). 40 CFR 257.73(f)(3) requires conducting these assessments every five years. The following report presents the results of our historical geotechnical exploration and slope stability and liquefaction analysis assessment of the CCR Impoundment System and Pump Back Ponds embankments at DGS to reflect the current site conditions.

2.0 PROJECT CONSIDERATIONS

UES conducted the geotechnical exploration and slope stability analysis in 2015 to address the United States Environmental Protection Agency's Request for Action Plan regarding Gainesville Regional Utilities – Deerhaven Power Plant, dated June 2, 2014.

The subject site is located within Sections 26 and 27, Township 8 South, Range 19 East in Gainesville, Alachua County, Florida. The Deerhaven Generating Station (DGS) is located approximately 1.25 miles north of NW 43rd Street along the north side of US HWY 441, in Gainesville, Alachua County, Florida. More specifically, the property is an approximately 930-acre parcel of land located at 10001 NW 13th Street in Gainesville, Alachua County, Florida.

DGS has a CCR surface impoundment system that is comprised of two ash ponds (i.e., Ash Cell #1, Ash Cell #2) located within a slurry wall containment system. The CCR impoundment system is situated just northwest of the generating facility. It is connected to the main plant by roadways that support asphalt/limerock base access roads. These ponds receive cooling tower blowdown and bottom ash sluice water from the site's coal-fired combustion unit (i.e., Unit #2) through a piping network that allows discharge to either pond. As the water moves through the ash ponds, bottom ash settles, and the decant water gravity drains to adjacent pump back ponds (i.e., Pump Back Cell #1, Pump Back Cell #2) through subsurface culverts, which run beneath the embankment separating each ash pond from its adjacent pump back pond. The culvert inlets are enclosed within stoplog structures (located inside the ash ponds near the embankment separating each ash pond from the adjacent pump back pond) to minimize ash entering the culverts. The adjacent pump back ponds are exclusively used to store the decant water prior to treatment and re-use in plant operations. The slurry wall containment system is located beneath the peripheral embankment, which encompasses the surface impoundment system, the pump back ponds, and two front-end treatment lime sludge ponds. The slurry wall is keyed into an existing, underlying clay layer. The description above is based on the information reported by IWCS (2020).

The interior area of each ash cell is approximately 2.6 acres, and each pump back pond is approximately an acre in area and is adjacent to wooded areas. The top of the as cell embankments are at or near elevation +195 feet, which is nearly 150 feet above the potentiometric surface level. The slopes vary in steepness from 3H: 1V to 4H: 1V throughout the sides of the embankments. The slopes are vegetated with grass along the exterior and covered with rock/boulders along the interior slopes. Moderately dense wooded areas surround much of the DGS. There are some water management areas/swales on the south side of the impoundment system.

3.0 PURPOSE AND SCOPE OF SERVICES

3.1 Purpose

As mentioned earlier, UES conducted geotechnical exploration and completed the initial assessment of the slope stability and liquefaction analysis of the CCR Impoundment System and Pump Back Ponds embankments at the DGS) in November 2015. This assessment was completed per the requirements of 40 CFR 257.73(e). 40 CFR 257.73(f)(3) requires conducting these assessments every five years. The purpose of this report is to update slope stability and liquefaction analysis assessment of the CCR Impoundment System and Pump Back Ponds embankments at DGS to reflect the current site conditions.

3.2 Scope of Service

A compilation of the services conducted by UES to date for the subsurface exploration program and slope stability analysis of the CCR impoundment system embankment at the existing Deerhaven Generating Station (DGS) in Alachua County, Florida are as follows:

- Previous geotechnical exploration and laboratory testing programs were reviewed as part of the scope. Field and laboratory information from the previous exploration are incorporated in the findings of this report.

- Prepared a report which documents the results of our previous subsurface exploration and slope stability/liquefaction potential analysis.

This report presents updated slope stability and liquefaction analysis assessment of the CCR Impoundment System and Pump Back Ponds embankments at DGS to reflect the current site conditions.

4.0 LITERATURE REVIEW

We reviewed commonly available references for general information about the property along the proposed project. A Site Location Map and a USGS Map is included in **Appendix A**.

4.1 Soil Survey

We reviewed commonly available references for general information about the property along the proposed project. A Site Location Map and a USGS Map are included in **Appendix A**.

4.1 Soil Survey

Based on the Soil Survey for Alachua County, Florida, as prepared by the US Department of Agriculture, Natural Resource Conservation Service, the predominant soil types at the site are identified as Pomona and Surrency soil (Thomas 1985). A summary of the characteristics of these soil series was obtained from the Soil Survey and have been presented in Table 1.

Table 1
Summary of NRCS Soil Survey Information

Soil Type	Constituents	Classification	% Passing 200 sieve	Soil Permeability (Inches/Hr)	Seasonal High Water Table
14-Pomona	0-5" - Sand 5-16" - Sand, fine sand 16-24" - Sand, fine sand 24-43" - Sand , fine sand 43-84" - Sandy clay loam, sandy loam, sandy clay	SP, SP-SM SP, SP-SM SP-SM, SM SP, SP-SM SC, SM-SC, SM	2-12 2-12 5-15 2-12 25-50	6.0 - 20 6.0.- 20 0.6 - 20 2.0 - 2.0 0.2 - 20	0 to 1' Apparent
16 - Surrency	0-28" – Sand 28-44" – Sandy loam, sandy clay loam 44-80" – Sandy clay loam	SM SM, SM-SC, SC SM, SM-SC, SC	10-26 22-35 30-44	2.0 – 20 0.6 – 6.0 0.06 – 2.0	0 to 0.5' Apparent

4.2 Topography

According to information obtained from the United States Geologic Survey (USGS) Florida, the natural ground surface elevation across the general site area ranges between approximately +175 feet to +185 feet NGVD. A copy of a portion of the USGS Map for the site area is included in **Appendix A**.

4.3 Geology

The general geology of central Alachua County is characterized by a surface veneer of Pleistocene and Pliocene sands and sandy clays overlying the Miocene-age Hawthorn Group. The Hawthorn Group includes a highly variable mixture of interbedded quartz sands, clays, carbonates, pebbles, and grains occurring with thicknesses of up to 150 feet.

The general hydrogeology of Alachua County consists of three aquifer systems; the uppermost aquifer, and intermediate aquifer, and the Floridan Aquifer system. The uppermost aquifer exists as an unconfined water table situated over the impermeable Hawthorn Group and is usually a subdued reflection of surface topography. The intermediate aquifer system includes all rocks that collectively retard the exchange of water between the overlying surficial aquifer system and the underlying Floridan aquifer system. Water in this system is contained under confined conditions. The Floridan aquifer system is a thick, carbonate sequence that functions regionally as a water-yielding hydraulic unit. Water exists under confined conditions.

Information obtained from the USGS Potentiometric Surface Map dated May 2009 suggests the potentiometric level of the Floridan Aquifer in the general area of the project site to be in the elevation range of +40 to +50 feet, NGVD (SJRWMD 2009).

5.0 FIELD EXPLORATION

5.1 General

The soil borings were performed with a truck-mounted drill rig. The general locations of the soil borings were selected based on the height of the embankments, as well as the observed moisture and/or potential seepage along some areas of the embankments. The approximate locations of the borings are shown on the Boring Location Plan presented in **Appendix B**. UES received horizontal and vertical control data for each boring which is presented in tabular form, Boring Survey Control, in Appendix B with ground surface elevations also presented on the boring logs.

5.2 Standard Penetration Test Borings

The Standard Penetration Test (SPT) borings were performed in general accordance with the procedures of ASTM D 1586 (Standard Method for Penetration Test and Split-Barrel Sampling of Soils). Continuous sampling was performed within the upper 10 feet. The SPT drilling technique involves driving a standard split-barrel sampler into the soil by a 140-pound hammer, free falling 30 inches. The number of blows required to drive the sampler 1 foot, after an initial seating of 6 inches, is designated the penetration resistance, or N-value, an index to soil strength and consistency. These tests were performed in July 2015.

5.3 Groundwater Observation Level/Piezometers

UES installed six (6) piezometers (PZ-1 and PZ-6) completed to depths of 6 to 12 feet at the borehole locations. The piezometers were completed with 2" PVC riser material connected to a section of 0.010-inch slot screen, 6/20 clean washed silica sand was placed around the annulus of the screen to at least two feet above the screen. A 30/60 fine sand seal was placed on top of the 6/20 silica sand pack to the ground surface. These piezometers were installed in July 2015.

5.4 Undisturbed Sampling

SPT borings were used to provide access for the Shelby tubes to collect undisturbed soils samples. Four (4) undisturbed samples were collected for shear testing of cohesive soils. The ASTM procedure of Thin-Walled Sampling Soils, ASTM-D-1578-13, was used to collect undisturbed soil samples in July 2015.

6.0 LABORATORY TESTING

6.1 Visual Classification

The soil samples recovered from the soil test borings were returned to our laboratory, where an engineer visually reviewed the field descriptions in accordance with ASTM D-2488. We then selected representative soil samples for laboratory testing. Using the results of the laboratory tests, our visual examination, and our review of the field boring logs, we classified the soil borings in accordance with the current Unified Soil Classification System (USCS). These laboratory tests were performed in July 2015 to collect data for the initial embankment stability assessment.

6.2 Index Testing

Laboratory testing was performed on selected samples of the soils encountered in the field exploration to better define soil composition and properties. Testing was performed in accordance to ASTM procedures and included Grain Size Analysis (ASTM D-422, Percent Passing No. 200 Sieve (ASTM D-1140), Moisture Content (ASTM D-2216), Atterberg Limits (ASTM D-4318), Consolidated Drained (ASTM D-7181) and Undrained Triaxial Tests (ASTM D-4767) and Direct Shear Test (ASTM D-3080). The test results have been presented on the attached Boring Logs.

The laboratory classification data is presented on the Boring Logs at the approximate depth sampled in Appendix B. All laboratory data are summarized, and report sheets included in Appendix C. In addition, detailed laboratory test procedures are enclosed in **Appendix C.**

7.0 SOIL STRATIGRAPHY

7.1 Generalized Soil Profile

The general profile depicts horizons or layers that are in the stratigraphy sequence of descending lithology as described below. The slope stability sections present these layers in graphical manner.The site topography ranges from an elevation of +180 feet, NGVD to elevation +195 feet, NGVD.

The soils consists of silty sand [SM] to approximate elevations of +186 to +184 feet and +180 to +175 feet, NGVD, and a clayey sand to sandy clay [SC/CH] liner to elevations to +184 to +180 feet, NGVD. Based on the SPT-N values and laboratory strength testing, the silty sands have relative densities of loose to medium dense to very dense and the clayey soils have relative densities of medium dense to very stiff.

The results of our field exploration and laboratory analysis, together with pertinent information obtained from the SPT, such as soil profiles, penetration resistance and stabilized groundwater levels are shown on the boring logs included in **Appendix B**. The Key to Boring Logs is also included in Appendix B. The soil profiles were prepared from field logs after the recovered soil samples were visually classified by a member of our geotechnical staff. The stratification lines shown on the boring logs represent the approximate boundaries between soil types, and may not depict exact subsurface soil conditions. The actual soil boundaries may be more transitional than depicted.

8.0 GROUNDWATER CONSIDERATIONS

8.1 Existing Groundwater Level

Groundwater levels were measured between 4 and 20.5 feet below existing site grades at the time of drilling (approximate elevations +182 to +193 feet, NGVD). Typically, fluctuations in groundwater levels should be anticipated throughout the year, primarily due to seasonal variations in rainfall, surface runoff, and other specific site factors that may vary from the time the soil test borings were conducted. Additional water table elevation can be seen in the table below:

Table 2 – Groundwater Elevations							
Boring Location	Top of Piezometer Elevation Feet (NGVD)	Ground Surface Elevation[1] Feet (NGVD)	Piezometer Depth Below Ground Surface Elevation, Feet	Groundwater Level Readings Water Table Elevations (NGVD)[2]			
No.				07/17/15	07/30/15	06/08/20	08/10/20
B-1/P1	198.67	195.30	12	192.02	193.07	194.37	190.95
B-2/P2	198.85	195.42	12	187.35	188.00	191.85	184.27
B-3/P3	198.72	195.17	12	185.77	186.77	187.62	187.77
B-4/P4	197.90	194.60	8	186.65	187.30	182.90	187.96
B-5/P5	191.41	188.1	6	184.96	186.56	NA	NA
B-6/P6	191.70	188.40	6	182.40	184.95	NA	NA

Notes: [1].-Ground surface elevations are estimated based on topography maps provided by IWCS
[2].-Groundwater elevations reading from 06/08/20 and 08/10/20 provided by IWCS-GRU

8.2 Typical Wet Season Groundwater Level

The typical wet season groundwater level is defined as the highest groundwater level sustained for a period of 2 to 4 weeks during the "wet" season of the year, for existing site conditions, in a year with average normal rainfall amounts. Based on historical data, the rainy season in Alachua County, Florida typically occurs between June and September.

To estimate the wet season groundwater level at the soil test boring locations, many factors such as the following should be considered:

a. Measured groundwater level
b. Drainage characteristics of existing soil types
c. Season of the year (wet/dry season)
d. Current & historical rainfall data (recent and year-to-date)
e. Natural relief points (such as lakes, rivers, swamp areas, etc.)
f. Man-made drainage systems (ditches, canals, etc.)
g. Distances to relief points and man-made drainage systems
h. On-site types of vegetation
i. Area topography (ground surface elevations)
j: Available Published Data

Based on the groundwater levels encountered, the historical rainfall data, our review of our regional hydrogeology, and the Alachua County Soil Survey, we estimate that the typical wet season groundwater levels around the CCR impoundment system will range approximately 4 to 10 feet below much of the existing land surface (approximate elevations +180 feet, NGVD).

As mentioned previously, we found shallow deposits of silty sands across the site during our site exploration. Due to the poor permeability characteristics of these silty soils, these soils tend to act as an aquiclude (sediment through which groundwater cannot pass easily) to the natural infiltration of the rainwater. Therefore, surface water will most likely temporarily perch on top of these relatively impermeable soils causing isolated areas with temporary groundwater levels significantly higher during periods of heavy rainfall or artificial irrigation.

It should be noted, however, that peak stage elevations immediately following various intense storm events, may be somewhat higher than the estimated typical wet season levels. Further, it should be understood that changes in the surface hydrology and subsurface drainage from on-site or off-site improvements could have significant effects on the normal and seasonal high groundwater levels.

9.0 ASSESSMENT SAFETY FACTORS

Our assessment program included calculating factors of safety under specific loading conditions to determine the stability of the existing CCR surface impoundment embankments. Static, Seismic and Liquefaction factors of safety were evaluated following the requirements established by Environmental Protection Agency (EPA) in 40 CFR Part 257 and 261 – Hazards and Solid Waste management System; Disposal of Coal Combustion Residuals from Electric Utilities.

Accordingly the following minimum factor of safety should be achieved;

- Long-term- maximum storage pool loading conditions must equal or exceed 1.50
- Maximum surcharge pool loading conditions must equal or exceed 1.40
- Seismic factor must equal or exceed 1.00
- Liquefaction factor of safety must equal or exceed 1.20

Seismic Impact zones mean an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years. Based on the USGS Hazards map included in Appendix D, the maximum expected horizontal acceleration in the impoundments is less than 0.02 g. A seismic stability analysis was conducted for these impoundments.

9.1 Slope Stability Analysis

The CCR surface impoundment system is located just northwest of the generating facility. The system is accessible from the main plant by asphalt/limerock base access roads. The impoundment system consists of two ash cells (Ash Cell #1 and Ash Cell #2). The area of each cell is approximately 2.6 acres. The area of the pump back pond located adjacent to each ash cell is approximately 1 acre. The top of the ash cell embankments are at or near elevation +195 feet, which is nearly 150 feet above the potentiometric surface level (Floridan Aquifer). The slopes vary in steepness from 3H: 1V to 4H: 1V throughout the sides of the CCR impoundment system embankments. The slopes are vegetated with grass along the exterior and covered with rock/rip-rap along the interior slopes. Moderately dense wooded areas surround much of the Deerhaven Generating Station (DGS). There are some water management areas/swales on the south side of the impoundment system.

The purpose of the stability analysis was to determine the minimum factor of safety of several potential failure surfaces for critical cross-sections. Stability analysis determines whether the existing slope meets the safety requirements. Conventional limit equilibrium methods of slope stability analysis were used to evaluate the equilibrium of soil/fill mass to move under the influence of gravity. We developed the parameters used in our slope stability evaluation from the information obtained during our field exploration and laboratory testing program, from the site topographic information provided by Innovative Waste Consulting Services, LLC. The slope stability analysis also considered a maintenance truck on top of the berm with an axle load of 16,000 pounds.

9.1.1 Geometry

Based on drawings received, we developed an internal geometry for the cross-sections analyzed. Selections of the cross sections were based on the steepness of the slope, height of the fill, phreatic level and subsurface conditions. Based on these conditions, six critical cross-sections were determined to be the most critical cross sections for the stability for the DGS impoundment system.

9.1.2 Failure Modes

Two potential failure scenarios were studied to evaluate if the impoundment system meets the required factor of safety against global slope failure:

Foundation Stability: Circular failure surfaces extending through the ash cells and into the foundation soils were generated and evaluated by Slide2018. The factor of safety values were evaluated using the “Janbu” and “Bishop” methods.

Face Stability: Small circular failure surfaces extending through the ash cell soils, including the grass-covered surficial layer, were generated and evaluated by Slide2018. The factor of safety values were evaluated using the Janbu method.

9.1.3 Failure Conditions

A major consideration in characterizing shear strength is determining whether the soil/fill mass will be drained or undrained for each condition. Stability analyses during construction and at the end of the construction are usually performed using drained strength in free-draining materials and undrained strengths in materials that drain slowly.

9.1.4 Materials Properties

Soil strength parameters were obtained from laboratory testing performed in 2015 on representative samples taken from the project site in July 2015. Below is a summary of the soil materials properties and strength parameters for the layers in the vicinity of the CCR impoundment system at the DGS. Most of the index and shear strength parameters were chosen based on the field and laboratory test performed. Certain parameters were selected based on the work by others, as noted.

Medium dense Silty Sand Ỹr=119 pcf			
Analysis	Type	Unit	Value
Un-Drained	Cohesion Intercept	PSF	192
Lab Testing Triaxial Test	Friction angle	Degree	31

Medium dense Very Clayey Sand Ỹr=127 pcf			
Analysis	Type	Unit	Value
Un-Drained	Cohesion Intercept	PSF	197
Lab Testing Triaxial Test	Friction angle	Degree	24.9

Medium dense Silty Sand * Ỹr=118 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	175
Lab Testing Direct Shear Test	Friction angle	Degree	31.1

Medium dense Silty-Clayey Sand * Ỹr=120 pcf			
Analysis	Type	Unit	Value
Undrained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	30

Loose Sand with silt Ỹr=110 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	29

Medium dense Sand with silt Ỹr=120 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	32

Medium dense Silty Sand Ỹr=120 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	30

9.1.5 Computational Results

Theoretically, when analyzing slopes, a factor of safety of less than 1.0 indicates unstable and unsafe conditions with the potential for failure to occur at any time. A factor of safety greater than 1.0 indicates the slope is stable. Presented below in Table 3 are the Factors of Safety required by 40 CFR 257.73(e).

Table 3: Required Minimum Values of Factor of Safety for Slope Stability Analysis*	
Condition	Safety Factor
Static safety factor/ long-term maximum storage pool loading condition	1.5
Static safety factor/maximum surcharge pool loading condition	1.4

**Source: 40 CFR 257.73(e)*

Results of the Factor of Safety for all scenarios run by Slide2018 are summarized in Table 4 below. The following summary table demonstrates that the CCR impoundment system embankments meet and exceed the required safety factors.

A slope stability analysis of the embankments was performed using the data gathered from the laboratory analysis of the soil samples collected from the impoundments. The stability analysis was conducted for both long-term maximum storage pool loading conditions and maximum surcharge pool loading conditions. Maximum surcharge pool loading conditions were considered at the top of the embankment, and long-term maximum storage pool loading conditions were considered at maximum operating levels. Slope stability analyses were conducted for the maximum water elevation corresponding to the top of the embankment (EL +195 ft, NGVD for Ash Cells 1 and 2) and EL +188 ft, NGVD for Pump Back Ponds 1 and 2) and for the maximum operating water levels (EL +193 ft, NGVD for Ash Cells 1 and 2) and EL +186 ft, NGVD for Pump Back Ponds 1 and 2).

Foundation stability and face stability were evaluated using failure modes, as described above. Table 4 below presents minimum factors from these analyses. Safety factors were obtained using updated software; thus new factor of safety are consistent with previous versions.

Table 4 Factors of Safety			
Pond	**Section/Boring**	**Static safety factor/ long-term maximum storage pool loading condition- Max Operating Levels**	**Static safety factor/maximum surcharge pool loading condition-Top of Embankment**
Ash Cell #1	B-1	1.784	1.511
Ash Cell #2	B-2/B-3/B4	1.542	1.501
Pump Back Cell #1	B-5	1.860	1.668
Pump Back Cell #2	B-6	1.723	1.639

The results of our evaluation indicate that factors of safety against shear failure of the existing slope areas exceed the generally required values of 1.5 for long-term maximum storage pool loading condition and 1.4 for maximum surcharge pool loading condition. A more detailed presentation of the results of our slope stability evaluations is included in **Appendix D**: Slope Stability Analysis.

9.2 Seismic Stability Analysis

Following the guidelines established by CCR rules, the stability of the surface impoundment was evaluated under seismic loading condition for a seismic loading event with a 2% probability of exceedance in 50 years, equivalent to approximately 2,500 years, and a horizontal spectral response acceleration for 1.0-second period (5% of Critical Damping). The seismic factor of safety was determined for stresses imposed by peak ground acceleration during earthquake motion. Maximum Considered Earthquake (MCR) ground motion basic parameters and response spectrum were based upon Seismic Design Web Services provided by U.S. Geological Survey Hazard Loads. The following table summarize the various ground motions parameters established.

Table 5 Ground Motion Parameters

Parameter	2% in 50 Years
PGA, Peak Ground Acceleration	0.037
Ss, MCE_R Ground Motion (period = 0.2 s)	0.086
S1, MCE_R Ground Motion (period = 1.0 s)	0.052
Fpga, Site Amplification factor at PGA	2.400
Fv, Site amplification factor at 1.0 s	4.200
PGV, Peak Ground Velocity, in/sec	12.01
β = by Fv S1 / kmax	2.46
Failure Slope Height, ft	15
α Factor = 1 + 0.01H*[0.5B - 1]	1.0
ks = r α PGA, Seismic Coefficient (r = 1.0 brittle system) (r = 0.5 ductile system)	0.089

The computer program Slide was used to determine the factor of safety, yield acceleration and estimated displacement.

Table 6 Factors of Safety

Pond	Section/Boring	Seismic Safety Factor	Yield Acceleration	Displacement (in)
Ash Cell #1	B-1	1.302	0.181	0.138
Ash Cell #2	B-2/B-3/B4	1.184	0.157	0.229
Pump Back Cell #1	B-5	1.486	0.294	0.033
Pump Back Cell #2	B-6	1.377	0.252	0.006

The results of our evaluation indicate that factors of safety against shear failure of the existing slope areas exceed the generally required values of 1 for seismic condition. A more detailed presentation of the results of our seismic stability evaluations is included in **Appendix D**: Slope Stability Analysis.

9.3 Liquefaction Potential Analysis

The potential for liquefaction was evaluated following the guidelines established by Environmental Protection Agency (EPA) in 40 CFR Part 257 and 261 – Hazards and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities and more specifically Seismic Design Guidance for Municipal Solid Waste Landfill Facilities, US EPA Office of Research and Development,1995.

Due to the expected range of ground motion in Gainesville, Florida (less than 0.5 g) a simplified procedure was applicable. The procedure is comprised of the following steps:

Identifying the potentially liquefiable layers of soils to be analyzed; the first step is assessing the potential for liquefaction of any cohesionless soils at the site. The most critical zone to be analyzed is based on the results of the in-situ testing and laboratory index tests (fine contents, plasticity index, saturation, and soil penetration resistance).

Once the zone of concern was defined, and based on total and effective vertical stresses, the Critical Stress Ratio (CSR) values required to cause liquefaction were obtained using relationships between stress ratio causing liquefaction and N_{60} values for sands for M 7.5 Earthquakes developed by Seed et al. (1985). CSR values were corrected by earthquake magnitude and stress levels exceeding 1 tsf.

The third step was calculating the equivalent uniform Critical Stress Ratio (CSREQ) based on the calculated total and effective vertical stresses and the maximum peak horizontal ground acceleration of 0.02 g.

The factor of safety against liquefaction was obtained by dividing the shear stress ratio required to cause liquefaction by the equivalent uniform cyclic stress ratio. The factor of safety ranged from 6.25 to more than 20. The minimum Liquefaction Factor of safety obtained exceeded the EPA minimum requirement of 1.2 for all critical strata considered.

10.0 LIMITATIONS

10.1 Limitations

This report has been prepared for the exclusive use of Innovative Waste Consulting Services, LLC. and Gainesville Regional Utilities (GRU). The scope is limited to the specific project and locations described herein. Our description of the project's design parameters represents our understanding of the significant aspects relevant to soil and foundation characteristics. In the event that any changes in the design or location of the CCR impoundment system as outlined in this report are planned, we should be informed so the changes can be reviewed and the conclusions of this report modified, if required, and approved in writing by UES.

All users of this report are cautioned that there was no requirement for UES to attempt to locate any man-made buried objects or identify any other potentially hazardous conditions that may exist at the site during the course of this exploration. Therefore, no attempt was made by UES to locate or identify such concerns. UES cannot be responsible for any buried man-made objects or subsurface hazards which may be subsequently encountered during construction that are not discussed within the text of this report. We can provide this service if requested. For a further description of the scope and limitations of this report, please review the document attached within **Appendix F**, "Important Information About Your Geotechnical Engineering Report" prepared by GBA.

11.0 REFERENCES

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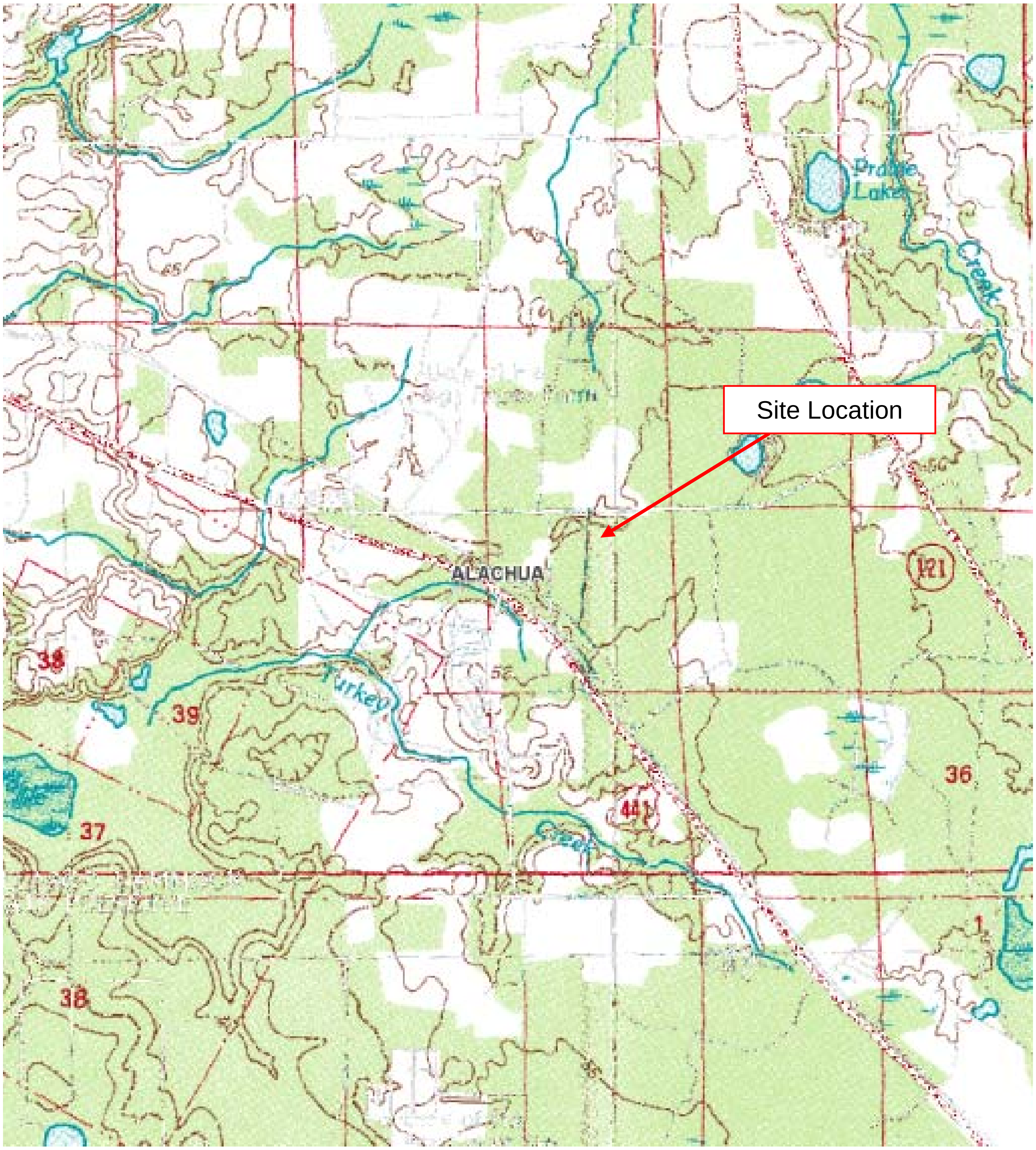
APPENDIX A

SITE LOCATION MAP
USGS SITE LOCATION MAP

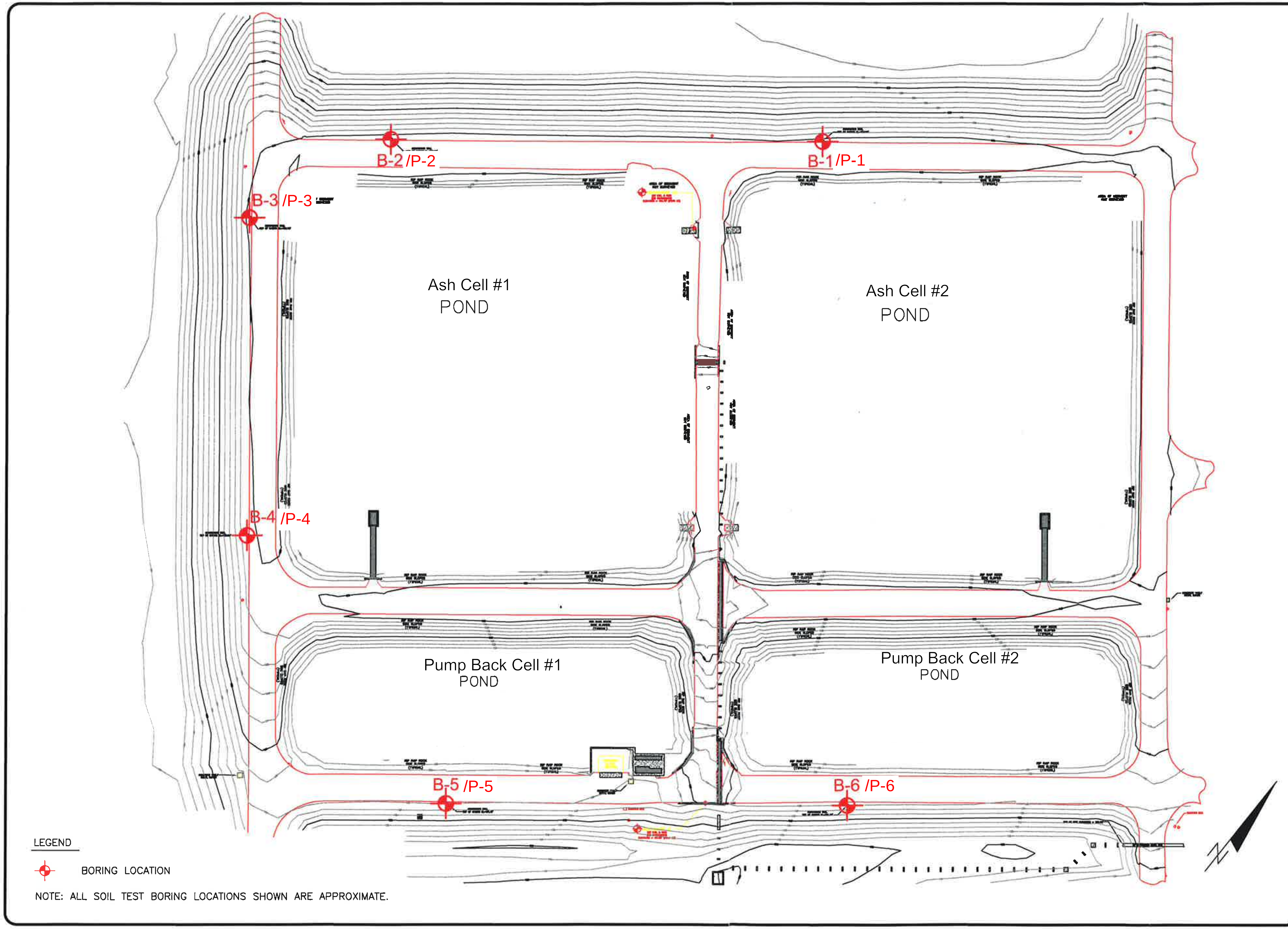
UNIVERSAL ENGINEERING SCIENCES	GRU Deerhaven Generating Station Gainesville, Alachua County, Florida		
	Site Location Map		
	DATE: 09-09-15	UES PROJECT NO.: 0230.1500077	APPENDIX NO.: A
	SCALE: N.T.S.	REPORT NO.: 1808777	FIGURE NO.:A 1



UNIVERSAL ENGINEERING SCIENCES	**GRU Deerhaven Generating Station Gainesville, Alachua County, Florida**		
	U.S.G.S. Map		
	DATE: 09-09-15	UES PROJECT NO.: 0230.1500077	APPENDIX NO.: A
	SCALE: N.T.S.	REPORT NO.: 1808777	FIGURE NO.:A 2

APPENDIX B

BORING LOCATION PLAN
BORING LOGS
KEY TO BORING LOGS



CLIENT:
INNOVATIVE WASTE CONSULTING SERVICES

DRAWN BY:	KD	DATE:	9/10/15
CHECKED BY:	ES	DATE:	9/10/15
SCALE:	1"=80'	ACADFILE:0230.1500077-A	
PROJECT NO:	0230.1500077.0000	REPORT NO:1251804	

GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

BORING LOCATION PLAN

UNIVERSAL
ENGINEERING SCIENCES

PAGE NO:
B - 1

UNIVERSAL ENGINEERING SCIENCES BORING LOG	PROJECT NO.: 0230.1500077.0000
	REPORT NO.: 1808777
	PAGE: A-2

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

BORING NO: **B-1** SHEET: 1 of 1

SECTION: TOWNSHIP: RANGE:

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES

LOCATION: SEE BORING LOCATION PLAN

REMARKS:

GS ELEVATION(ft): 195.30 DATE STARTED: 7/9/15

WATER TABLE (ft): 3.75 DATE FINISHED: 7/9/15

DATE OF READING: 7/17/15 DRILLED BY: R. WOODARD

EST. WSWT (ft): TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N VALUE	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./DAY)	ORG. CONT. (%)
0						Medium dense brown silty SAND [SM]						
1												
2	X	3-5-5	10									
3						Medium dense brown and gray sand, with silt [SP-SM]						
4	X	6-5-5	10	▼								
5	X	5-6-5	11									
6												
7	X	6-3-4	7				10	13				
8	X	4-2-2	4			Loose brown silty SAND [SM]						
9												
10	X	2-3-3	6				14	17				
11												
12												
13												
14						Medium dense gray-brown silty clayey SAND [SM-SC]						
15	X	2-4-7	11									
16												
17												
18												
19												
20	X	6-7-7	14									
21												
22												
23						Loose brown SAND, with trace of silt [SP-SM]						
24												
25	X	2-3-4	7			Boring Terminated at 25'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 0230.1500077.0000
REPORT NO.: 1808777
PAGE: A-3

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

BORING NO: **B-2** SHEET: 1 of 1

SECTION: TOWNSHIP: RANGE:

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

GS ELEVATION(ft): 195.42 DATE STARTED: 7/10/15
WATER TABLE (ft): 8.38 DATE FINISHED: 7/10/15
DATE OF READING: 7/17/15 DRILLED BY: R. WOODARD
EST. WSWT (ft): TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N VALUE	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0						Medium dense brown, gray and tan silty SAND, with trace of clay [SM]						
1–2	X	3-4-7	11									
2–3	X	8-9-10	19									
3–5	X	9-10-11	21									
5–7	X	11-9-9	18									
7.5						Medium dense gray very clayey SAND [SC]						
7–8.5	X	8-8-6	14	▼								
9.3						Medium dense gray silty SAND [SM]						
8.5–10	X	10-6-6	12									
13.5–15	X	8-10-6	16									
17						Medium dense light gray SAND, with silt [SP-SM]						
18.5–20	X	5-8-10	18									
21						Medium dense brown silty SAND [SM]						
23.5–25	X	4-8-17	25									
25						Boring Terminated at 25'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0230.1500077.0000
REPORT NO.:	1808777
PAGE:	A-4

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

BORING NO: **B-3**

SHEET: 1 of 1

SECTION:

TOWNSHIP:

RANGE:

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES

LOCATION: SEE BORING LOCATION PLAN

REMARKS: SHELBY TUBE SAMPLE TAKEN FROM 12' TO 14'

GS ELEVATION(ft): 195.17

DATE STARTED: 7/10/15

WATER TABLE (ft): 9.58

DATE FINISHED: 7/10/15

DATE OF READING: 7/17/15

DRILLED BY: R. WOODARD

EST. WSWT (ft):

TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N VALUE	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0						Medium dense brown and gray silty SAND, with trace of clay [SM]						
2		4-6-10	16									
4		9-10-12	22									
5		11-14-15	29									
7		19-14-12	26				14	7				
8		14-14-9	23									
9						Medium dense gray and orange clayey SAND [SC]						
10		7-4-6	10	▼			32	20	40	22		
15		3-4-10	14									
18.5						Medium dense brown silty SAND [SM]						
20		10-11-17	28									
22						Medium dense white and light brown silty clayey SAND [SM-SC]						
25		2-3-7	10									
25						Boring Terminated at 25'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.: 0230.1500077.0000
REPORT NO.: 1808777
PAGE: A-5

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

BORING NO: **B-4** SHEET: 1 of 1

SECTION: TOWNSHIP: RANGE:

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHELBY TUBE SAMPLE TAKEN FROM 10' TO 12'

GS ELEVATION(ft): 194.60
WATER TABLE (ft): NE
DATE OF READING: NA
EST. WSWT (ft):
DATE STARTED: 7/9/15
DATE FINISHED: 7/10/15
DRILLED BY: R. WOODARD
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N VALUE	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0						Loose to medium dense brown and tan silty SAND [SM]						
2		4-4-5	9				13	9				
3.5		8-9-10	19									
5		11-15-19	34									
6.5		17-14-12	26									
8		13-13-7	20									
9						Loose gray and green clayey SAND [SC]						
10		5-4-4	8				27	21	25	10		
14						Loose to medium dense brown and light gray silty SAND [SM]						
15		1-2-4	6									
20		7-7-17	24									
25		3-5-7	12			Boring Terminated at 25'						

UNIVERSAL ENGINEERING SCIENCES BORING LOG	
PROJECT NO.:	0230.1500077.0000
REPORT NO.:	1808777
PAGE:	A-6

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHELBY TUBE SAMPLE TAKEN FROM 5' TO 7'

BORING NO: **B-5** SHEET: 1 of 1

SECTION: TOWNSHIP: RANGE:

GS ELEVATION(ft): 188.10 DATE STARTED: 7/9/15
WATER TABLE (ft): 3.40 DATE FINISHED: 7/9/15
DATE OF READING: 7/17/15 DRILLED BY: R. WOODARD
EST. WSWT (ft): TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	BLOWS PER 6" INCREMENT	N VALUE	W.T.	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0				Loose light brown SAND, with trace of silt [SP-SM]						
2	2-3-2	5								
3			▼	Loose gray and orange clayey SAND [SC]						
4	1-2-3	5								
5	1-2-2	4			26	18	26	12		
6	2-3-4	7								
7				Medium dense to dense brown and tan silty SAND [SM]						
8	10-14-13	27								
10	15-16-19	35								
12				Medium dense gray silty SAND [SM]						
15	5-7-11	18								
16.5				Loose brown SAND, with silt [SP-SM]						
20	3-2-2	4			6	18				
21.5				Medium dense white SAND [SP]						
25	7-9-12	21		Boring Terminated at 25'						

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0230.1500077.0000
REPORT NO.:	1808777
PAGE:	A-7

PROJECT: GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

BORING NO: **B-6** SHEET: 1 of 1

SECTION: TOWNSHIP: RANGE:

CLIENT: INNOVATIVE WASTE CONSULTING SERVICES
LOCATION: SEE BORING LOCATION PLAN
REMARKS: SHELBY TUBE SAMPLE TAKEN FROM 4' TO 6'

GS ELEVATION(ft): 188.40
DATE STARTED: 7/9/15
WATER TABLE (ft): NE
DATE FINISHED: 7/9/15
DATE OF READING: NA
DRILLED BY: R. WOODARD
EST. WSWT (ft):
TYPE OF SAMPLING: ASTM D-1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N VALUE	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./DAY)	ORG. CONT. (%)
0						Loose brown silty SAND, with trace of clay [SM]						
2		3-4-5	9									
2.5						Loose dark gray clayey SAND [SC]						
3.5		4-3-3	6				24	13	23	9		
4–6	Shelby tube											
6		4-3-5	8									
6.5						Loose to dense brown and tan silty SAND, with trace of clay [SM]						
7		6-4-5	9									
8.5		7-8-12	20									
10		15-18-18	36									
12.5						Loose light brown SAND, with silt [SP-SM]						
15		5-4-4	8				11	18				
18						Medium dense white SAND [SP]						
20		4-9-9	18									
25		4-9-12	21			Boring Terminated at 25'						

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ENGINEERING SCIENCES

KEY TO BORING LOGS

SYMBOLS

22	Number of Blows of a 140–lb Weight Falling 30 in. Required to Drive Standard Spoon One Foot
WOR	Weight of Drill Rods
S	Thin–Wall Shelby Tube Undisturbed Sampler Used
90% Rec.	Percent Core Recovery from Rock Core–Drilling Operations
	Sample Taken at this Level
	Sample Not Taken at this Level
	Change in Soil Strata
	Free Ground Water Level
	Seasonal High Ground Water Level

GRANULAR MATERIALS

Relative Density	Safety Hammer SPT N (Blows/Ft.)	Automatic Hammer SPT N (Blows/Ft.)
Very Loose	Less than 4	Less than 3
Loose	4–10	3–8
Medium Dense	10–30	8–24
Dense	30–50	24–40
Very Dense	>50	>40

COHESIVE MATERIALS

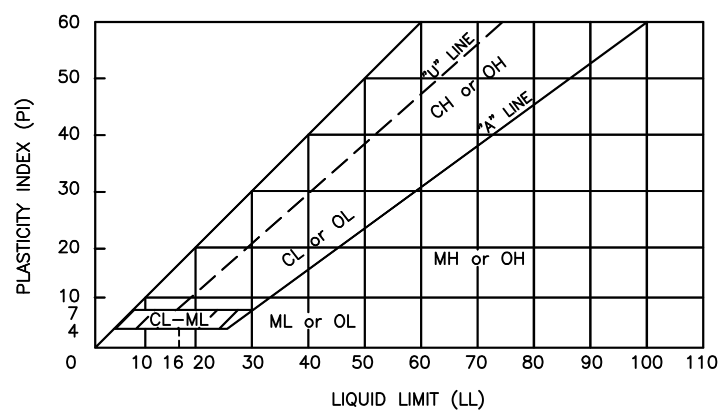
Consistency	Safety Hammer SPT N (Blows/Ft.)	Automatic Hammer SPT N (Blows/Ft.)
Very Soft	Less than 2	Less than 1
Soft	2–4	1–3
Firm	4–8	3–6
Stiff	8–15	6–12
Very Stiff	15–30	12–24
Hard	>30	>24

UNIFIED CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 200 sieve	CLEAN GRAVELS	GW	Well–graded gravels and gravel–sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel–sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels, gravel–sand–silt mixtures
			GC	Clayey gravels, gravel–sand–clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well–graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand–silt mixtures
			SC	Clayey sands, sand–clay mixtures
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomacaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly organic Soils			PT	Peat, muck and other highly organic soils

* Based on the material passing the 3–in. (75mm) sieve.

PLASTICITY CHART



APPENDIX C

LABORATORY TEST DATA
GRAIN SIEVE ANALYSIS/GRADATION CURVES
SHEAR TEST DATA
DESCRIPTION OF LABORATORY TESTING PROCEDURES
DESCRIPTION OF FIELD TESTING PROCEDURES

UNIVERSAL
ENGINEERING SCIENCES

SUMMARY OF LABORATORY RESULTS

PROJECT: GRU Deerhaven Ponds	REPORT: 1808777
CLIENT: Innovative Waste Consulting Services, LLC	September 9, 2015

BORING NO.	SAMPLE DEPTH (FT)	SOIL DESCRIPTION	SAMPLE TYPE*	NATURAL MOISTURE (%)	ATTERBERG LIMITS		PEMREABILITY (ft/day)	SIEVE ANALYSIS (% PASSING)						AASHTO SOIL CLASSIFICATION	UNIFIED SOIL CLASSIFICATION
					LIQUID LIMIT (%)	PLASTICITY INDEX (%)		No. 4	No. 10	No. 40	No. 60	No. 100	No. 200		
B-1	6	Gray and Brown Sand, with silt	SS	13				100	100	86	53	24	9.5		SP-SM
B-1	15	Gray, Brown and Orange Silty Sand	SS	17				100	99	90	60	30	14		SM
B-3	6	Brown and Gray Silty Sand, with traces of clay	SS	7				100	100	89	60	29	14		SM
B-3	12	Gray and Orange Clayey Sand	SS	20	40	22							32		SC
B-4	1	Brown and Tan Silty Sand	SS	9				100	100	88	58	28	13		SM
B-4	10	Dark Gray and Brown Clayey Sand	SS	21	25	10							27		SC
B-5	5	Gray and Orange Clayey Sand	SS	18	26	12							26		SC
B-5	25	Light Tan Sand, with silt	SS	18				100	100	91	62	27	6.3		SP-SM
B-6	4	Dark Gray Clayey Sand	SS	13	23	9							24		SC
B-6	15	Light Brown Sand, with silt	SS	18				100	100	89	56	25	11		SP-SM

*SS=Sample Spoon
A=Auger

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SUMMARY OF LABORATORY RESULTS

PROJECT: GRU Deerhaven Ponds	**REPORT: 1808777**
CLIENT: Innovative Waste Consulting Services, LLC	**September 9, 2015**

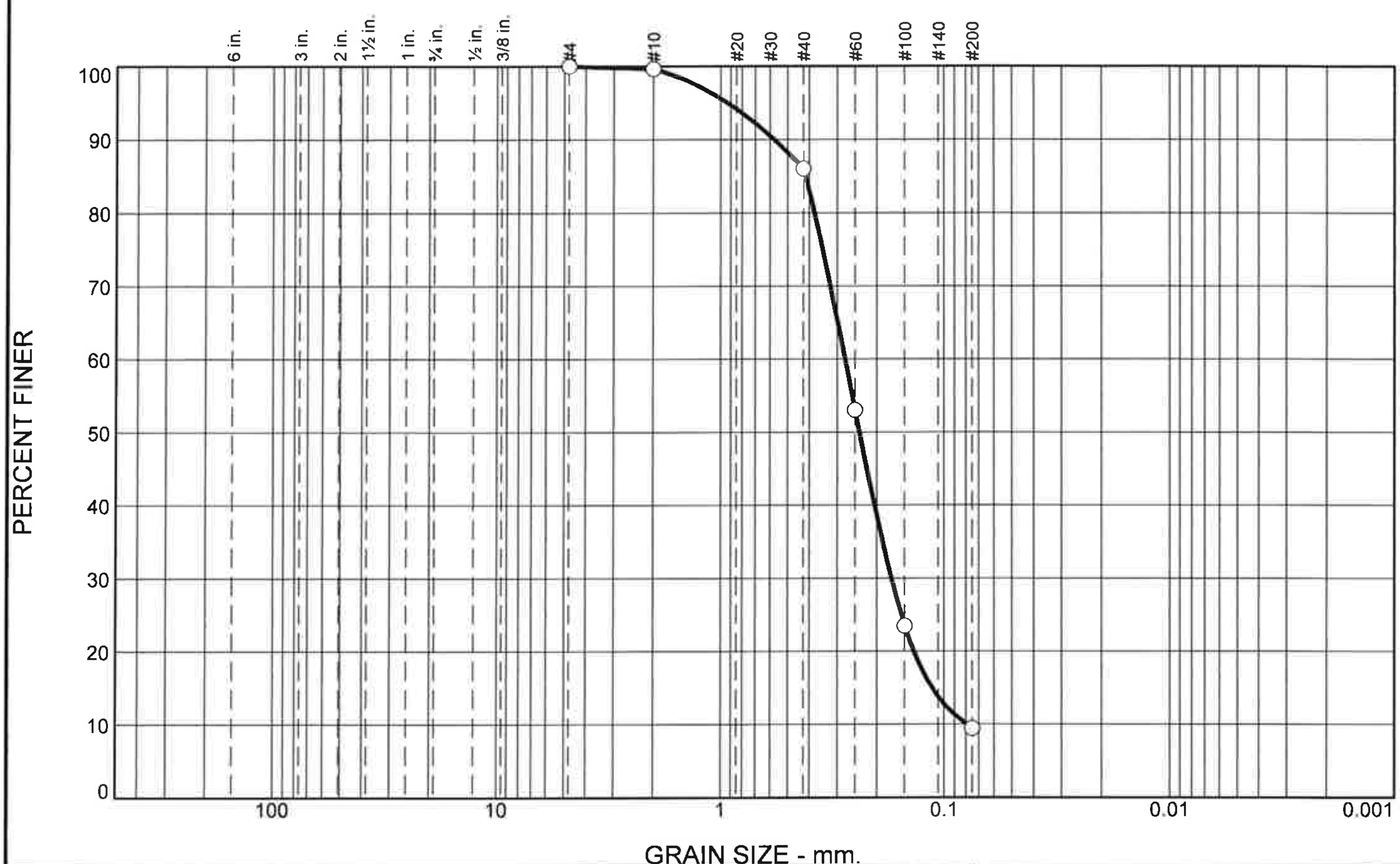
DIRECT SHEAR TEST RESULTS

LOCATION	SAMPLE DEPTH (Feet)	SOILS DESCRIPTION	MOISTURE CONTENT (%)	UNIT WEIGHT (pcf)	FRICTION ANGLE, ϕ (deg)
B-2	12.0 – 13.0	Gray, green and orange clayey Sand	11	118	31.1

DRAINED SHEAR AND CONSOLIDATED UNDRAINED TRIAXIAL TEST – TEST RESULTS

LOCATION	SAMPLE DEPTH (Feet)	SOILS DESCRIPTION	MOISTURE CONTENT (%)	UNIT WEIGHT (pcf)	SHEAR STRENGTH COHESION (psf)	FRICTION ANGLE, ϕ (deg)
B-3	12.0 – 13.0	Gray, green and orange very clayey Sand	21	127	197	24.9
B-4	5.0	Gray, orange silty Sand	11	119	192	31.3

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.4	13.6	76.5	9.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.6		
#40	86.0		
#60	53.1		
#100	23.5		
#200	9.5		

* (no specification provided)

Material Description

Gray and Brown SP-SM

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5765 D_{85}= 0.4165 D_{60}= 0.2769
D_{50}= 0.2389 D_{30}= 0.1722 D_{15}= 0.1134
D_{10}= 0.0793 C_u= 3.49 C_c= 1.35

Classification

USCS= SP-SM AASHTO=

Remarks

Location: B-1
Sample Number: 4 **Depth:** 6 **Date:**

Universal Engineering Sciences

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments

Project No: 0230.1500077.0000 **Figure**

Tested By: PH **Checked By:** ES/TK

GRAIN SIZE DISTRIBUTION TEST DATA

9/24/2015

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments
Project Number: 0230.1500077.0000
Location: B-1
Depth: 6
Sample Number: 4
Material Description: Gray and Brown SP-SM
USCS Classification: SP-SM
Tested by: PH
Checked by: ES/TK

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
57.10	0.00	0.00	#4	0.00	100.0
			#10	0.20	99.6
			#40	8.00	86.0
			#60	26.80	53.1
			#100	43.70	23.5
			#200	51.70	9.5

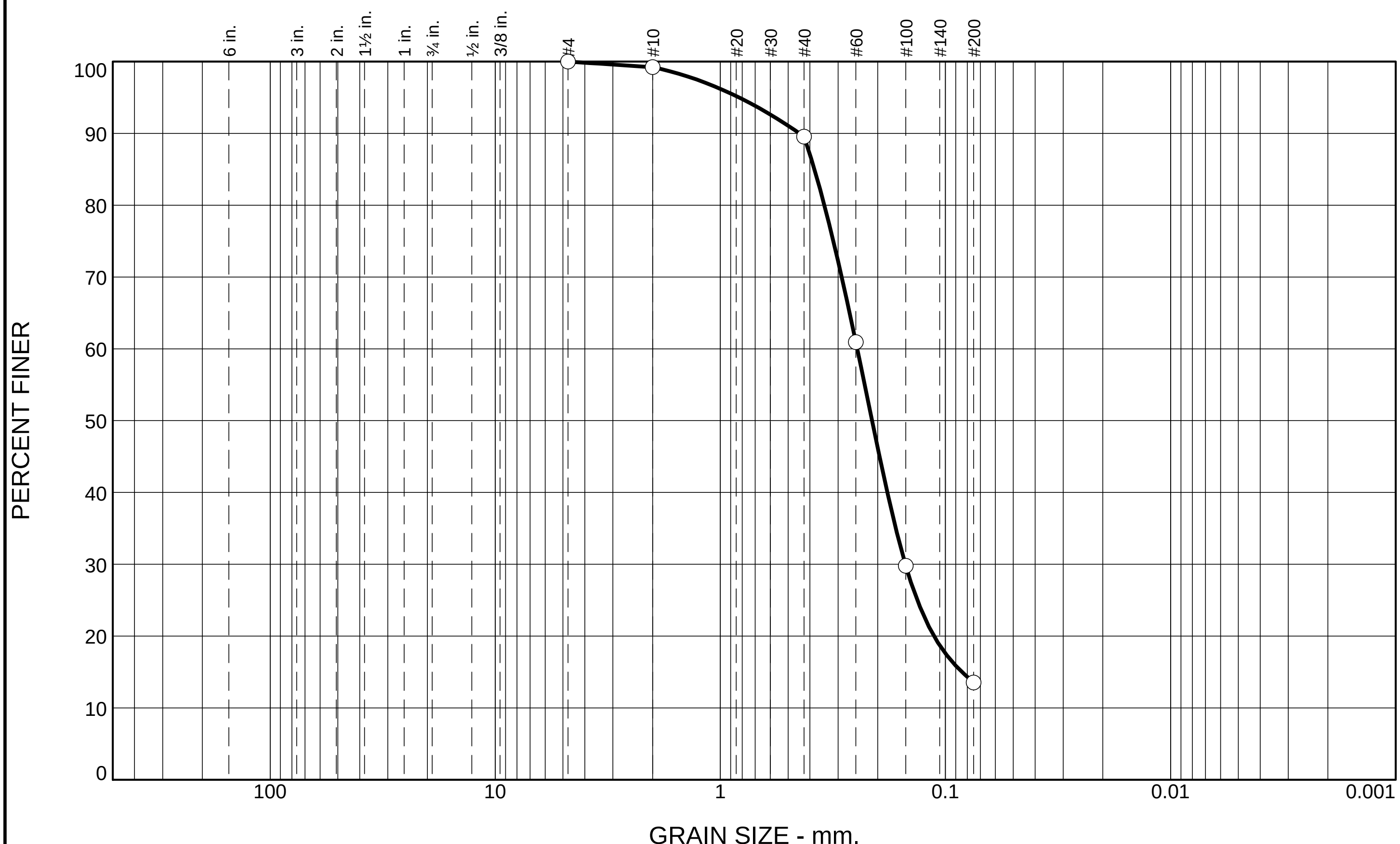
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.4	13.6	76.5	90.5			9.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0793	0.1134	0.1367	0.1722	0.2389	0.2769	0.3792	0.4165	0.5765	0.9314

Fineness Modulus	C_u	C_c
1.24	3.49	1.35

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.8	9.6	76.1	13.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.2		
#40	89.6		
#60	60.9		
#100	29.8		
#200	13.5		

* (no specification provided)

Material Description

Gray, Brown and Orange SM

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4452 D_{85}= 0.3819 D_{60}= 0.2465
D_{50}= 0.2118 D_{30}= 0.1507 D_{15}= 0.0844
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: B-1
Sample Number: 7 **Depth:** 15 **Date:**

Universal Engineering Sciences

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments

Project No: 0230.1500077.0000 **Figure**

Tested By: PH **Checked By:** ES/TK

GRAIN SIZE DISTRIBUTION TEST DATA

9/24/2015

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments
Project Number: 0230.1500077.0000
Location: B-1
Depth: 15 **Sample Number:** 7
Material Description: Gray, Brown and Orange SM
USCS Classification: SM
Tested by: PH **Checked by:** ES/TK

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
51.70	0.00	0.00	#4	0.00	100.0
			#10	0.40	99.2
			#40	5.40	89.6
			#60	20.20	60.9
			#100	36.30	29.8
			#200	44.70	13.5

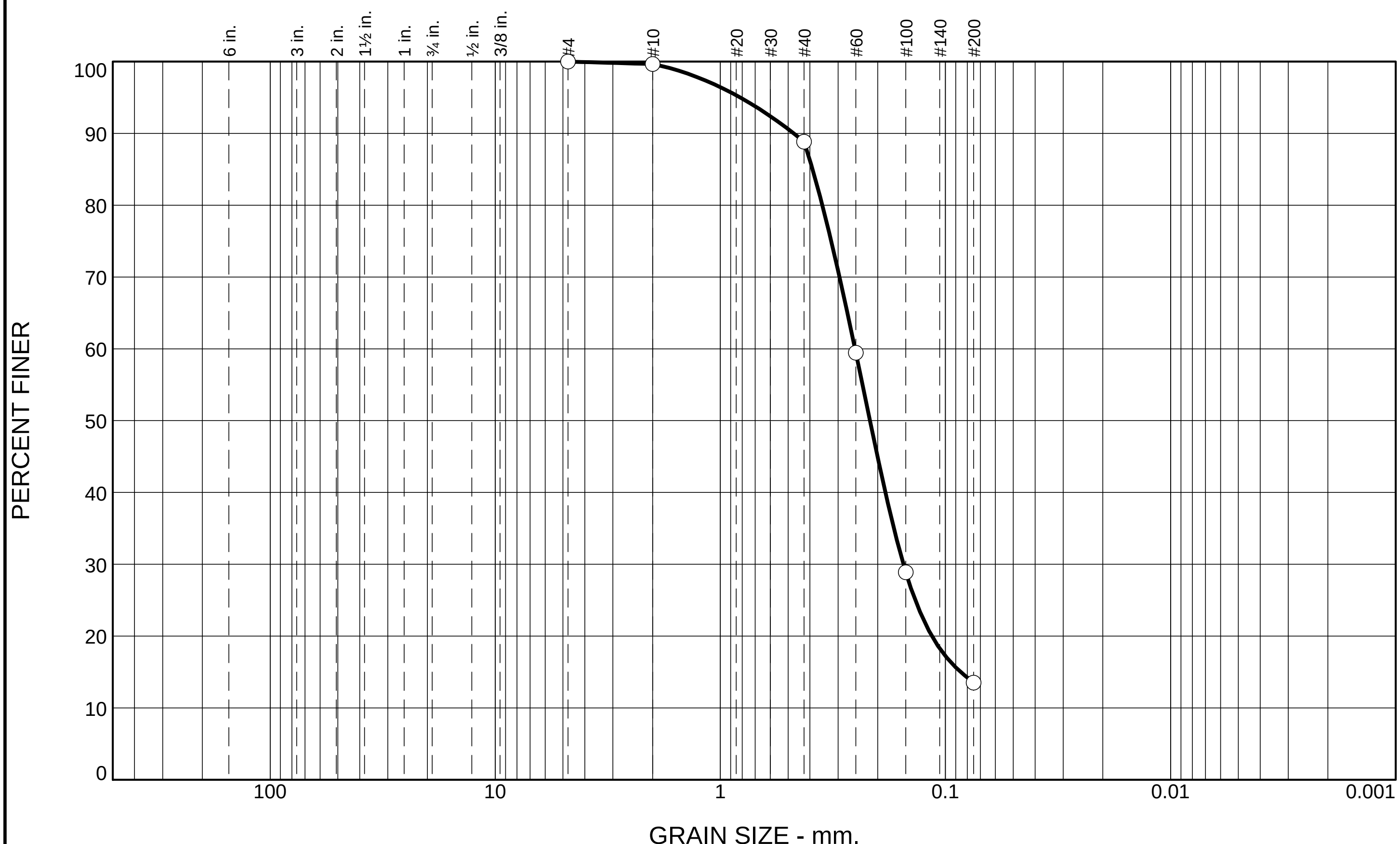
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.8	9.6	76.1	86.5			13.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0844	0.1125	0.1507	0.2118	0.2465	0.3450	0.3819	0.4452	0.8252

Fineness Modulus
1.09

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	10.8	75.4	13.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.7		
#40	88.9		
#60	59.5		
#100	28.9		
#200	13.5		

* (no specification provided)

Material Description

Brown and Gray SM, with traces of clay

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4721 D_{85}= 0.3893 D_{60}= 0.2521
D_{50}= 0.2164 D_{30}= 0.1537 D_{15}= 0.0856
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: B-3
Sample Number: 4 **Depth:** 6 **Date:**

Universal Engineering Sciences

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments

Project No: 0230.1500077.0000 **Figure**

Tested By: PH **Checked By:** ES/TK

GRAIN SIZE DISTRIBUTION TEST DATA

9/24/2015

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments
Project Number: 0230.1500077.0000
Location: B-3
Depth: 6 **Sample Number:** 4
Material Description: Brown and Gray SM, with traces of clay
USCS Classification: SM
Tested by: PH **Checked by:** ES/TK

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
59.20	0.00	0.00	#4	0.00	100.0
			#10	0.20	99.7
			#40	6.60	88.9
			#60	24.00	59.5
			#100	42.10	28.9
			#200	51.20	13.5

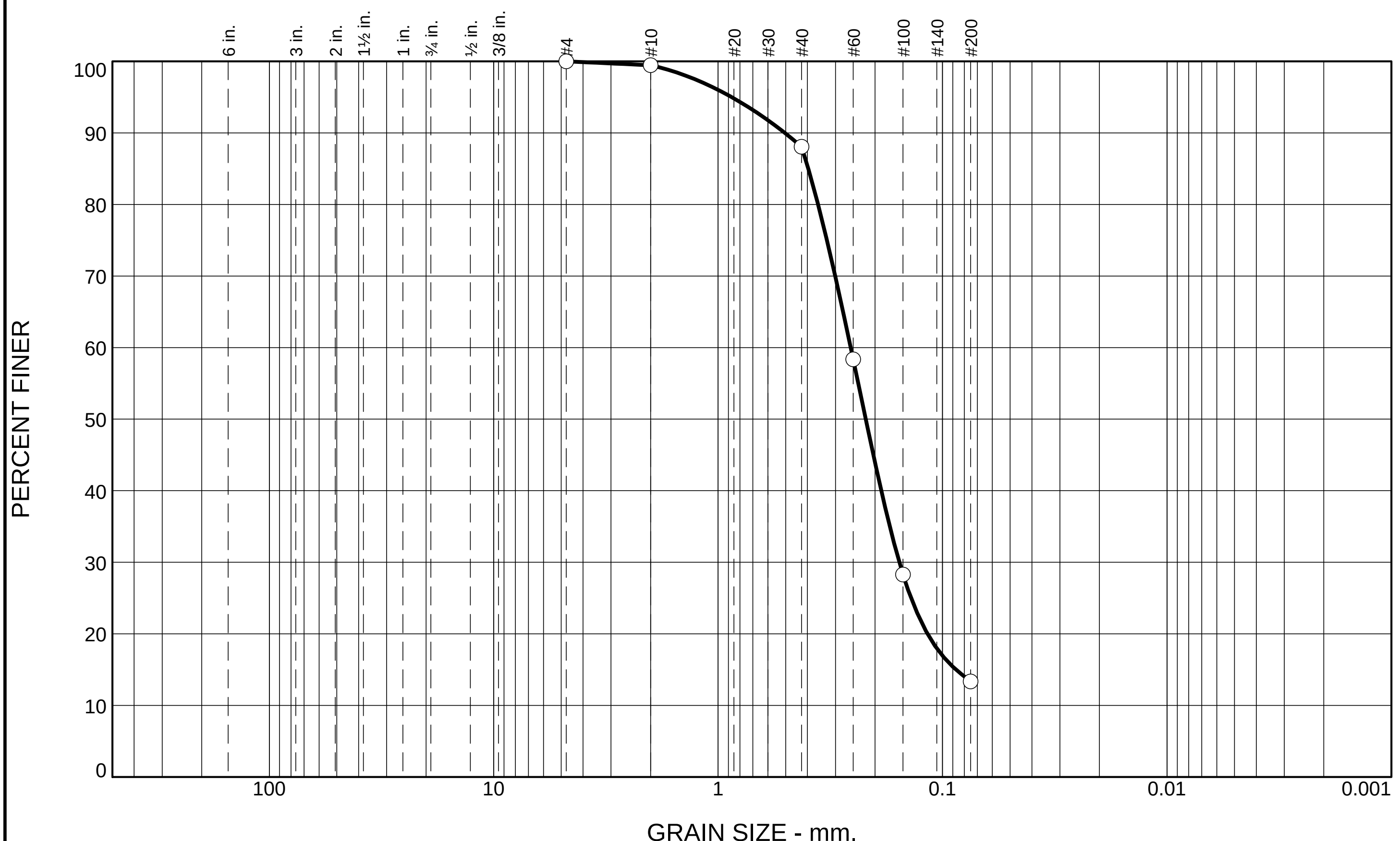
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.3	10.8	75.4	86.5			13.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0856	0.1150	0.1537	0.2164	0.2521	0.3522	0.3893	0.4721	0.8159

Fineness Modulus
1.11

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.5	11.4	74.8	13.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.5		
#40	88.1		
#60	58.4		
#100	28.3		
#200	13.3		

* (no specification provided)

Material Description

Brown and Tan SM

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5046 D_{85}= 0.3964 D_{60}= 0.2564
D_{50}= 0.2198 D_{30}= 0.1557 D_{15}= 0.0871
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Location: B-4
Sample Number: 1 **Depth:** 1 **Date:**

Universal Engineering Sciences

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments

Project No: 0230.1500077.0000 **Figure**

Tested By: PH **Checked By:** ES/TK

GRAIN SIZE DISTRIBUTION TEST DATA

9/24/2015

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments
Project Number: 0230.1500077.0000
Location: B-4
Depth: 1 **Sample Number:** 1
Material Description: Brown and Tan SM
USCS Classification: SM
Tested by: PH **Checked by:** ES/TK

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
56.20	0.00	0.00	#4	0.00	100.0
			#10	0.30	99.5
			#40	6.70	88.1
			#60	23.40	58.4
			#100	40.30	28.3
			#200	48.70	13.3

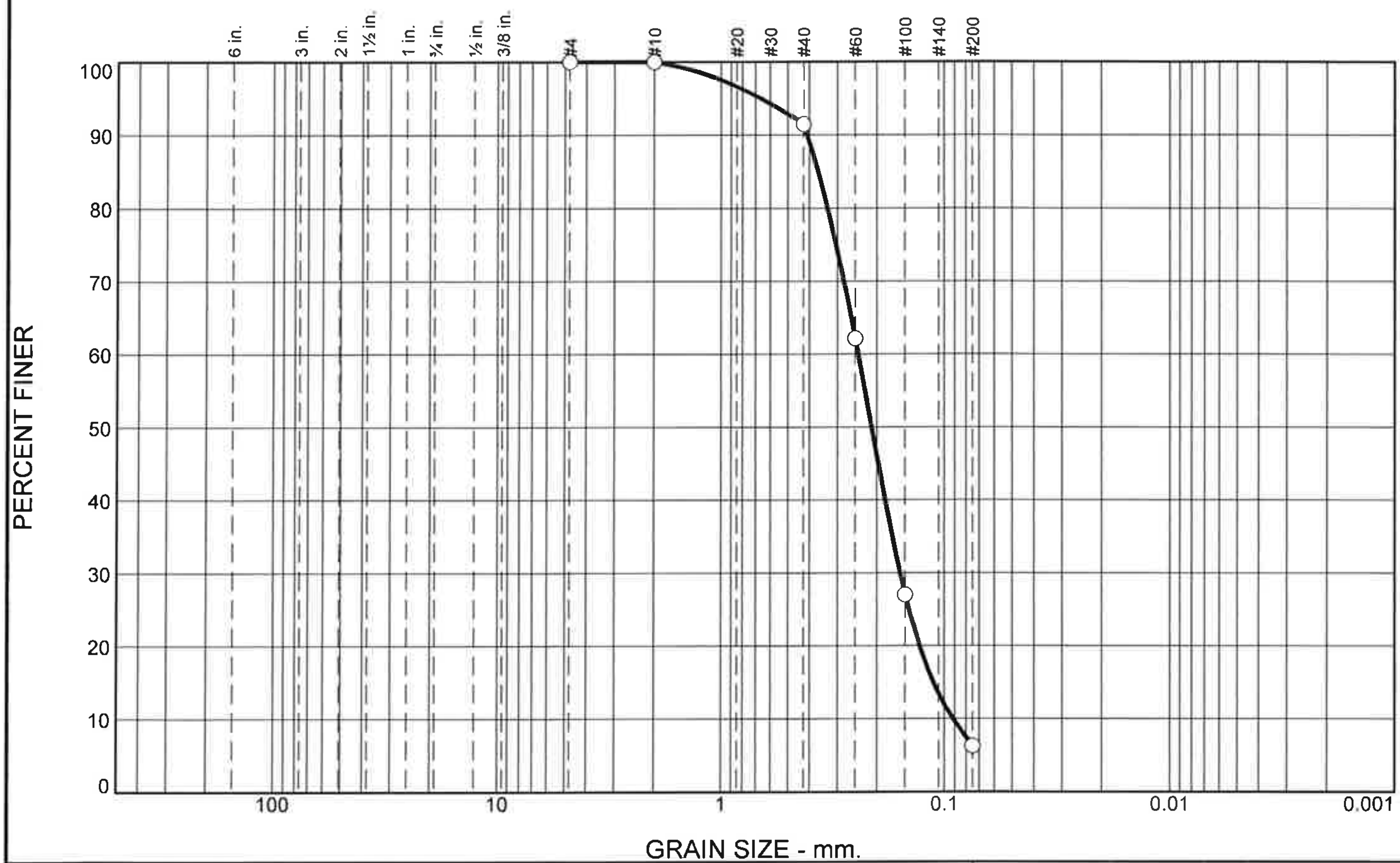
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.5	11.4	74.8	86.7			13.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0871	0.1168	0.1557	0.2198	0.2564	0.3585	0.3964	0.5046	0.8689

Fineness Modulus
1.13

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	8.6	85.1	6.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#40	91.4		
#60	62.2		
#100	27.0		
#200	6.3		

* (no specification provided)

Material Description

Light Tan SP-SM

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4098 D_{85}= 0.3664 D_{60}= 0.2424
D_{50}= 0.2114 D_{30}= 0.1581 D_{15}= 0.1121
D_{10}= 0.0917 C_u= 2.64 C_c= 1.12

Classification

USCS= SP-SM AASHTO=

Remarks

Location: B-5
Sample Number: 8 **Depth:** 25 **Date:**

Universal Engineering Sciences

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments
Project No: 0230.1500077.0000 **Figure**

Tested By: PH **Checked By:** ES/TK

GRAIN SIZE DISTRIBUTION TEST DATA

9/24/2015

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments
Project Number: 0230.1500077.0000
Location: B-5
Depth: 25 **Sample Number:** 8
Material Description: Light Tan SP-SM
USCS Classification: SP-SM
Tested by: PH **Checked by:** ES/TK

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
52.60	0.00	0.00	#4	0.00	100.0
			#10	0.00	100.0
			#40	4.50	91.4
			#60	19.90	62.2
			#100	38.40	27.0
			#200	49.30	6.3

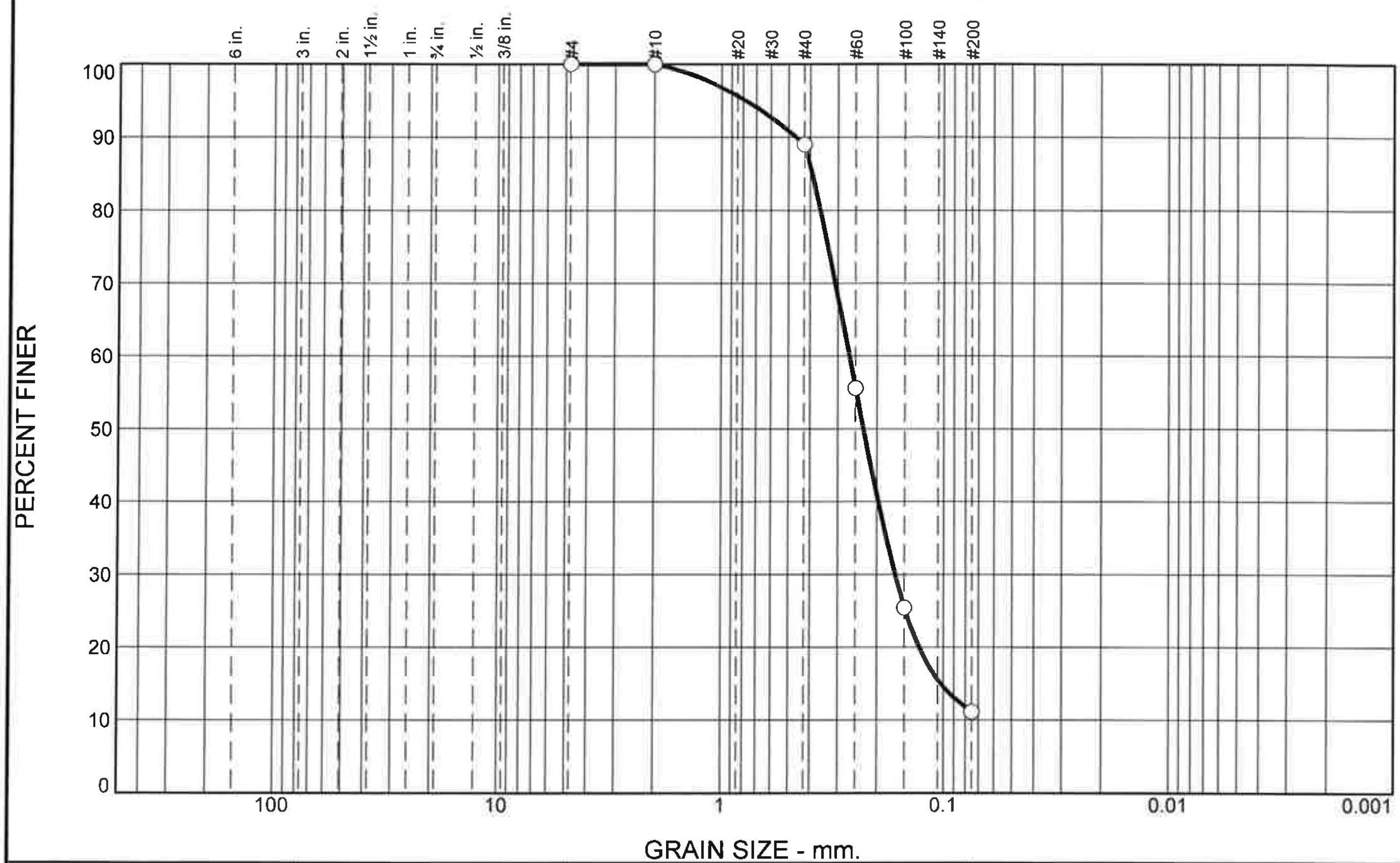
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	8.6	85.1	93.7			6.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0917	0.1121	0.1294	0.1581	0.2114	0.2424	0.3325	0.3664	0.4098	0.6607

Fineness Modulus	C_u	C_c
1.06	2.64	1.12

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	11.0	77.8	11.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#40	89.0		
#60	55.6		
#100	25.4		
#200	11.2		

* (no specification provided)

Material Description

Light Brown SP-SM

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4628 D_{85}= 0.3930 D_{60}= 0.2665
D_{50}= 0.2304 D_{30}= 0.1656 D_{15}= 0.1032
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Location: B-6
Sample Number: 7 **Depth:** 15 **Date:**

Universal Engineering Sciences

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments
Project No: 0230.1500077.0000 **Figure**

Tested By: PH **Checked By:** ES/TK

GRAIN SIZE DISTRIBUTION TEST DATA

9/24/2015

Client: Innovative Waste Consulting Services, LLC
Project: GRU Deerhaven Power Plant - Pond Embankments
Project Number: 0230.1500077.0000
Location: B-6
Depth: 15 **Sample Number:** 7
Material Description: Light Brown SP-SM
USCS Classification: SP-SM
Tested by: PH **Checked by:** ES/TK

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
54.70	0.00	0.00	#4	0.00	100.0
			#10	0.00	100.0
			#40	6.00	89.0
			#60	24.30	55.6
			#100	40.80	25.4
			#200	48.60	11.2

Fractional Components

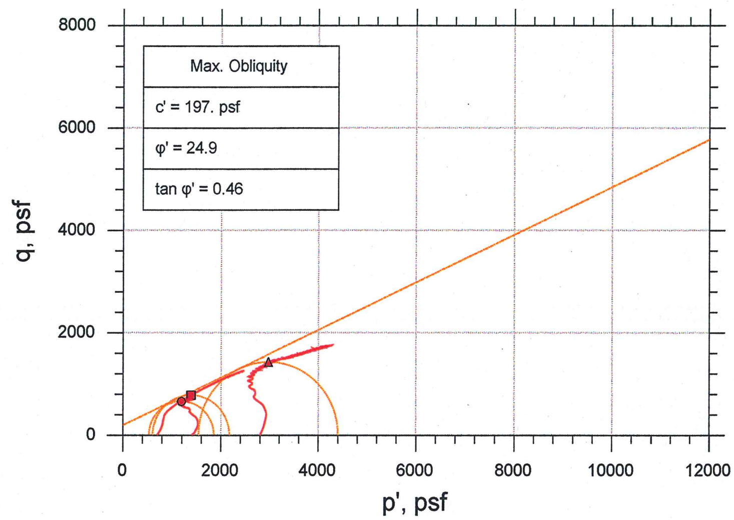
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	11.0	77.8	88.8			11.2

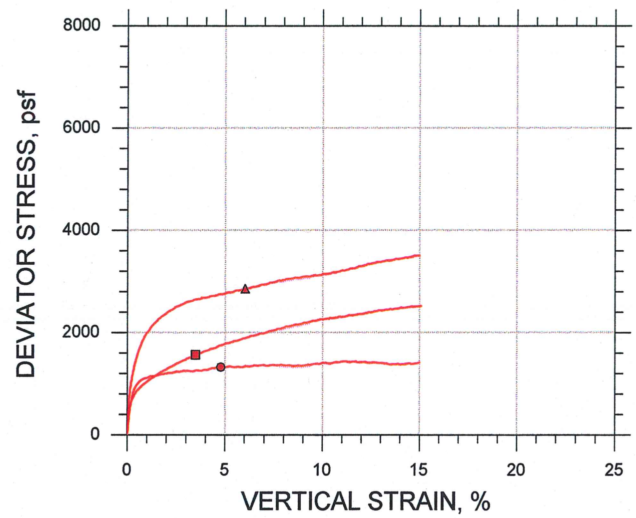
D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.1032	0.1288	0.1656	0.2304	0.2665	0.3604	0.3930	0.4628	0.7791

Fineness Modulus
1.16

Client: Universal Engineering Sciences	
Project Name: Pond Embankment Stability	
Project Location: ---	
Project Number: GTX-303487	
Tested By: jm	Checked By: mcm
Boring ID: B-3	
Preparation: intact	
Description: Gray, green, orange sandy Clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

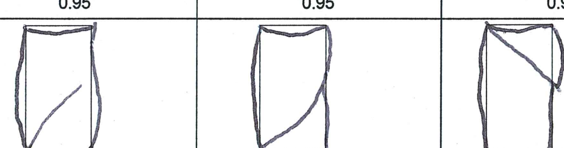
CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		■	●	▲	
Sample ID		---	---	---	
Depth, ft		12-13 ft	12-13 ft	12-13 ft	
Test Number		CU-1-1	CU-1-2	CU-1-3	
Initial	Height, in	4.101	4.163	4.250	
	Diameter, in	2.040	2.030	2.040	
	Moisture Content (from Cuttings), %	18.1	22.7	21.5	
	Dry Density, pcf	108.	103.	106.	
	Saturation (Wet Method), %	87.3	96.4	98.4	
	Void Ratio	0.559	0.637	0.590	
Before Shear	Moisture Content, %	19.8	22.1	20.7	
	Dry Density, pcf	110.	106.	108.	
	Cross-sectional Area (Method A), in²	3.235	3.174	3.232	
	Saturation, %	100.0	100.0	100.0	
	Void Ratio	0.536	0.596	0.559	
	Back Pressure, psf	9647.	8494.	1.800e+004	
Vertical Effective Consolidation Stress, psf		700.1	1403.	2800.	
Horizontal Effective Consolidation Stress, psf		700.2	1404.	2802.	
Vertical Strain after Consolidation, %		0.07041	0.3546	0.7990	
Volumetric Strain after Consolidation, %		0.3954	1.821	1.735	
Time to 50% Consolidation, min		2.560	13.69	46.24	
Shear Strength, psf		783.8	664.1	1430.	
Strain at Failure, %		3.48	4.78	6.03	
Strain Rate, %/min		0.01600	0.01600	0.01600	
Deviator Stress at Failure, psf		1568.	1328.	2859.	
Effective Minor Principal Stress at Failure, psf		605.1	529.5	1543.	
Effective Major Principal Stress at Failure, psf		2173.	1858.	4403.	
B-Value		0.95	0.95	0.96	

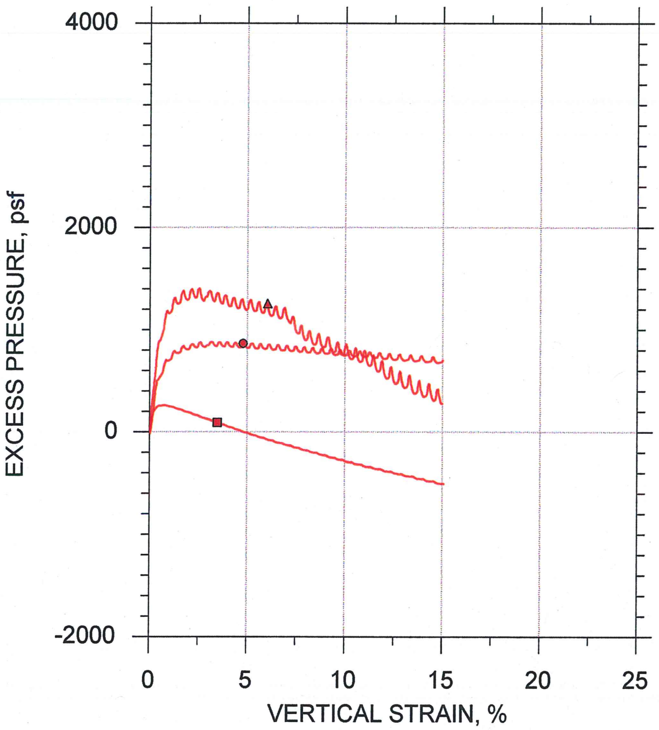
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

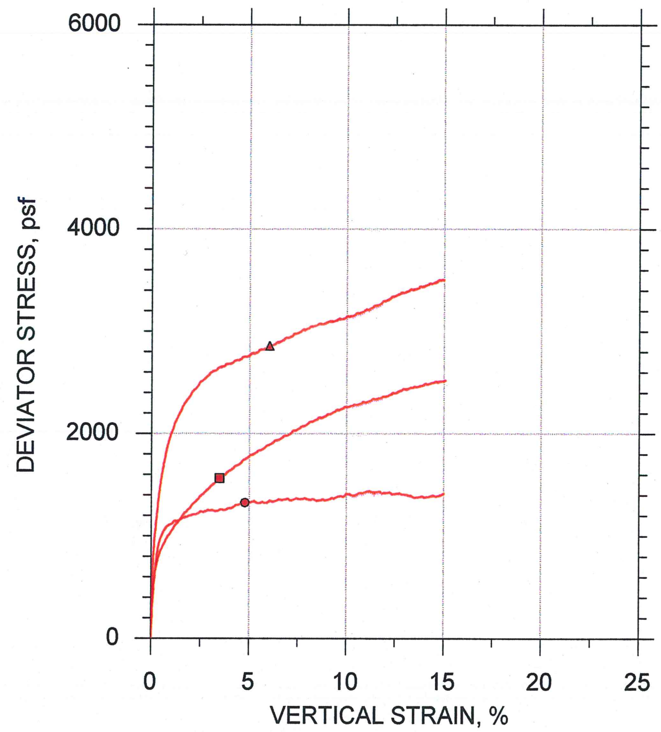


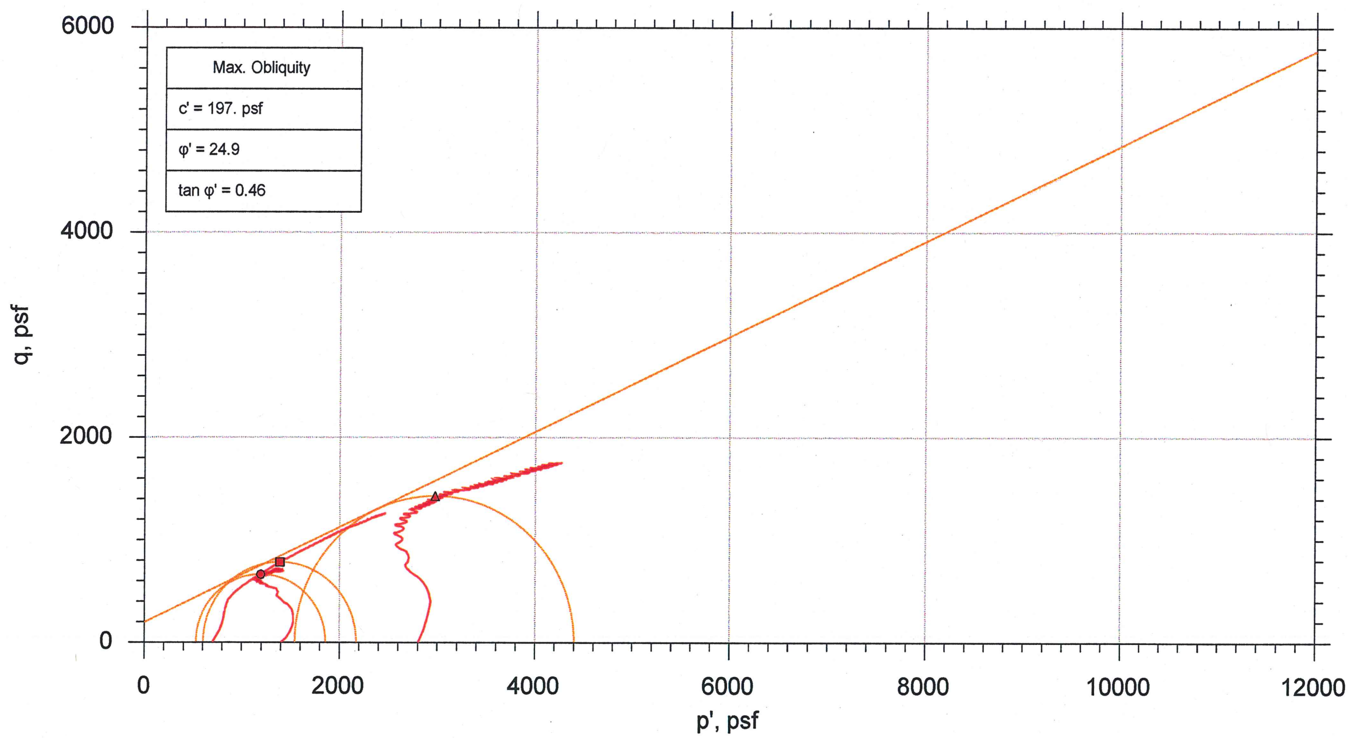
Remarks:

System A

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







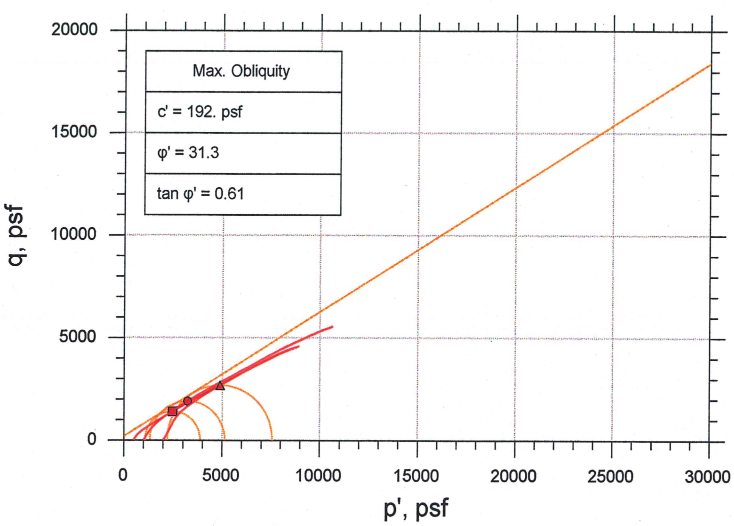
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	---	CU-1-1	12-13 ft	jm	7/21/15	mcm	8/4/15	303487-CU-1-1m.dat
●	---	CU-1-2	12-13 ft	jm	7/21/15	mcm	8/4/15	303487-CU-1-2m.dat
▲	---	CU-1-3	12-13 ft	jm	7/21/15	mcm	8/4/15	303487-CU-1-3m.dat

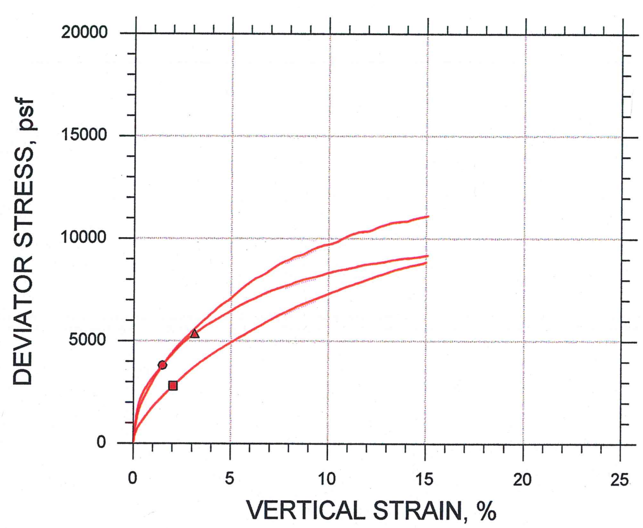
GeoTesting EXPRESS

Project: Pond Embankment Stability	Location: ---	Project No.: GTX-303487
Boring No.: B-3	Sample Type: intact	
Description: Gray, green, orange sandy Clay		
Remarks: System A		

Client: Universal Enginnering Sciences	
Project Name: Pond Embankment Stability	
Project Location: ---	
Project Number: GTX-303487	
Tested By: jm	Checked By: mcm
Boring ID: B-4	
Preparation: reconstituted	
Description: Brown, tan Silty Sand	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

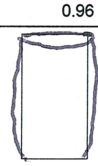
CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

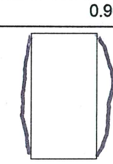




Symbol		■	●	▲	
Sample ID		---	---	---	
Depth, ft		5 ft	5 ft	5 ft	
Test Number		CU-2-1	CU-2-2	CU-2-3	
Initial	Height, in	4.082	4.062	4.079	
	Diameter, in	2.020	2.020	2.020	
	Moisture Content (from Cuttings), %	11.9	12.1	12.1	
	Dry Density, pcf	107.	108.	107.	
	Saturation (Wet Method), %	56.4	57.5	57.0	
	Void Ratio	0.571	0.567	0.571	
Before Shear	Moisture Content, %	20.2	20.7	20.6	
	Dry Density, pcf	109.	108.	108.	
	Cross-sectional Area (Method A), in²	3.170	3.193	3.179	
	Saturation, %	100.0	100.0	100.0	
	Void Ratio	0.547	0.560	0.555	
	Back Pressure, psf	2.000e+004	1.942e+004	1.856e+004	
Vertical Effective Consolidation Stress, psf		499.9	1002.	2002.	
Horizontal Effective Consolidation Stress, psf		499.9	1002.	2001.	
Vertical Strain after Consolidation, %		0.01344	0.03090	0.09907	
Volumetric Strain after Consolidation, %		0.09779	0.2919	0.6374	
Time to 50% Consolidation, min		0.06000	0.4200	0.04000	
Shear Strength, psf		1406.	1909.	2683.	
Strain at Failure, %		2.03	1.48	3.13	
Strain Rate, %/min		0.06000	0.06000	0.06000	
Deviator Stress at Failure, psf		2811.	3819.	5366.	
Effective Minor Principal Stress at Failure, psf		1072.	1324.	2206.	
Effective Major Principal Stress at Failure, psf		3883.	5142.	7573.	
B-Value		0.96	0.96	0.96	

Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

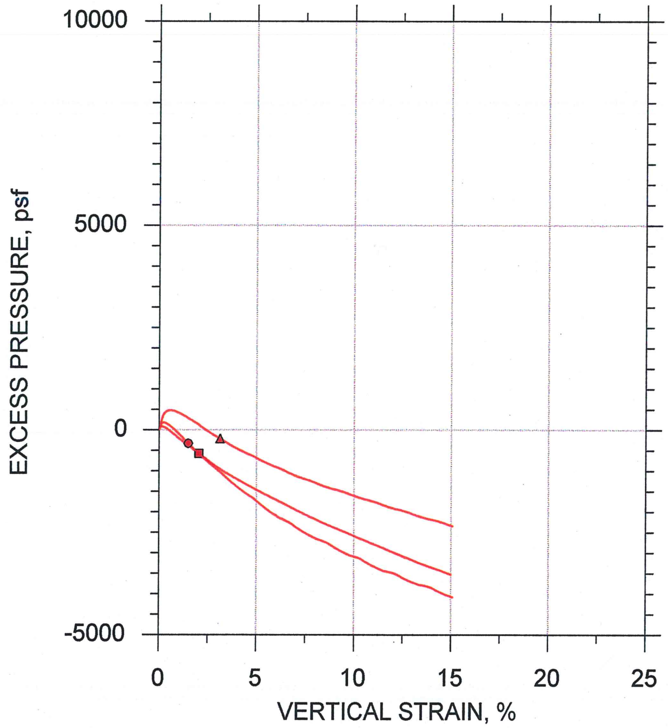


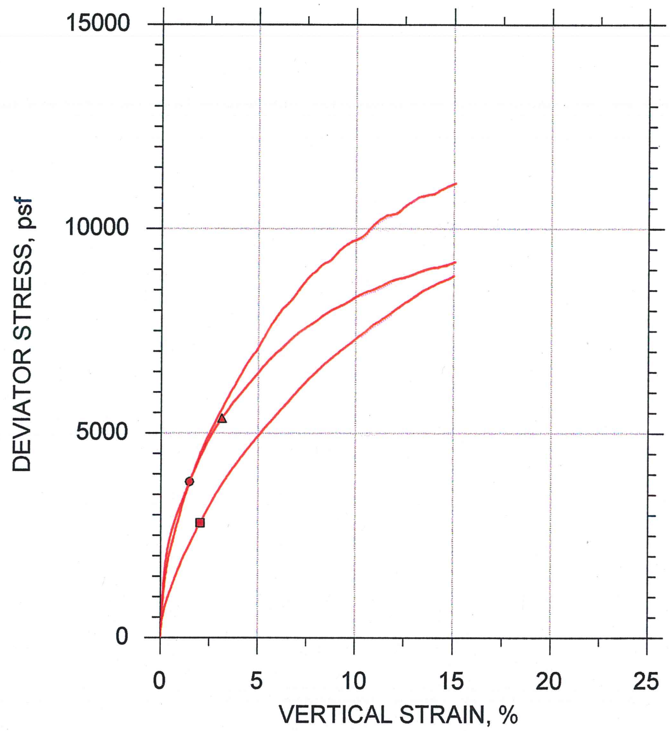


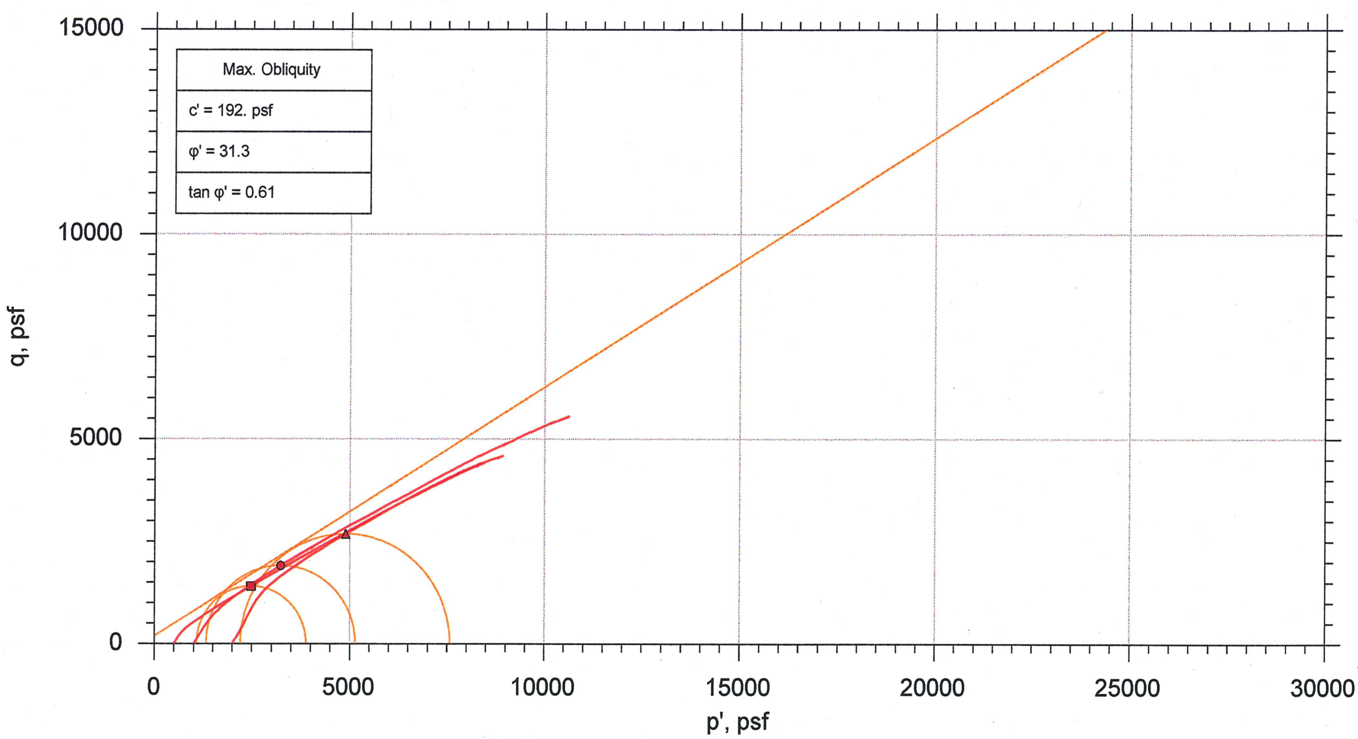
Remarks:

Targe Compaction: 90% of (119.0 pcf) at Optimum Moisture Content (11.0%) + 0-2% - Values Provided by Client

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	---	CU-2-1	5 ft	jm	7/25/15	mcm	8/5/15	303487-CU-2-1m.dat
●	---	CU-2-2	5 ft	jm	7/24/15	mcm	8/5/15	303487-CU-2-2m.dat
▲	---	CU-2-3	5 ft	jm	7/24/15	mcm	8/5/15	303487-CU-2-3m.dat

GeoTesting EXPRESS

Project: Pond Embankment Stability	Location: ---	Project No.: GTX-303487
Boring No.: B-4	Sample Type: reconstituted	
Description: Brown, tan Silty Sand		
Remarks: Targe Compaction: 90% of (119.0 pcf) at Optimum Moisture Content (11.0%) + 0-2% - Values Provided by Client		

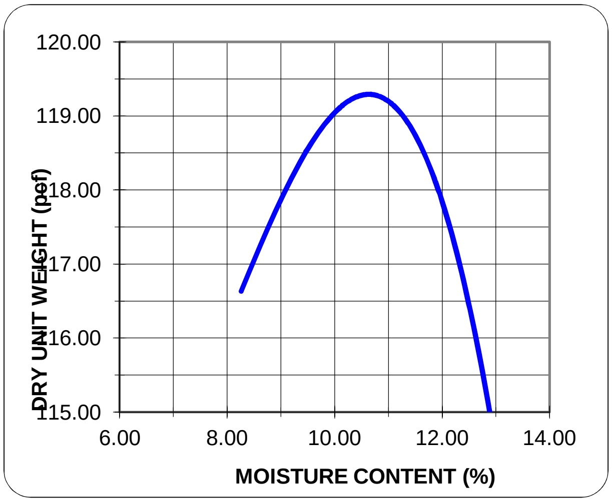
SHEAR DIRECT TEST RESULTS
ASTM D-3080-04

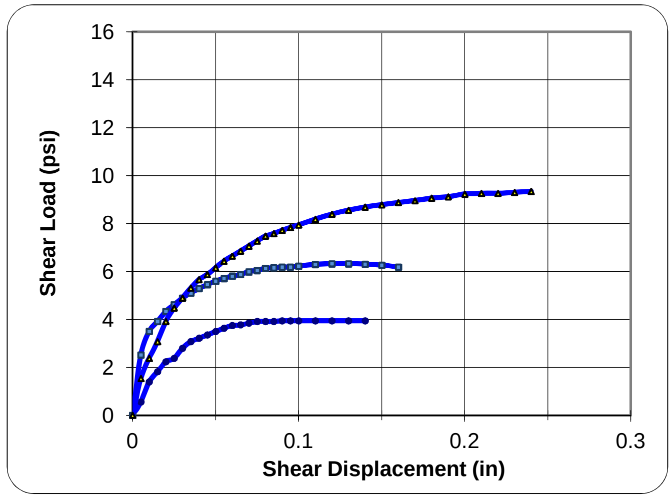
TESTED FOR: Innovative Waste Consulting
6628 NW 9tjh Boulevard, Suite 3
Gainesville, FL

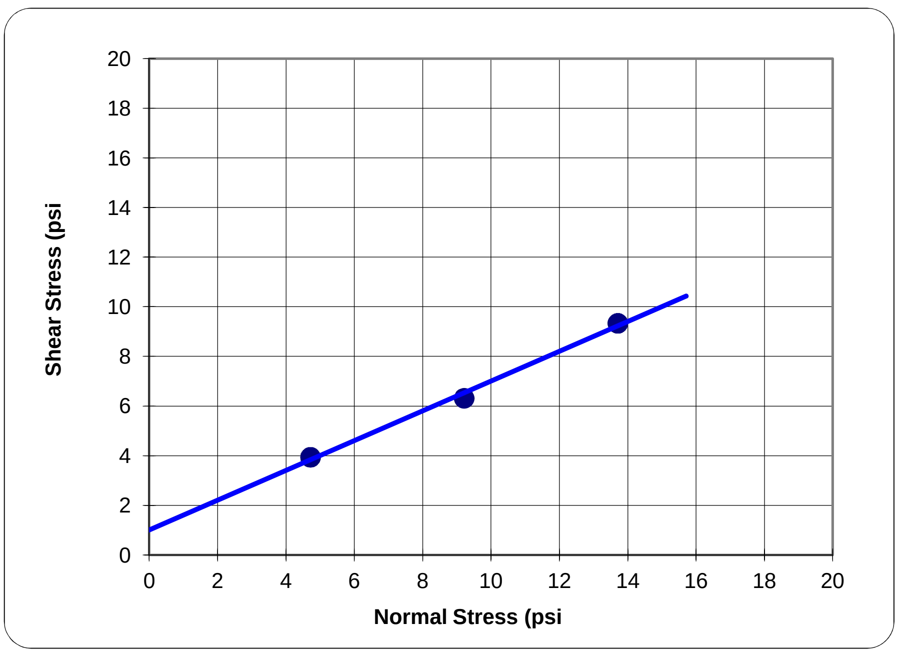
PROJECT: Process Pond Impoundment Dikes
GRU Deerhaven Genrting Facility
1001 NW 13th Street
Gainesville, Alachua County, FL

DATE TESTED: August, 2015

SAMPLE LOCATION:
SOIL DESCRIPTION: Brown Silty Sand with Clay







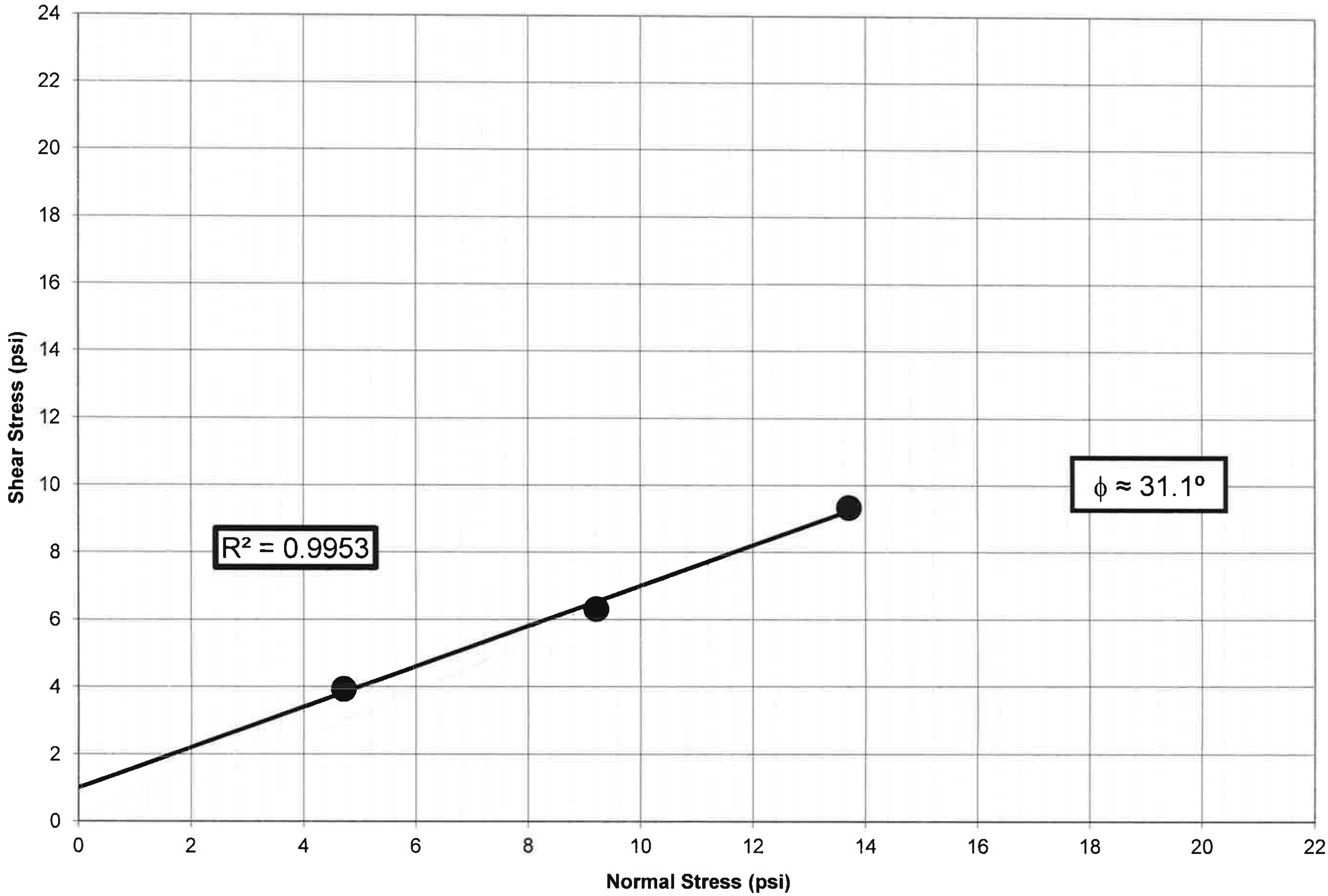
TEST RESULTS

Friction Angle	**31.1**
Opt. Mositure:	**11.0**
Max Density:	**119.0**

UNIVERSAL ENGINEERING SCIENCES
4475 S.W. 35TH TERRACE, GAINESVILLE, FL. 32608
(352)372-3392 (352)336-7914 (FAX)

8.119 . 120

Direct Shear . Drained



APPENDIX C

DESCRIPTION OF LABORATORY TESTING PROCEDURES

UNIFIED SOIL CLASSIFICATION - ASTM D-2487

This practice describes a system for classifying mineral and organo-mineral soils for engineering purposes based on laboratory determination of particle size characteristics, liquid limit, and plasticity index.

WASH 200 TEST - ASTM D-1140

The Wash 200 test is performed by passing a representative soil sample over a No. 200 sieve and rinsing with water. The percentage of the soil grains passing this sieve is then calculated.

FULL SIEVE GRADATION TEST – ASTM D-422

On occasion it is helpful to evaluate the overall compositional characteristics of a soil and the #200 sieve analysis is supplemented with a full grain size distribution. A set of sieves with varying mesh sizes is used to determine the gradation of the soil particle sizes.

MOISTURE CONTENT DETERMINATION - ASTM D-2216

Moisture content is the ratio of the weight of water to the dry weight of soil. Moisture content is measured by drying a sample at 105 degrees Celsius. The moisture content is expressed as a percent of the oven dried soil mass.

ATTERBERG LIMITS – ASTM D-4318

The Atterberg limits are the upper and lower limits of the range of water content over which a soil exhibits plastic behavior, and are defined as the liquid limit and plastic limit, respectively.

The liquid limit is estimated as follows: The soil is mixed with distilled water to form a thick paste, which is then placed in a brass cup mounted on an edge pivot and rests initially on a rubber base. The base is then leveled off horizontally and divided by cutting a groove with a standard tool. The two halves of the soil gradually flow together as the cup is repeatedly dropped onto its base at a specified rate. The liquid limit is defined as the water content at which 25 blows are required to close the groove over a distance of 1/2 inch.

The plastic limit is estimated as follows: The soil is mixed with distilled water until it can be molded. A ball of soil is then rolled into a thread 1/8 inch in diameter between the hand and a glass plate. The soil is molded together again and the process repeated until the thread cracks when its diameter is 1/8 inch. The water content of the soil at this state is determined and defined as the plastic limit.

TRIAXIAL CONSOLIDATED UNDRAINED (CU) TEST – ASTM D-4767

This test method measure the shear strength characteristics under undrained conditions where soils have been fully consolidated under a set of stresses and stress changes under drained conditions that are similar to the test method. The shear stress is expressed in terms of total stress. This test method determines the strength and stress strain relationship of a cylindrical specimen of either undisturbed soil using a triaxial chamber and no drainage of the specimen is permitted. This test procedure is similar to the CU Test however, the sample is sealed within a rubber membrane and O-rings, and a chamber pressure is applied to the chamber fluid exerting a pressure on the specimen.

SPECIFIC GRAVITY OF SOIL ASTM D-854

This test method determines the ratio of the mass of a unit volume of soil solids to the mass of the same volume of gas free distilled water at 20 degrees Celsius. Soil is placed into a calibrated pycnometer, water is added, and then the soil and water are de-aired. The specific gravity of the soil specimen is determined through the mass of the pycnometer and water, the calibrated mass of the dry pycnometer, the calibrated volume of the pycnometer, the density of the water at the test temperature, the mass of the oven dried soils, and the mass of the pycnometer water and soil solids at the test temperature.

APPENDIX C

DESCRIPTION OF FIELD TESTING PROCEDURES

STANDARD PENETRATION TESTING – ASTM D-1586

Penetration tests were performed in accordance with ASTM Procedure D-1586, Penetration Test and Split-Barrel Sampling of Soils. This test procedure generally involves driving a 1.4-inch I.D. split-tube sampler into the soil profile in six inch increments for a minimum distance of 18 inches using a 140-pound hammer free-falling 30 inches. The total number of blows required to drive the sampler the second and third 6-inch increments is designated as the N-value, and provides an indication of in-place soil strength, density and consistency.

APPENDIX C

DESCRIPTION OF LABORATORY TESTING PROCEDURES

UNIFIED SOIL CLASSIFICATION - ASTM D-2487

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The plastic limit is estimated as follows: The soil is mixed with distilled water until it can be molded. A ball of soil is then rolled into a thread 1/8 inch in diameter between the hand and a glass plate. The soil is molded together again and the process repeated until the thread cracks when its diameter is 1/8 inch. The water content of the soil at this state is determined and defined as the plastic limit.

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This test method measure the shear strength characteristics under undrained conditions where soils have been fully consolidated under a set of stresses and stress changes under drained conditions that are similar to the test method. The shear stress is expressed in terms of total stress. This test method determines the strength and stress strain relationship of a cylindrical specimen of either undisturbed soil using a triaxial chamber and no drainage of the specimen is permitted. This test procedure is similar to the CU Test however, the sample is sealed within a rubber membrane and O-rings, and a chamber pressure is applied to the chamber fluid exerting a pressure on the specimen.

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APPENDIX C

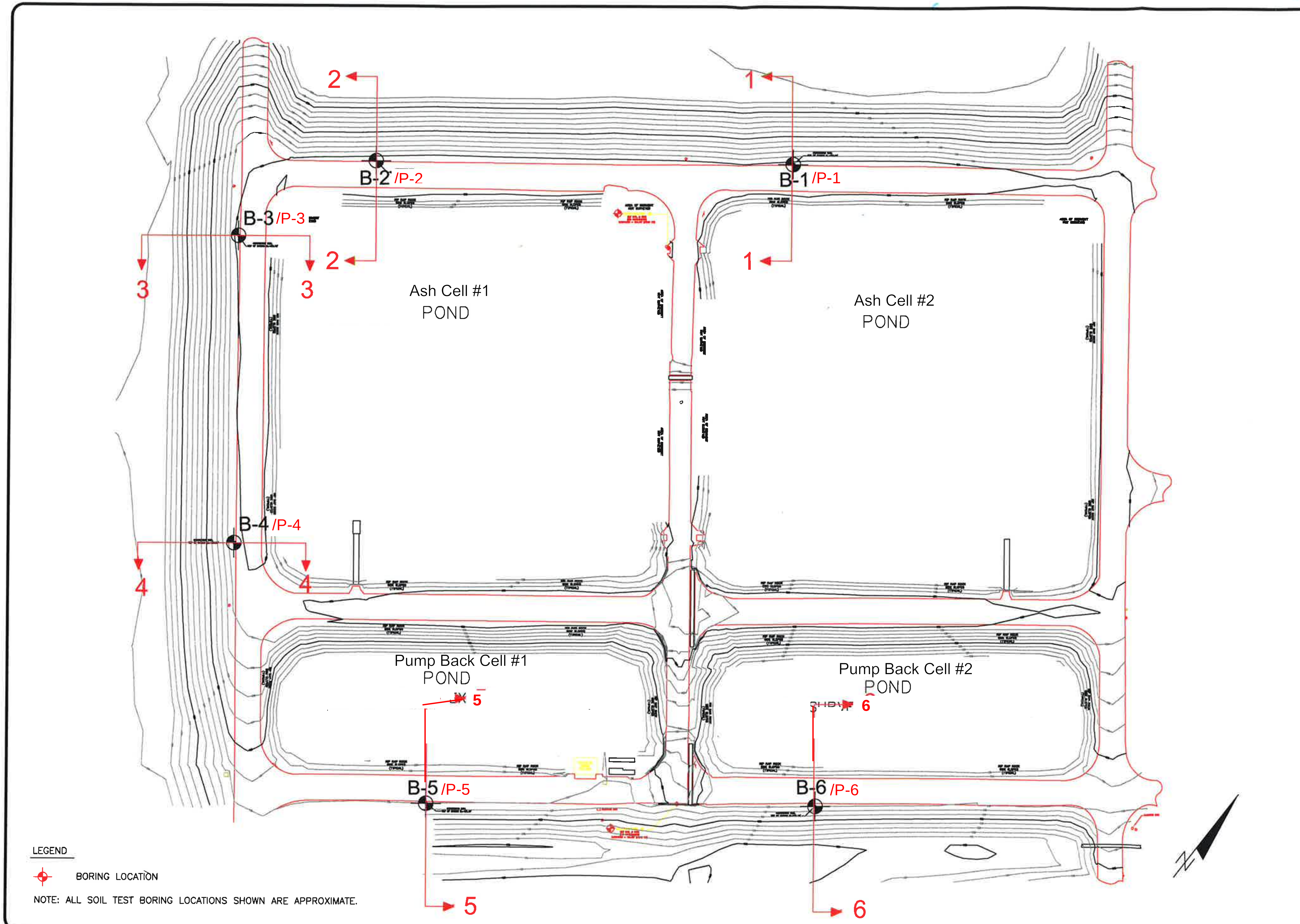
DESCRIPTION OF FIELD TESTING PROCEDURES

STANDARD PENETRATION TESTING – ASTM D-1586

Penetration tests were performed in accordance with ASTM Procedure D-1586, Penetration Test and Split-Barrel Sampling of Soils. This test procedure generally involves driving a 1.4-inch I.D. split-tube sampler into the soil profile in six inch increments for a minimum distance of 18 inches using a 140-pound hammer free-falling 30 inches. The total number of blows required to drive the sampler the second and third 6-inch increments is designated as the N-value, and provides an indication of in-place soil strength, density and consistency.

APPENDIX D

SLOPE STABILITY ANALYSIS



CLIENT: INNOVATIVE WASTE CONSULTING SERVICES

DRAWN BY: KD DATE: 9/10/15

CHECKED BY: ES DATE: 9/10/15

SCALE: 1"=80' ACADFILE:0230.1500077-B

PROJECT NO: 0230.1500077.0000 REPORT NO:1251804

GRU DEERHAVEN POWER PLANT-POND EMBANKMENT
10001 NW 13TH STREET
GAINESVILLE, FLORIDA

CROSS SECTION FOR SLOPE STABILITY

UNIVERSAL
ENGINEERING SCIENCES

PAGE NO: D - 1

SLOPE STABILITY ANALYSIS

Soil Parameters

Soil strengths parameters were obtained from laboratory testing performed on representative samples taken from the project site. Below is a summary of the soil materials properties and strength parameters for the layer units at the DGS process ponds project site.

Medium dense Silty Sand Ỹr=119 pcf			
Analysis	Type	Unit	Value
Un-Drained	Cohesion Intercept	PSF	192
Lab Testing Triaxial Test	Friction angle	Degree	31

Medium dense Very Clayey Sand Ỹr=127 pcf			
Analysis	Type	Unit	Value
Un-Drained	Cohesion Intercept	PSF	197
Lab Testing Triaxial Test	Friction angle	Degree	24.9

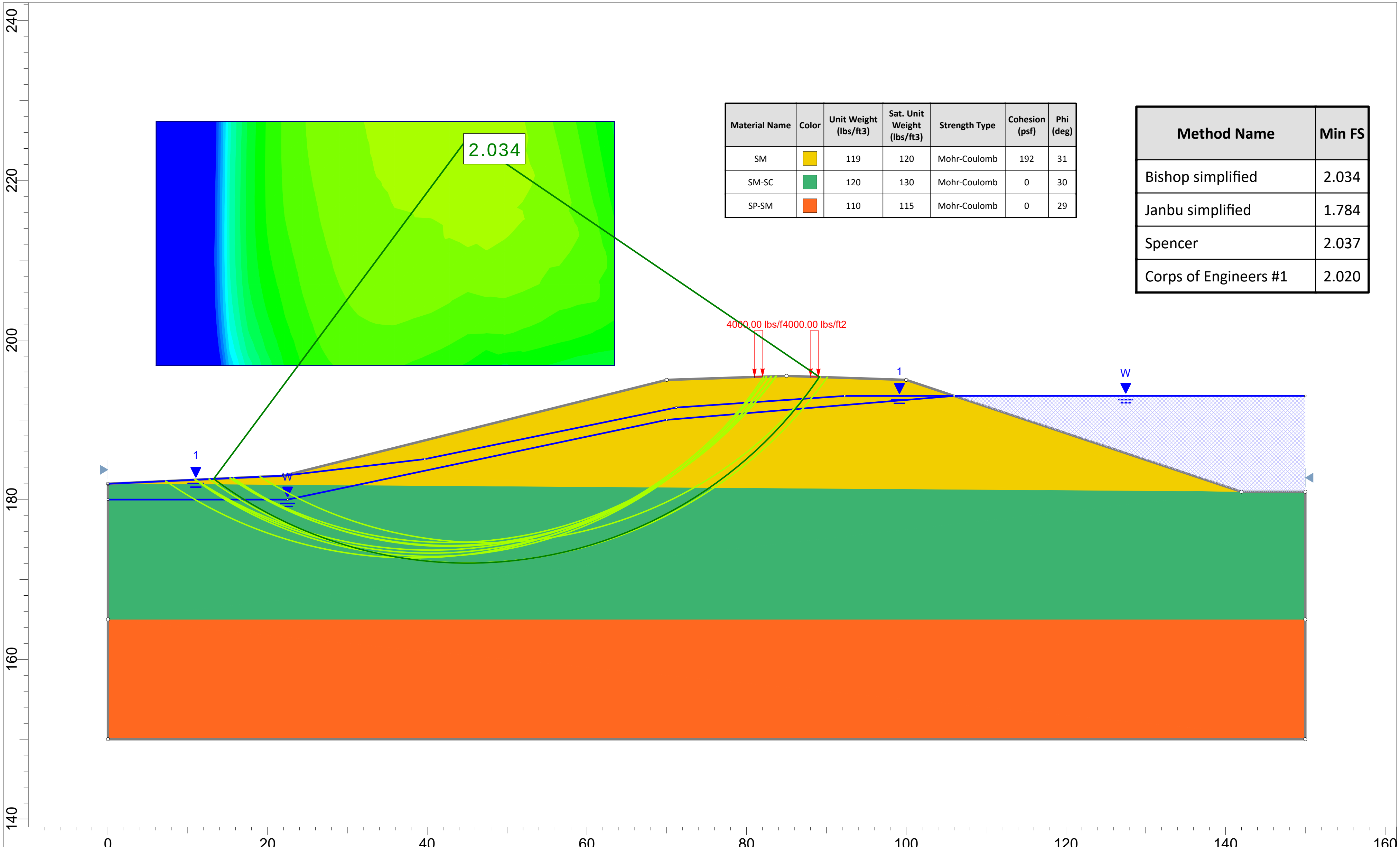
Medium dense Silty Sand * Ỹr=118 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	175
Lab Testing Direct Shear Test	Friction angle	Degree	31.1

Medium dense Silty-Clayey Sand * Ỹr=120 pcf			
Analysis	Type	Unit	Value
Undrained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	30

Loose Sand with silt Ỹr=110 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	29

Medium dense Sand with silt Ỹr=120 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	32

Medium dense Silty Sand Ỹr=120 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	30



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	115	Mohr-Coulomb	0	29

Method Name	Min FS
Bishop simplified	2.034
Janbu simplified	1.784
Spencer	2.037
Corps of Engineers #1	2.020

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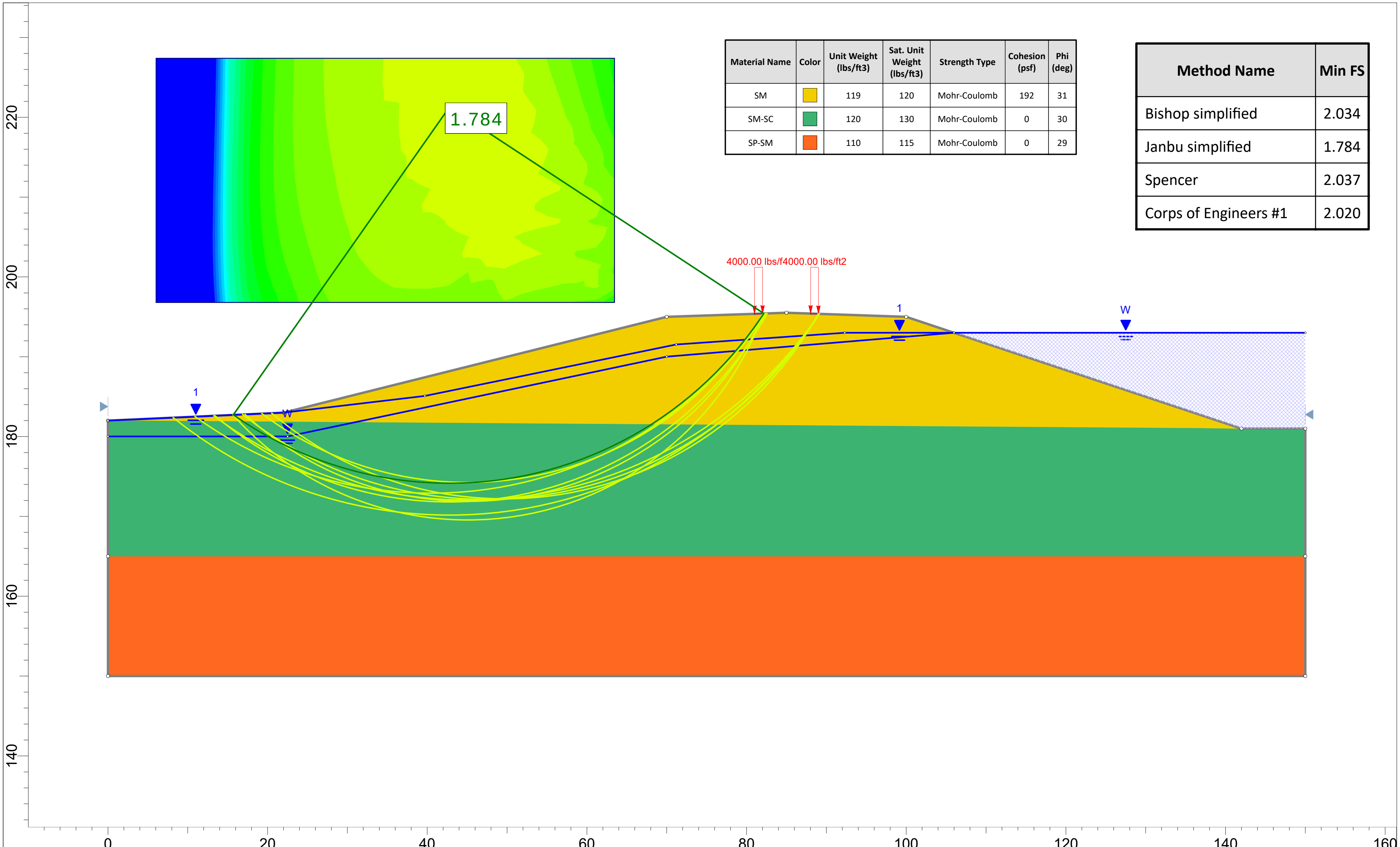
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-1		
Analysis Description	Max Operating Levels		
Drawn By ES/TK	*Scale* 1:200	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B1 Max Operating Level.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	115	Mohr-Coulomb	0	29

Method Name	Min FS
Bishop simplified	2.034
Janbu simplified	1.784
Spencer	2.037
Corps of Engineers #1	2.020

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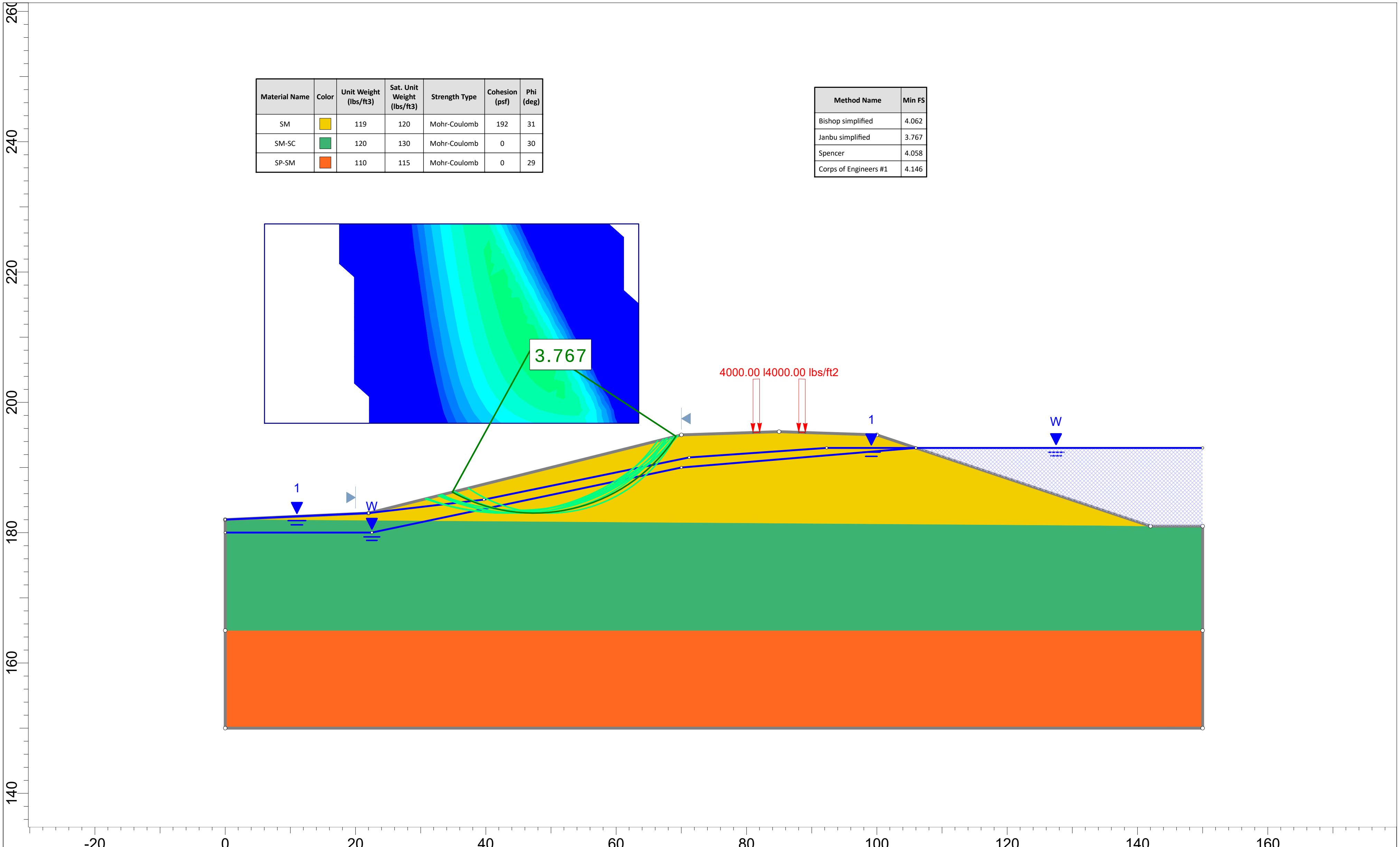
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-1		
Analysis Description	Max Operating Levels		
Drawn By ES/TK	*Scale* 1:200	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B1 Max Operating Level.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	115	Mohr-Coulomb	0	29

Method Name	Min FS
Bishop simplified	4.062
Janbu simplified	3.767
Spencer	4.058
Corps of Engineers #1	4.146



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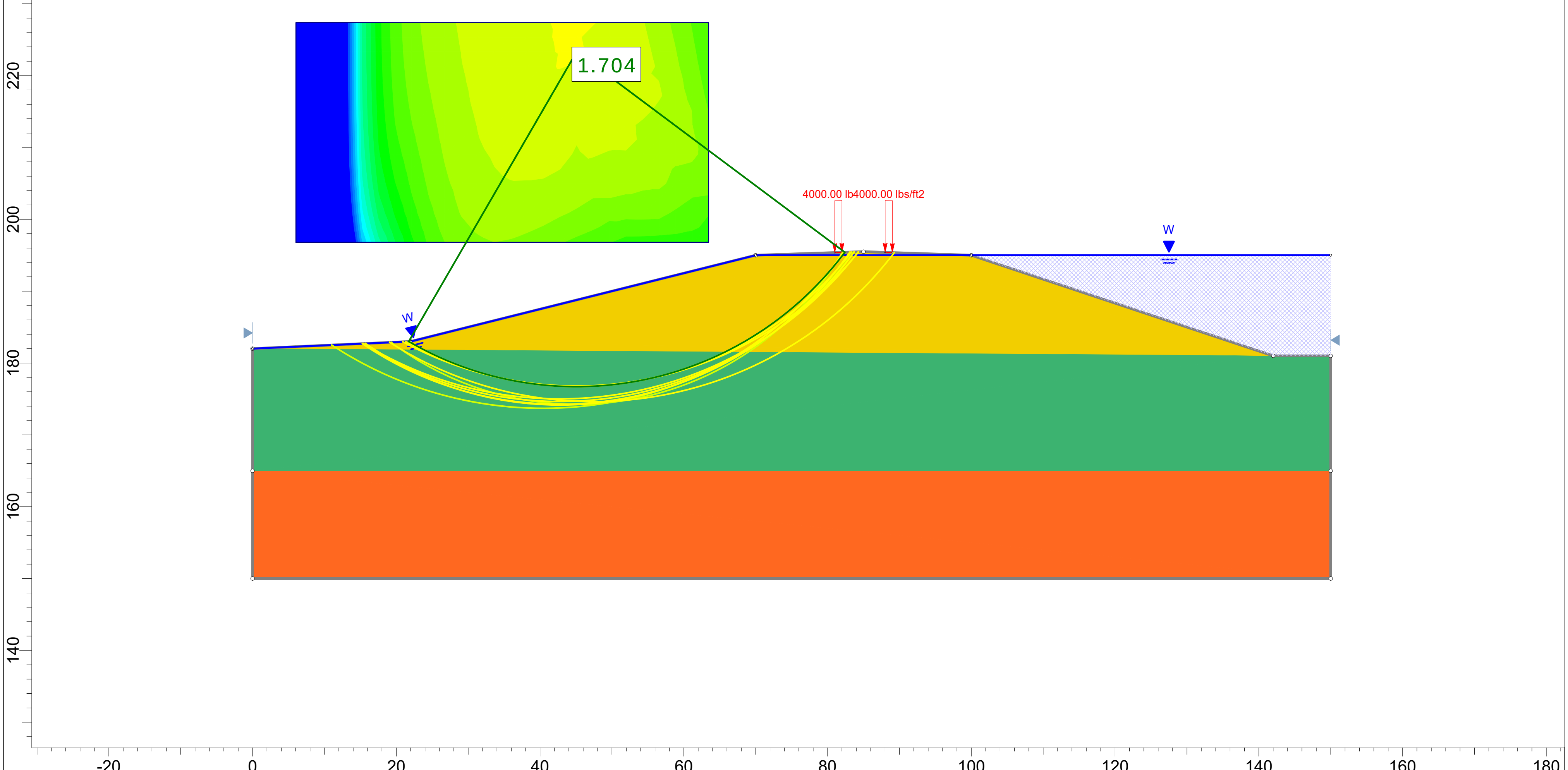
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-1
Analysis Description	Max Operating Levels
Drawn By	ES/TK
Scale	1:244
Company	Universal Engineering Sciences
Date	
File Name	GRU B1 Max Operating Level Surface.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	115	Mohr-Coulomb	0	29

Method Name	Min FS
Bishop simplified	1.704
Janbu simplified	1.511
Spencer	1.713
Corps of Engineers #1	1.718



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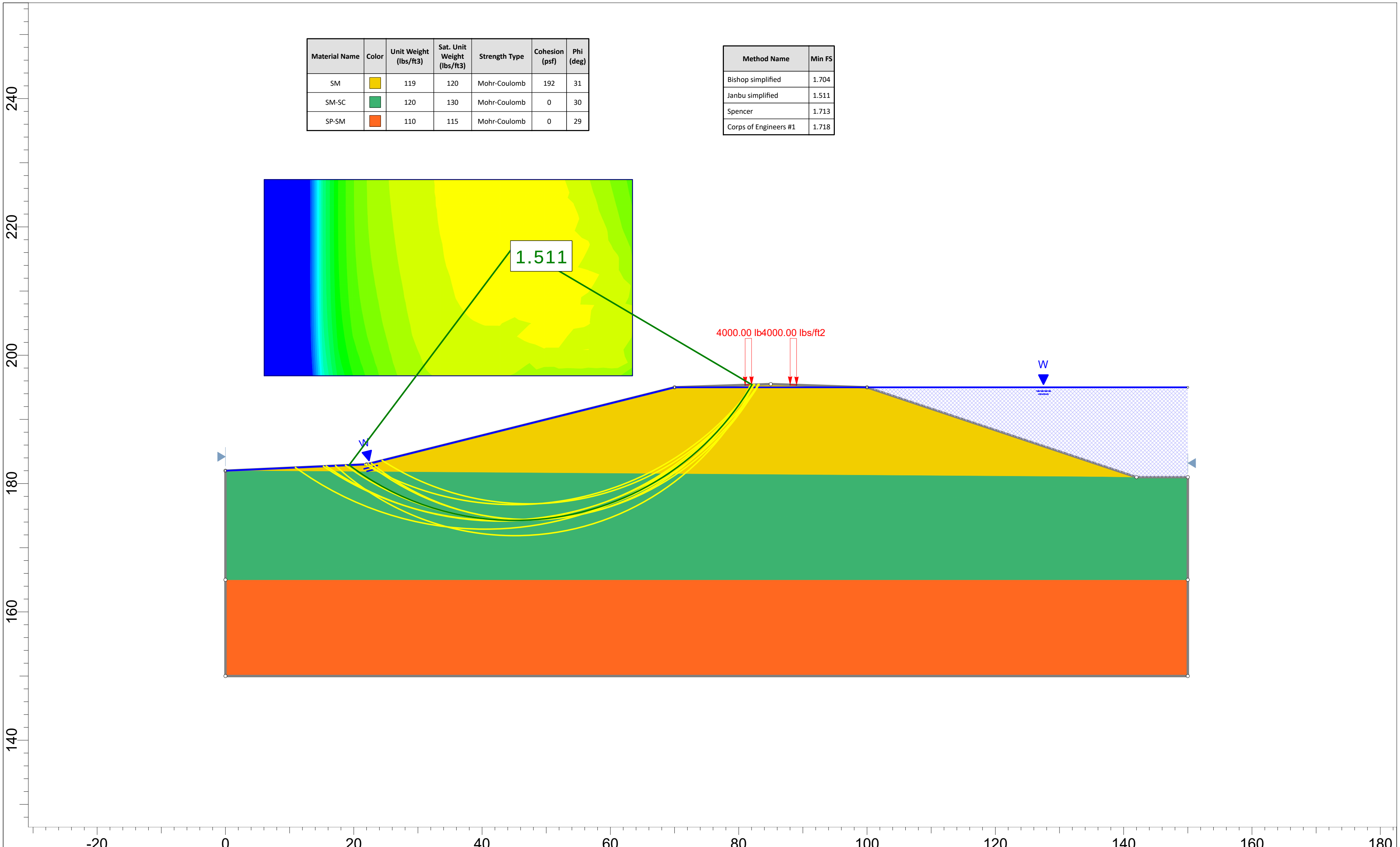
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-1
Analysis Description	Max Water Elevation
Drawn By	ES/TK
Scale	1:248
Company	Universal Engineering Sciences
Date	
File Name	GRU B1 - Max Water Elevation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	115	Mohr-Coulomb	0	29

Method Name	Min FS
Bishop simplified	1.704
Janbu simplified	1.511
Spencer	1.713
Corps of Engineers #1	1.718

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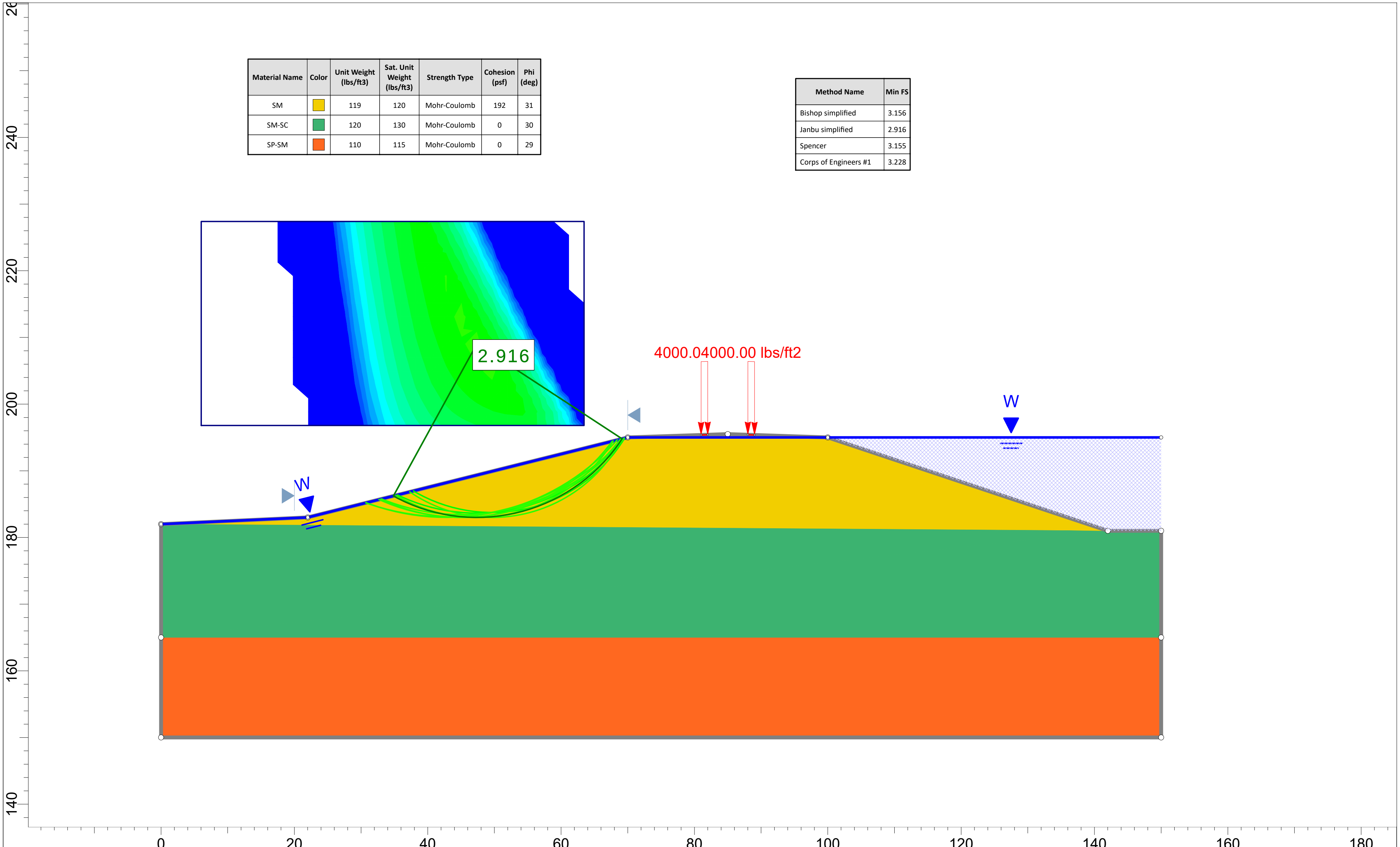
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-1
Analysis Description	Max Water Elevation
Drawn By	ES/TK
Scale	1:248
Company	Universal Engineering Sciences
Date	
File Name	GRU B1 - Max Water Elevation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	115	Mohr-Coulomb	0	29

Method Name	Min FS
Bishop simplified	3.156
Janbu simplified	2.916
Spencer	3.155
Corps of Engineers #1	3.228

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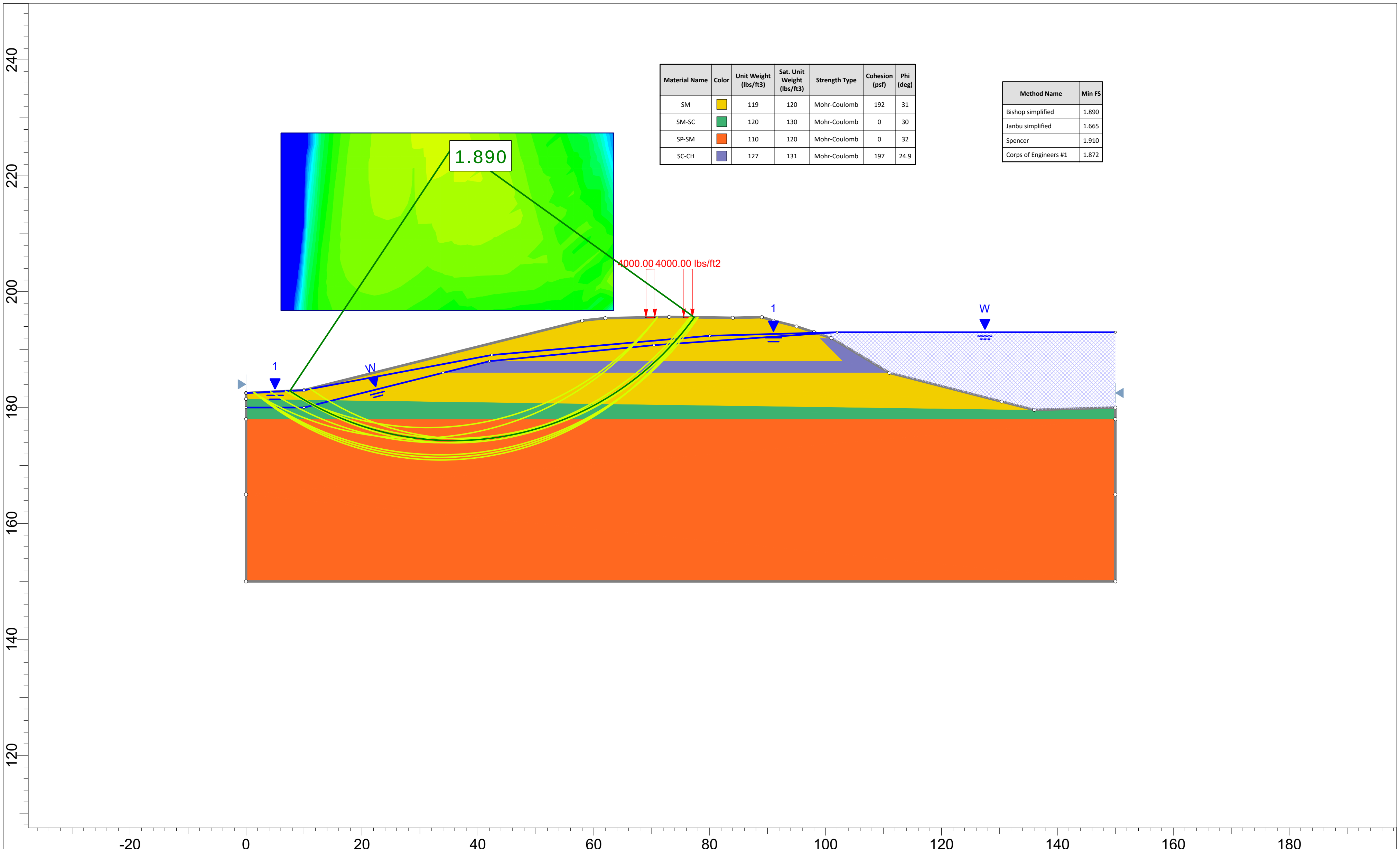
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-1		
Analysis Description	Max Water Elevation		
Drawn By ES/TK	*Scale* 1:239	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B1 - Max Water Elevation Surface.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.890
Janbu simplified	1.665
Spencer	1.910
Corps of Engineers #1	1.872

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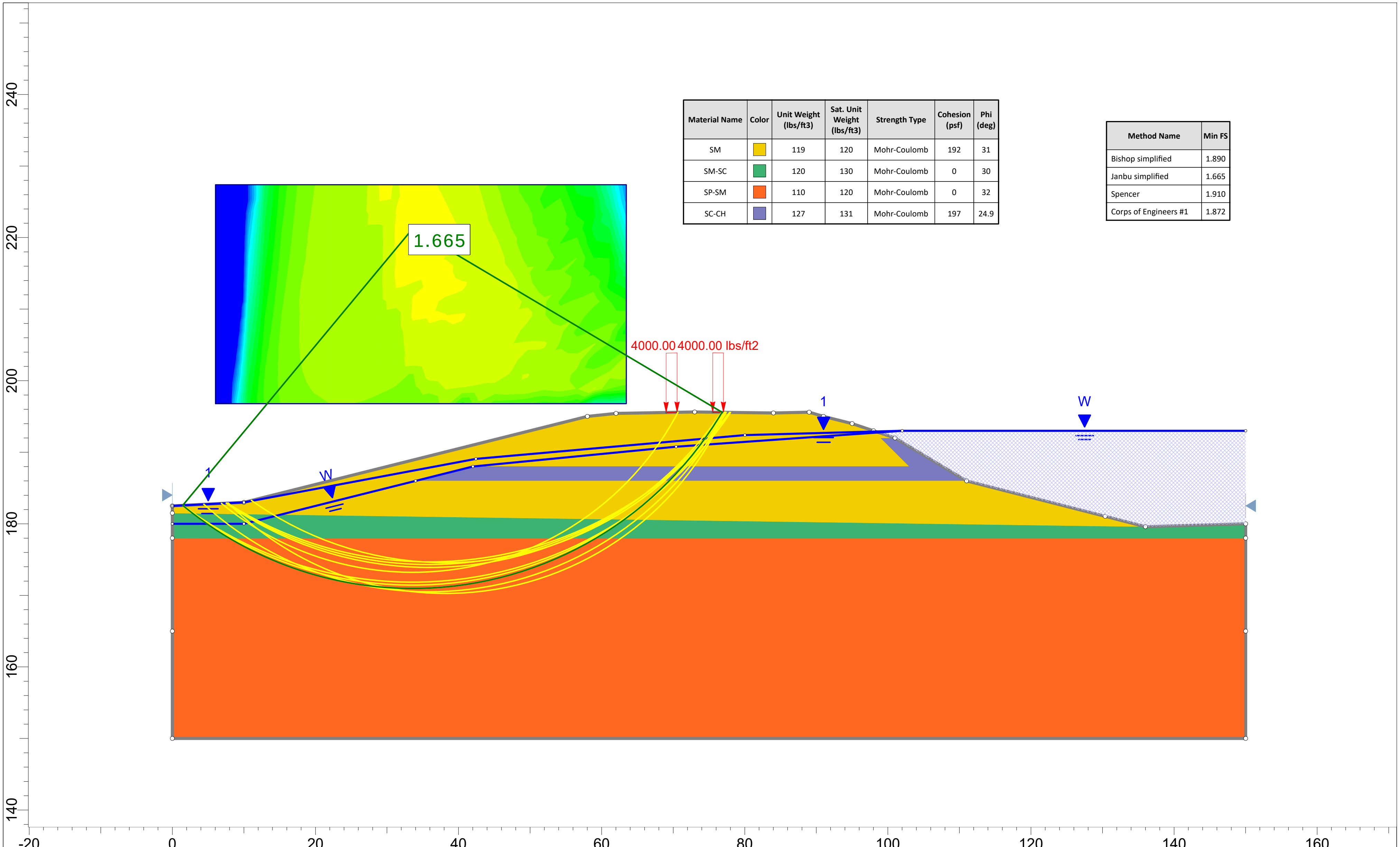
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-2
Analysis Description	
Drawn By	
Scale	1:275
Company	Universal Engineering Sciences
Date	
File Name	GRU B2- Max Operating Level.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.890
Janbu simplified	1.665
Spencer	1.910
Corps of Engineers #1	1.872



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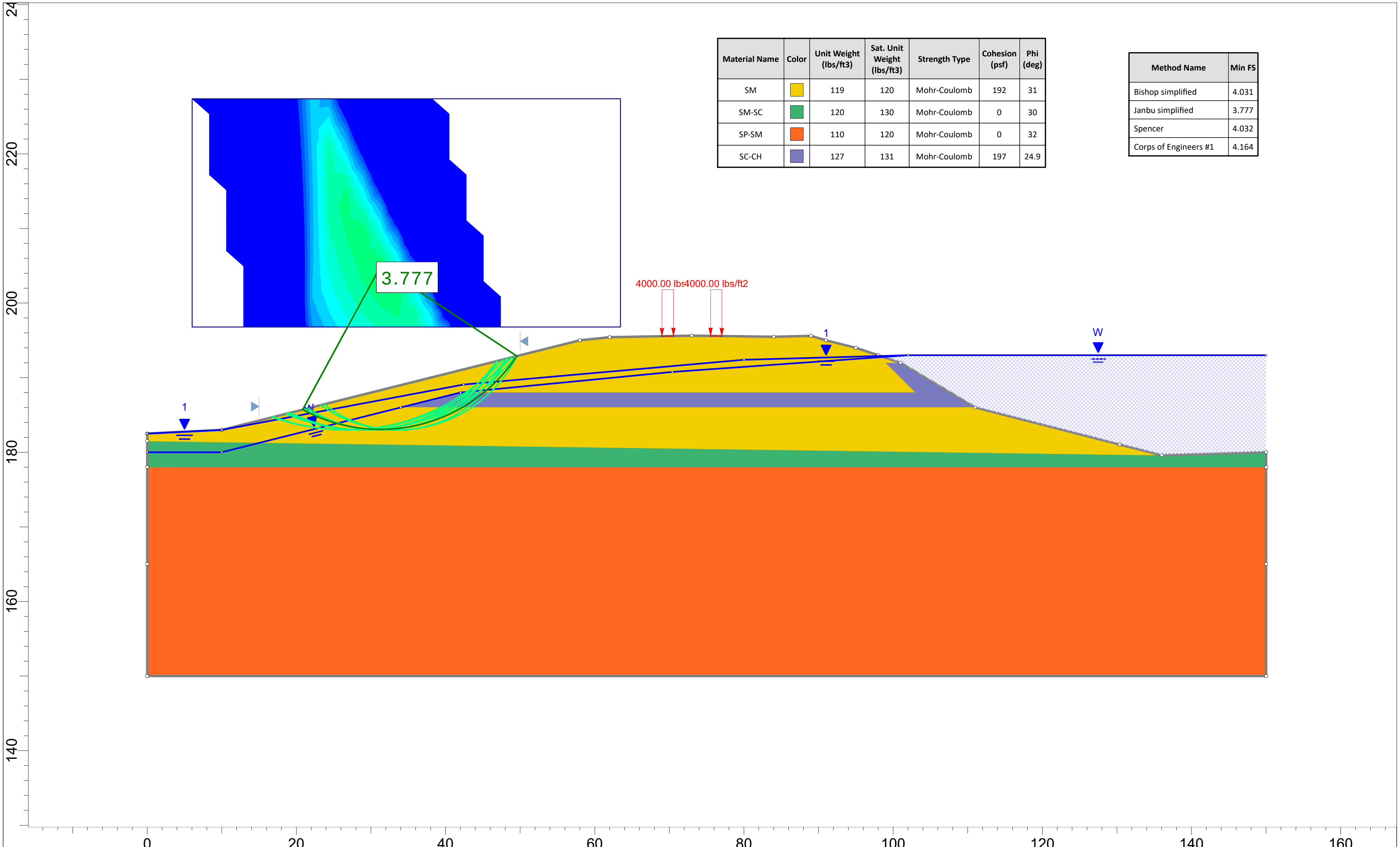
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-2
Analysis Description	
Drawn By	
Scale	1:223
Company	Universal Engineering Sciences
Date	
File Name	GRU B2- Max Operating Level.slmd



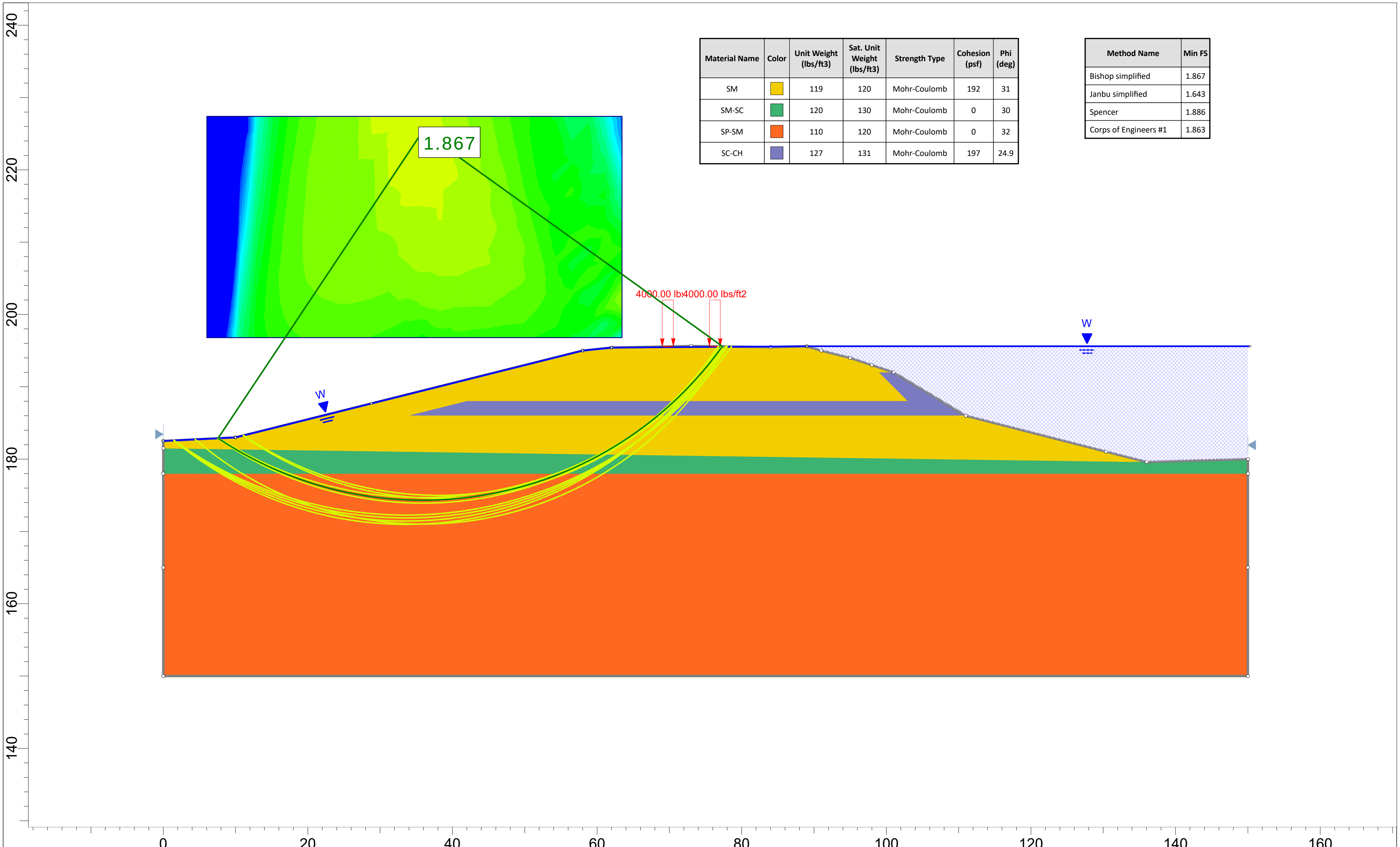
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	4.031
Janbu simplified	3.777
Spencer	4.032
Corps of Engineers #1	4.164

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-2
Analysis Description	
Drawn By	
Scale	1:214
Company	Universal Engineering Sciences
Date	
File Name	GRU B2- Max Operating Level Surface.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.867
Janbu simplified	1.643
Spencer	1.886
Corps of Engineers #1	1.863

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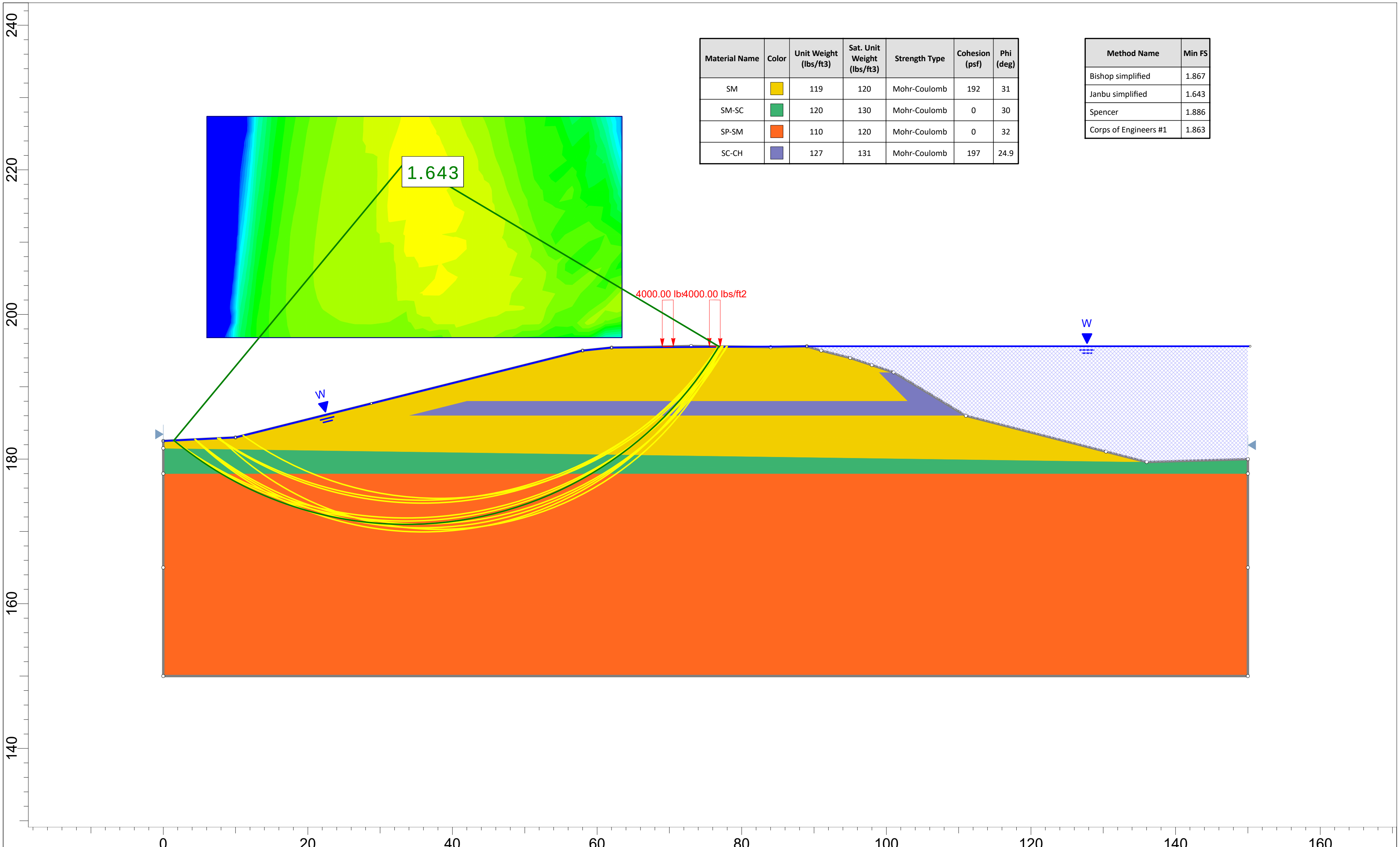
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-2
Analysis Description	Max Water Elevation
Drawn By	ES/TK
Scale	1:220
Company	Universal Engineering Sciences
Date	
File Name	GRU B2 Max Water Elevation.slmd



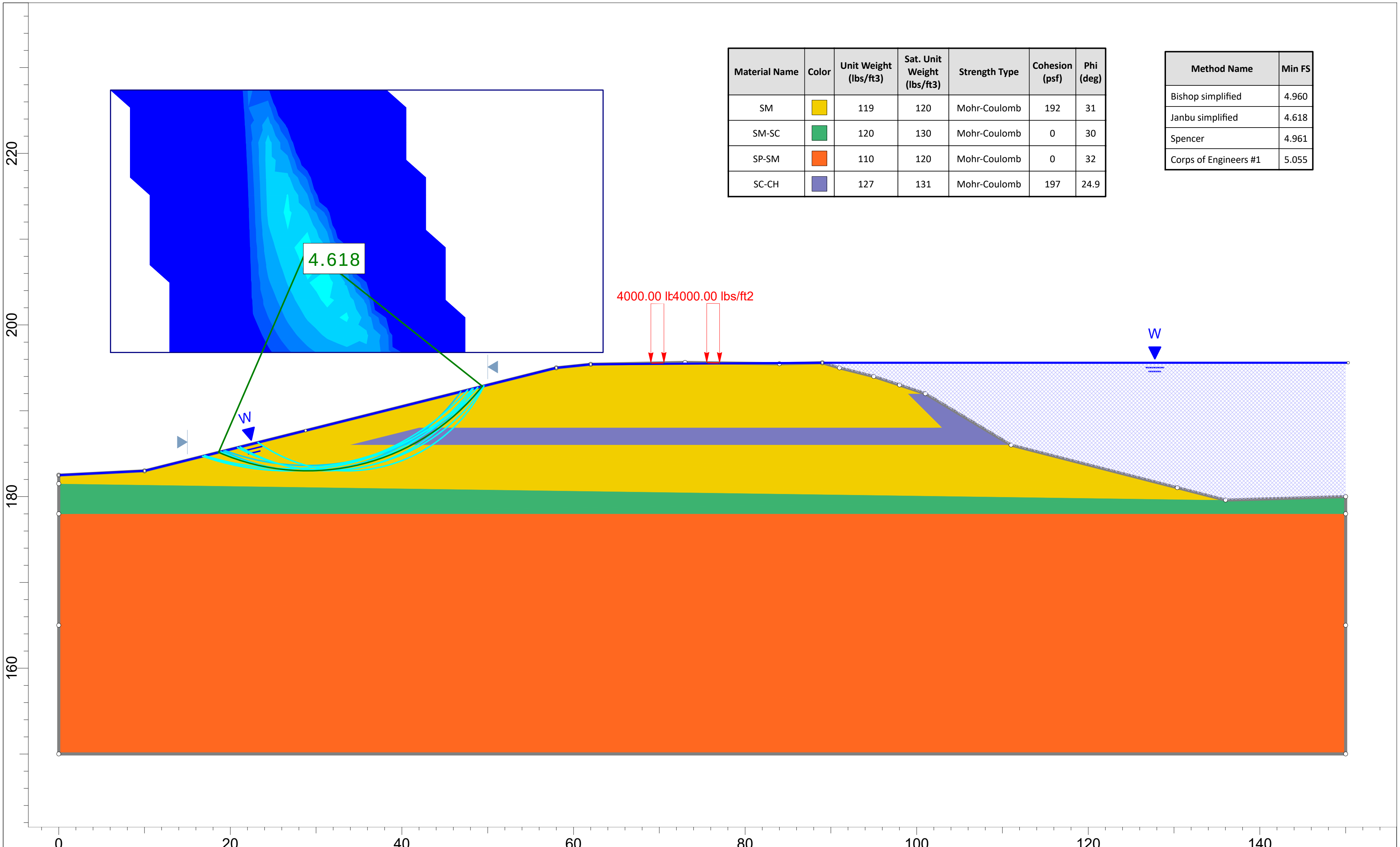
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.867
Janbu simplified	1.643
Spencer	1.886
Corps of Engineers #1	1.863

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-2
Analysis Description	Max Water Elevation
Drawn By	ES/TK
Scale	1:220
Company	Universal Engineering Sciences
Date	
File Name	GRU B2 Max Water Elevation.slmd



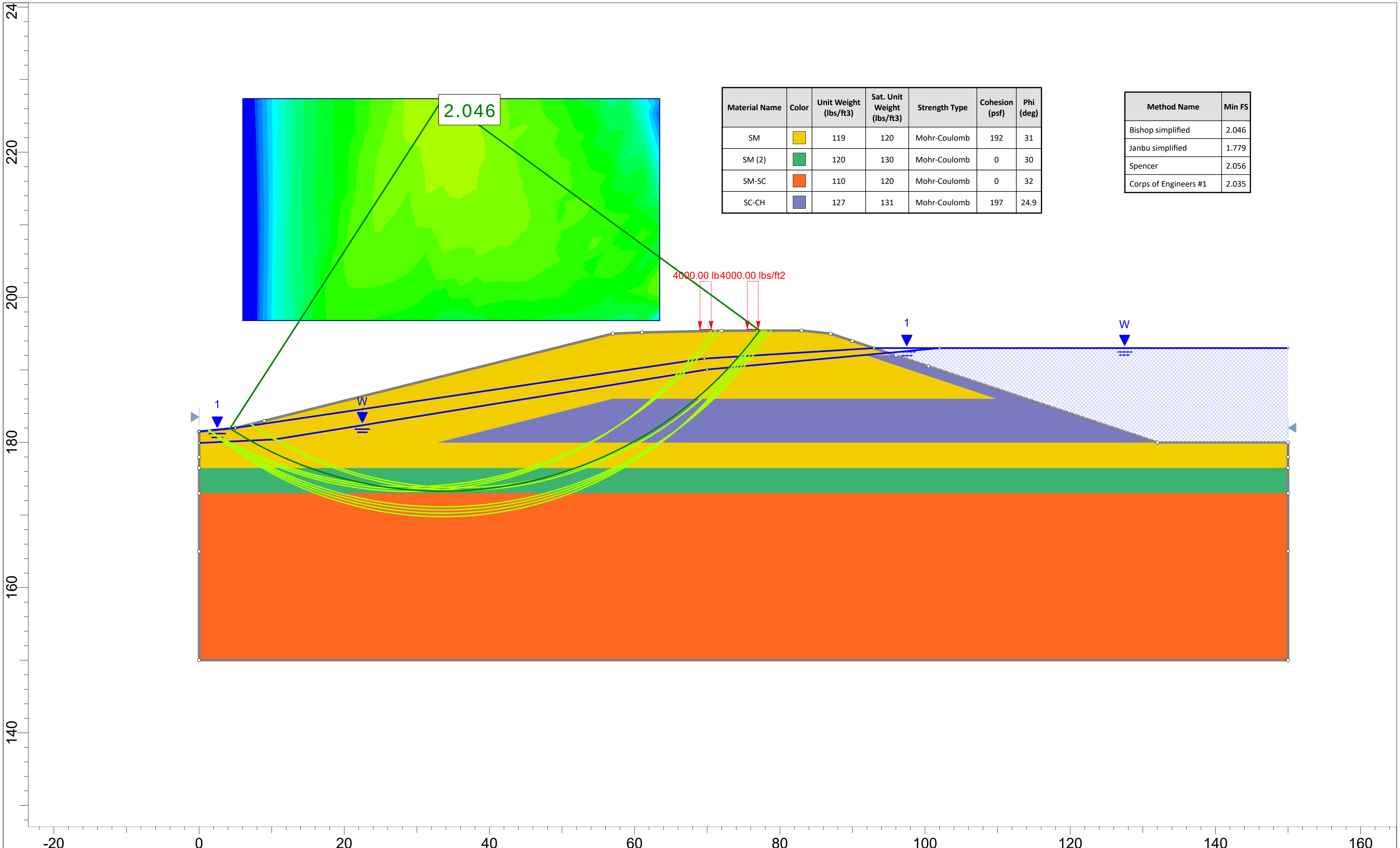
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	4.960
Janbu simplified	4.618
Spencer	4.961
Corps of Engineers #1	5.055

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-2
Analysis Description	Max Water Elevation
Drawn By	ES/TK
Scale	1:186
Company	Universal Engineering Sciences
Date	
File Name	GRU B2 Max Water Elevation Surface.slmd



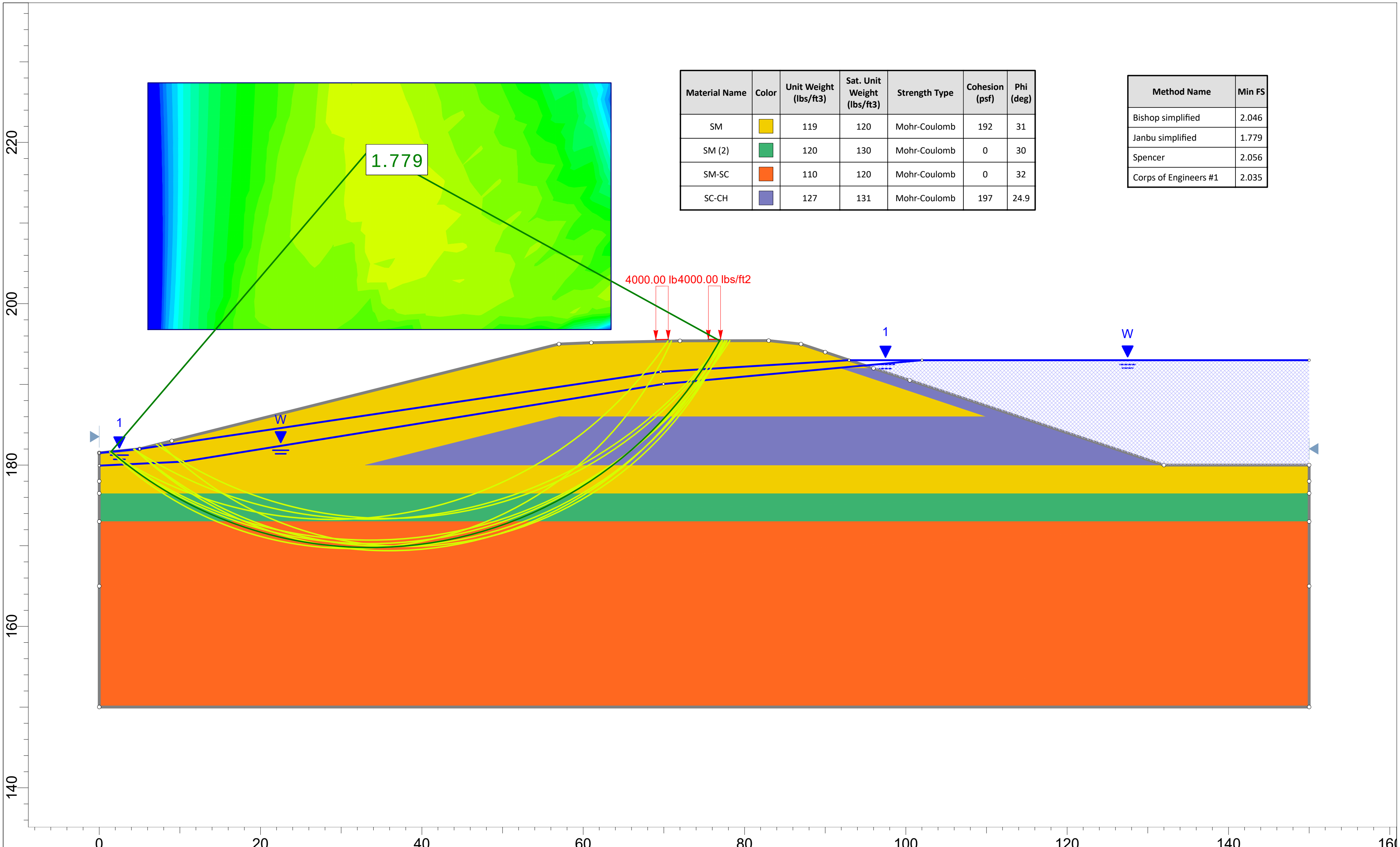
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SM-SC		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	2.046
Janbu simplified	1.779
Spencer	2.056
Corps of Engineers #1	2.035

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-3
Analysis Description	
Drawn By	
Scale	1:219
Company	Universal Engineering Sciences
Date	
File Name	GRU B3 - Max Operating Level.slmd



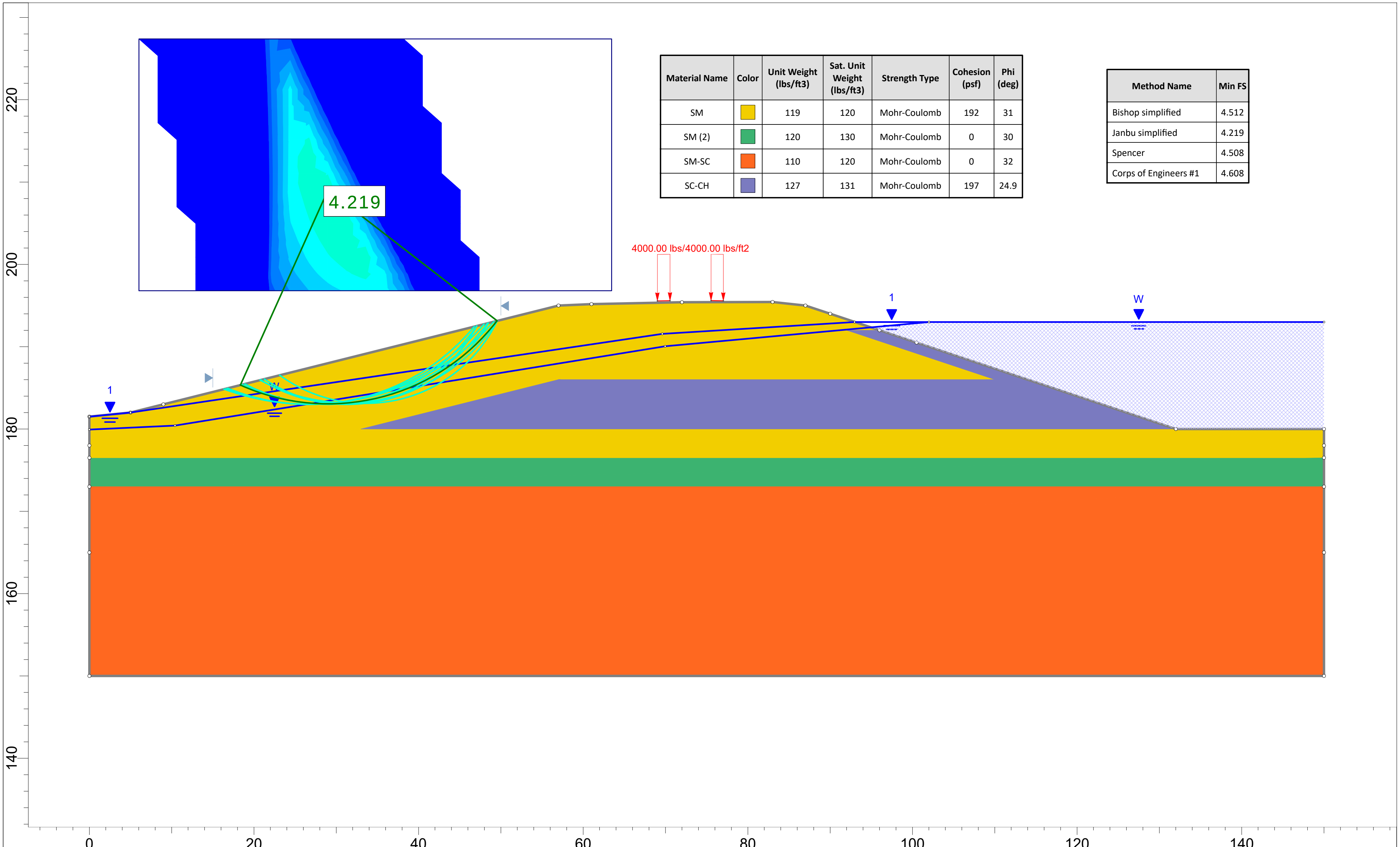
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SM-SC		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	2.046
Janbu simplified	1.779
Spencer	2.056
Corps of Engineers #1	2.035

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-3
Analysis Description	
Drawn By	
Scale	1:197
Company	Universal Engineering Sciences
Date	
File Name	GRU B3 - Max Operating Level.slmd



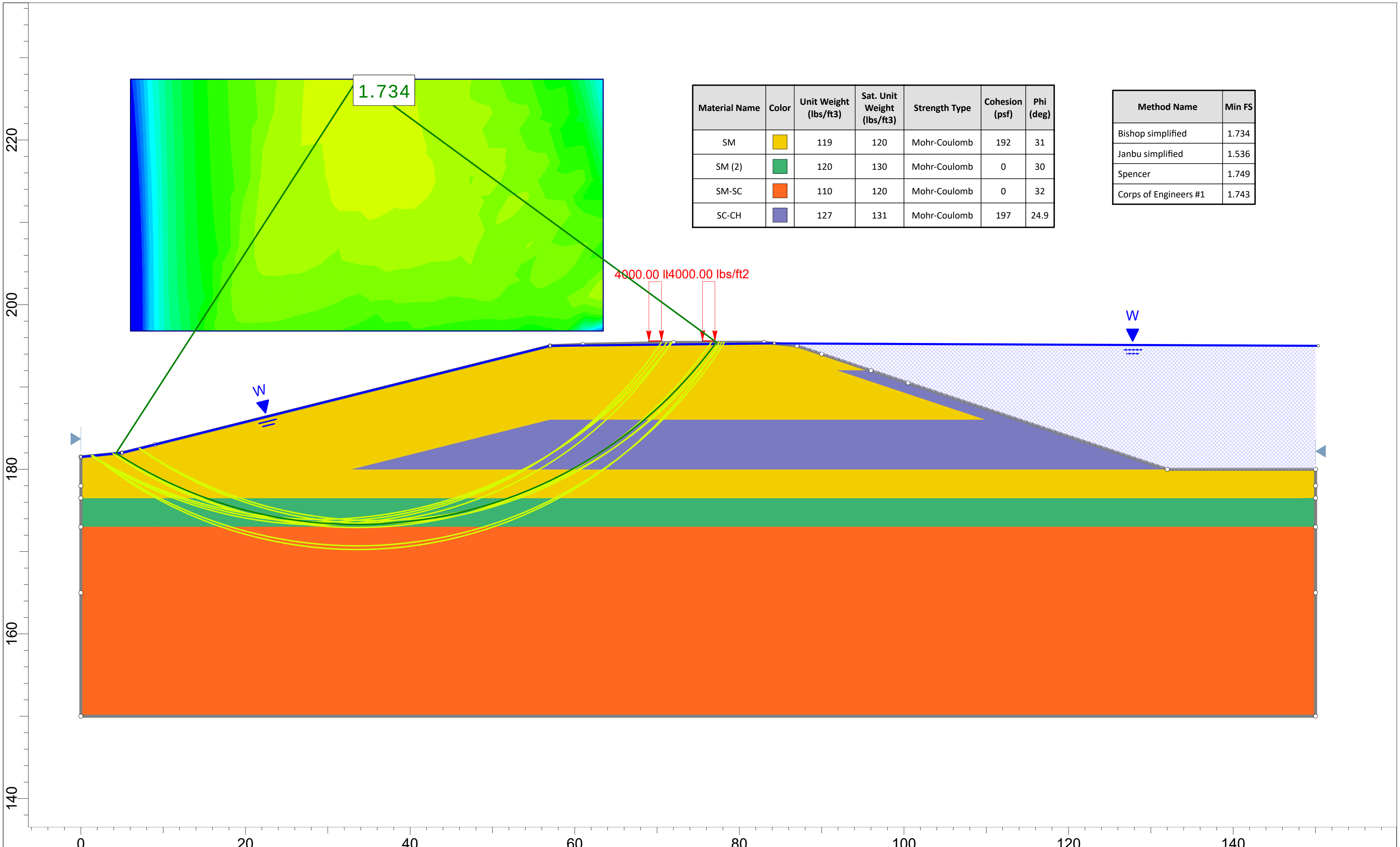
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SM-SC		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	4.512
Janbu simplified	4.219
Spencer	4.508
Corps of Engineers #1	4.608

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-3		
Analysis Description			
Drawn By	*Scale* 1:194	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B3 - Max Operating Level Surface.slmd



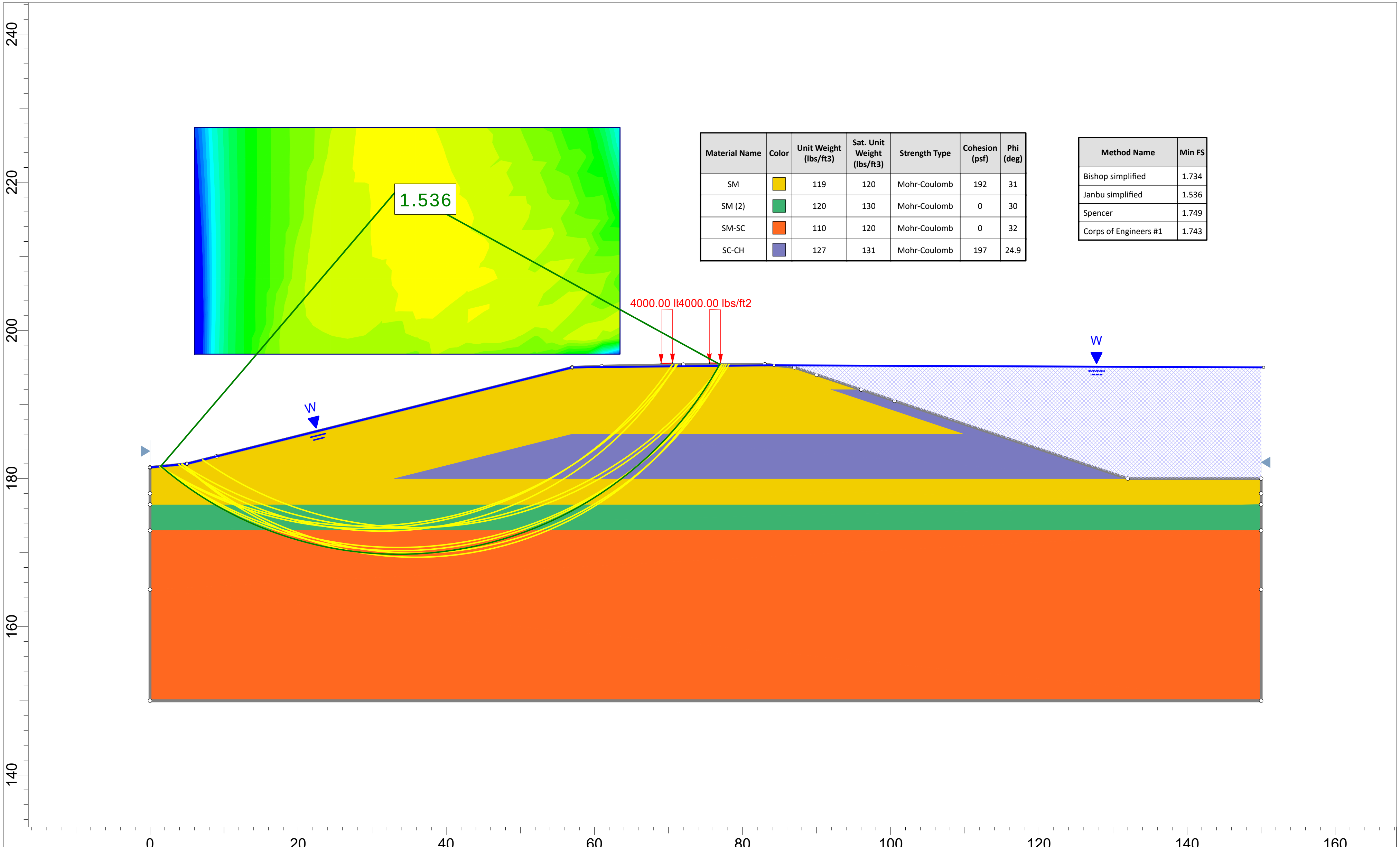
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SM-SC		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.734
Janbu simplified	1.536
Spencer	1.749
Corps of Engineers #1	1.743

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-3
Analysis Description	Max Water Elevation
Drawn By	ES/TK
Scale	1:194
Company	Universal Engineering Sciences
Date	
File Name	GRU B3 Max Water Elevation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SM-SC		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.734
Janbu simplified	1.536
Spencer	1.749
Corps of Engineers #1	1.743

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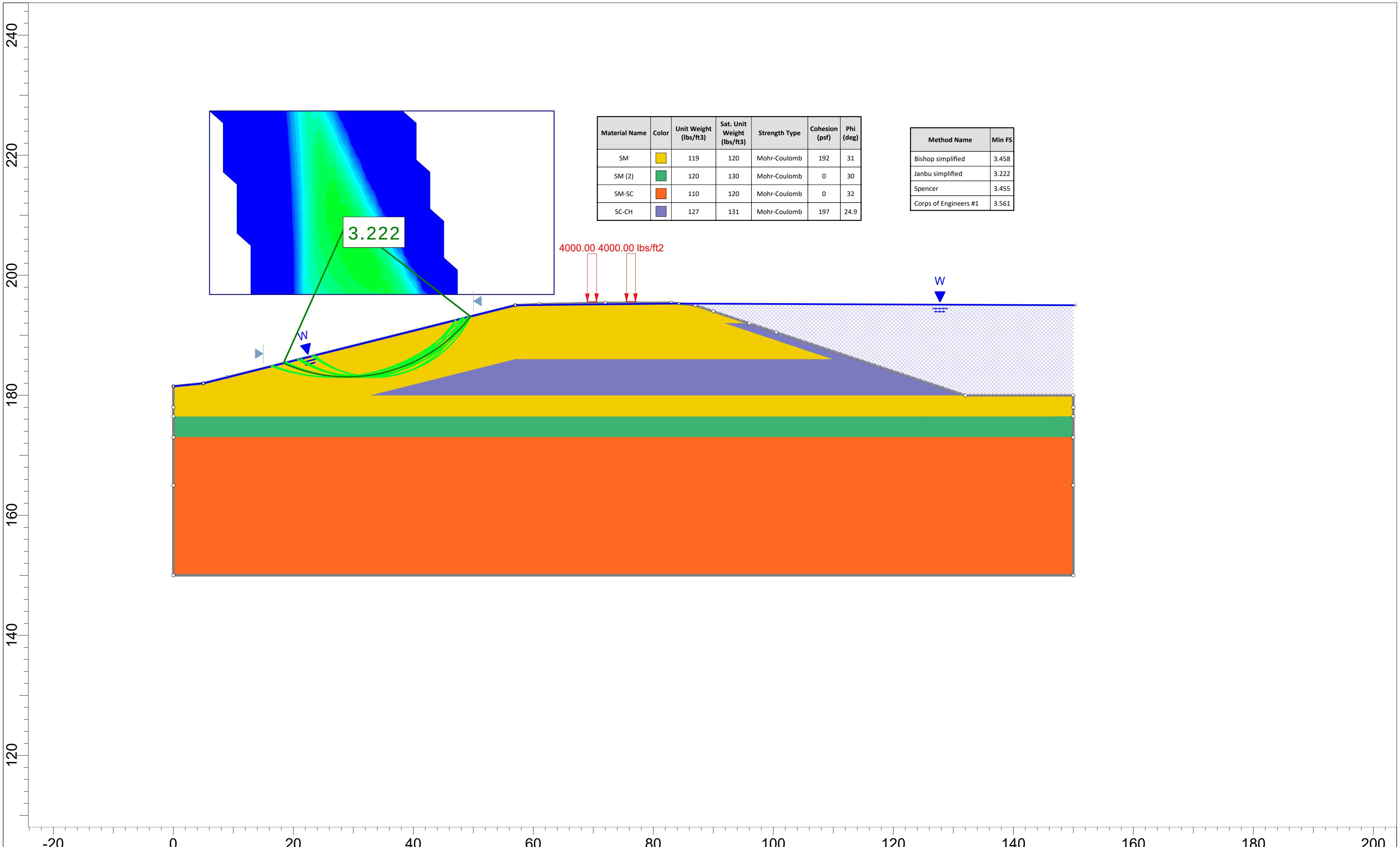
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-3
Analysis Description	Max Water Elevation
Drawn By	ES/TK
Scale	1:215
Company	Universal Engineering Sciences
Date	
File Name	GRU B3 Max Water Elevation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SM-SC		110	120	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	3.458
Janbu simplified	3.222
Spencer	3.455
Corps of Engineers #1	3.561

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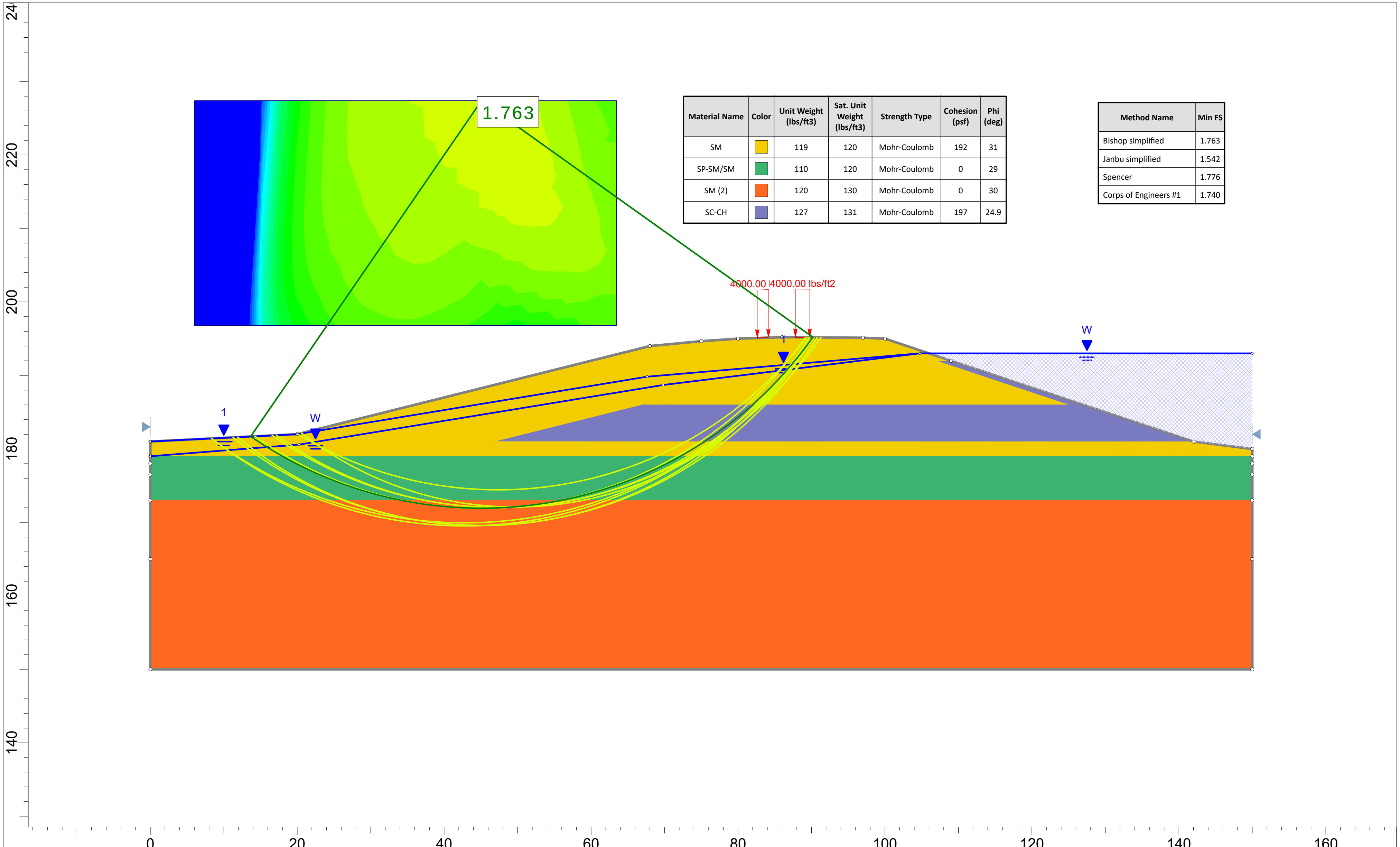
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-3		
Analysis Description	Max Water Elevation		
Drawn By ES/TK	*Scale* 1:265	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B3 Max Water Elevation Surface.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SP-SM/SM		110	120	Mohr-Coulomb	0	29
SM (2)		120	130	Mohr-Coulomb	0	30
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.763
Janbu simplified	1.542
Spencer	1.776
Corps of Engineers #1	1.740

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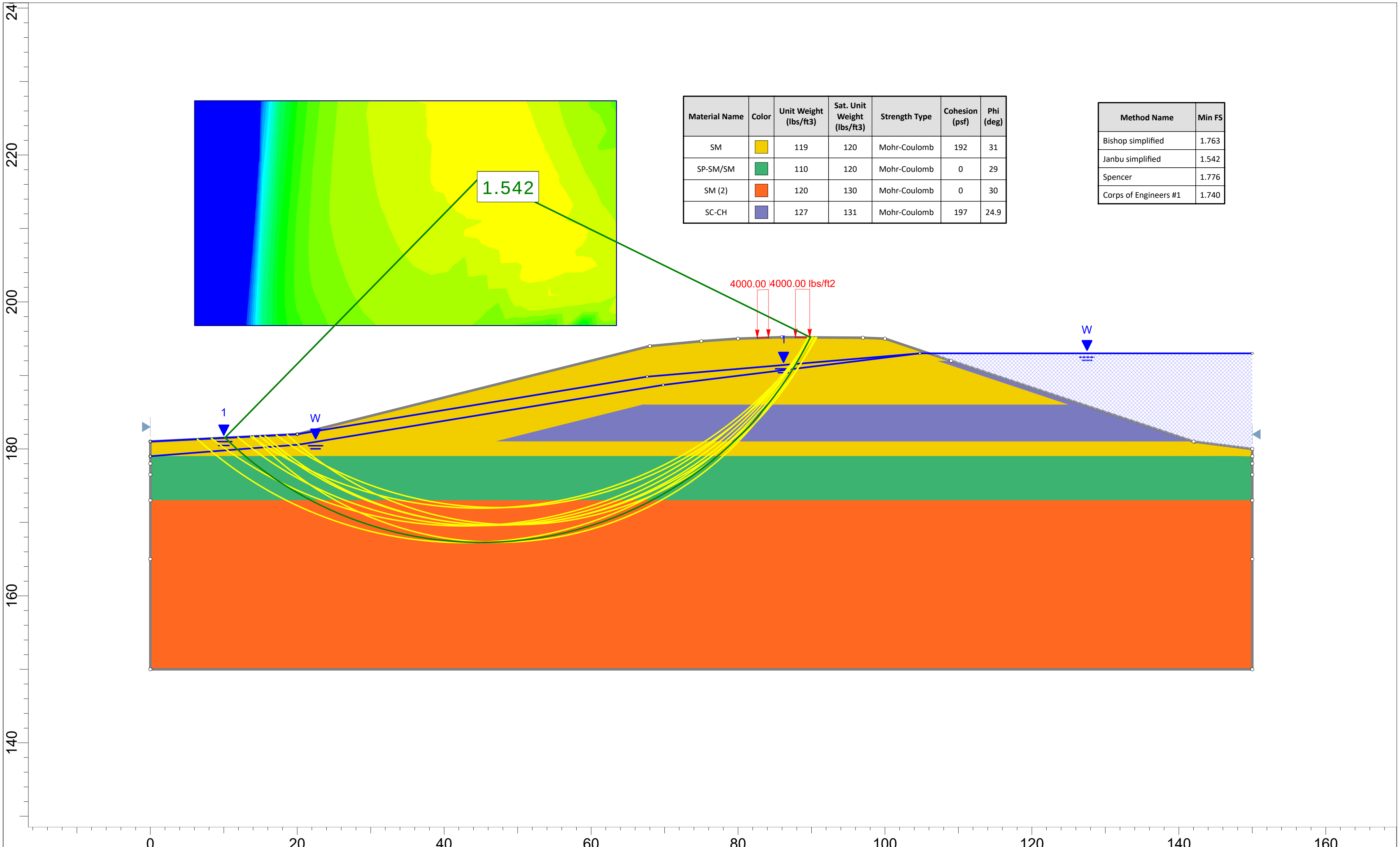
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-4		
Analysis Description	Max Operating Levels		
Drawn By ES/TK	*Scale* 1:217	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B4 - Max Operating Level.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SP-SM/SM		110	120	Mohr-Coulomb	0	29
SM (2)		120	130	Mohr-Coulomb	0	30
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.763
Janbu simplified	1.542
Spencer	1.776
Corps of Engineers #1	1.740

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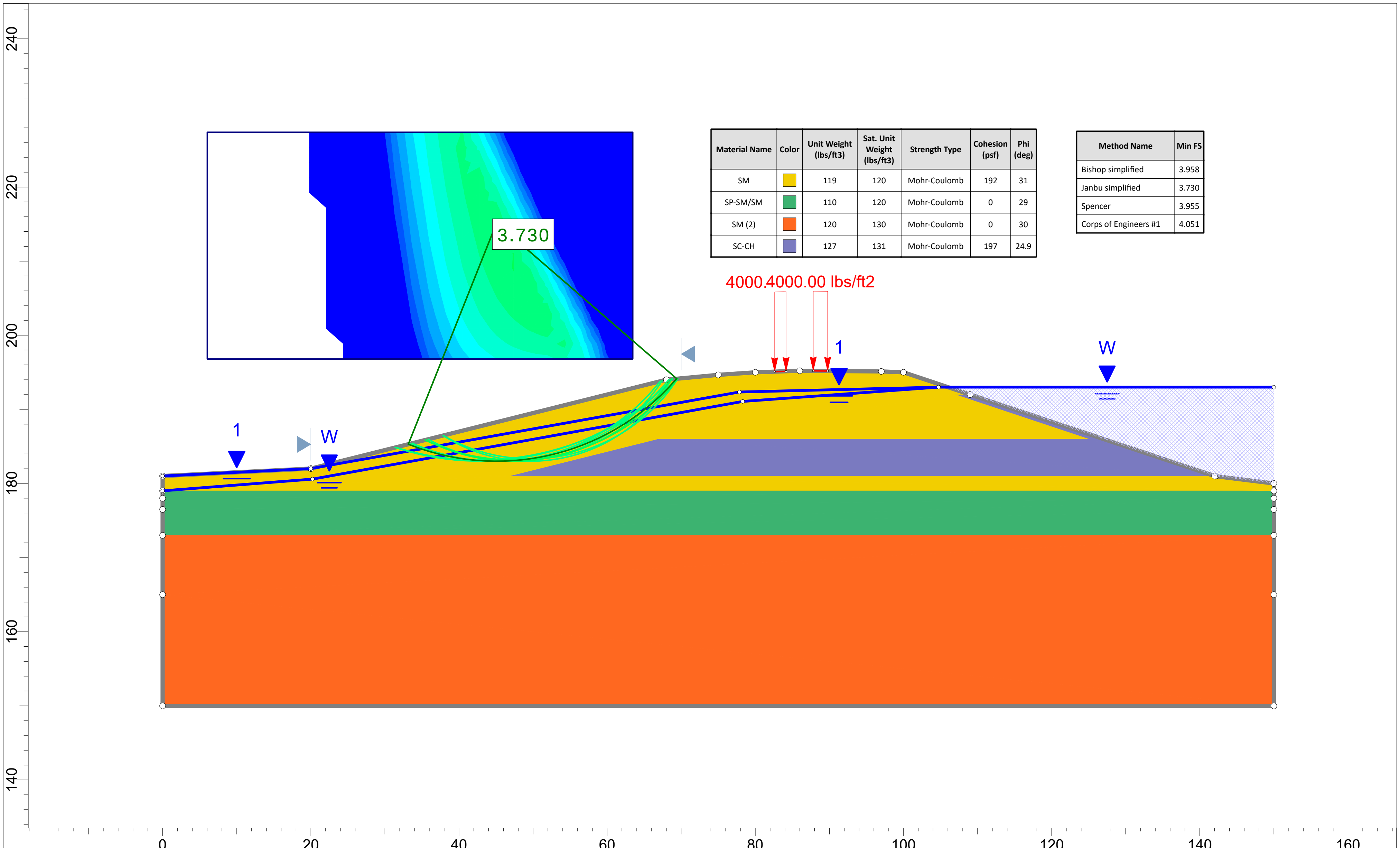
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-4		
Analysis Description	Max Operating Levels		
Drawn By ES/TK	*Scale* 1:217	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B4 - Max Operating Level.slmd



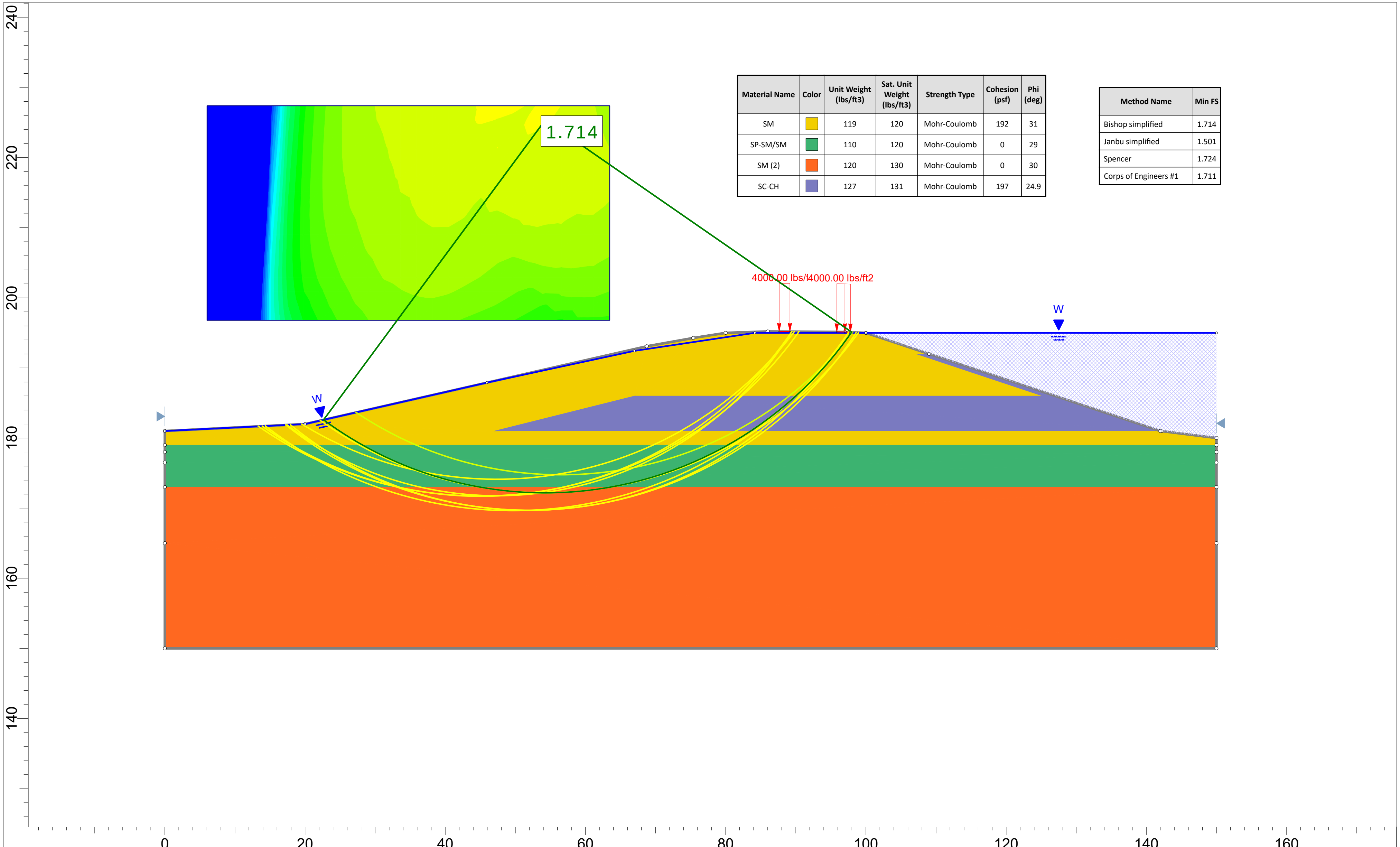
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SP-SM/SM		110	120	Mohr-Coulomb	0	29
SM (2)		120	130	Mohr-Coulomb	0	30
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	3.958
Janbu simplified	3.730
Spencer	3.955
Corps of Engineers #1	4.051

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-4
Analysis Description	Max Operating Levels
Drawn By	ES/TK
Scale	1:215
Company	Universal Engineering Sciences
Date	
File Name	GRU B4 - Max Operating Level Surface.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SP-SM/SM		110	120	Mohr-Coulomb	0	29
SM (2)		120	130	Mohr-Coulomb	0	30
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.714
Janbu simplified	1.501
Spencer	1.724
Corps of Engineers #1	1.711

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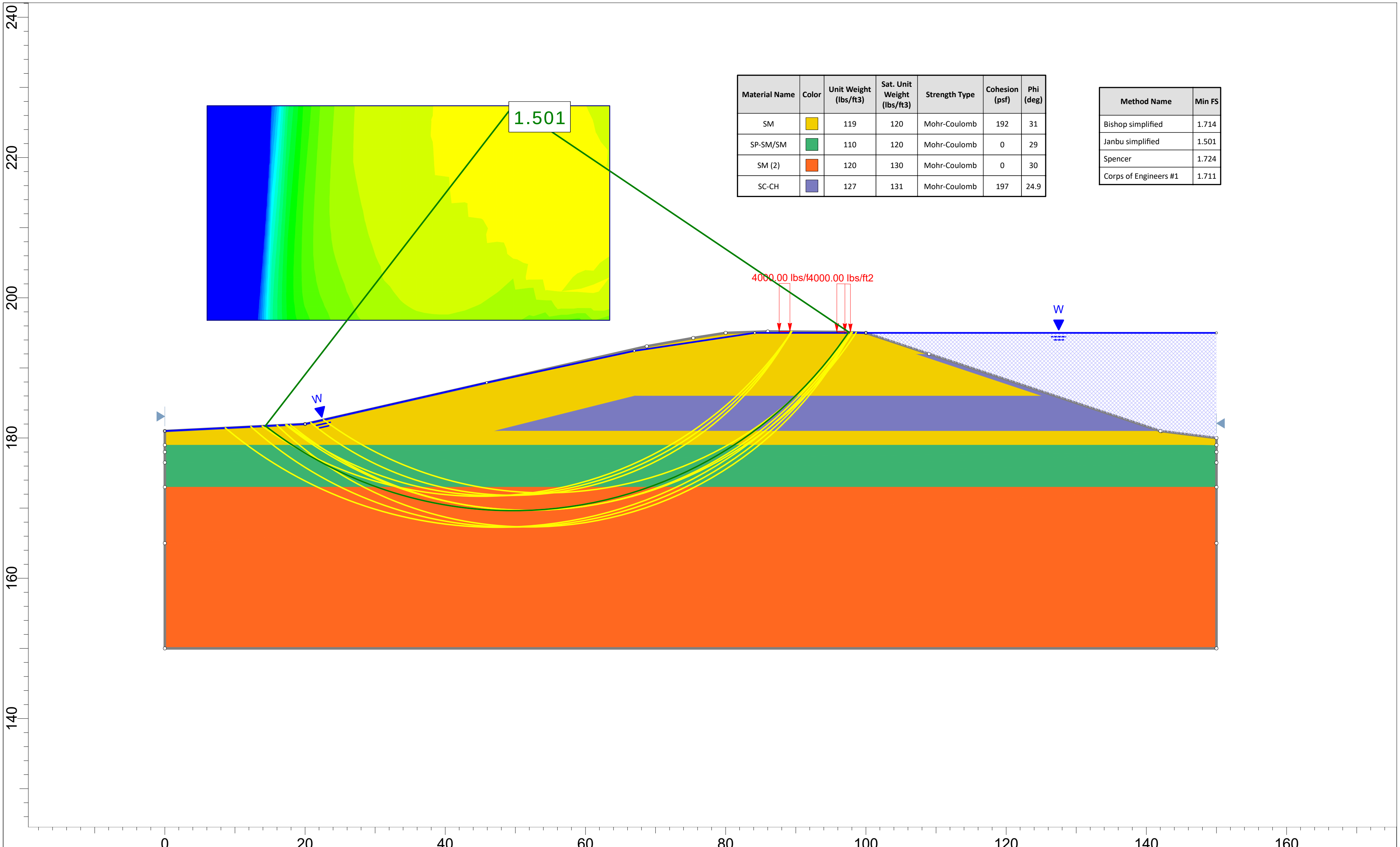
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-4		
Analysis Description	Max Water Elevations		
Drawn By ES/TK	*Scale* 1:227	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B4 Max Water Elevation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SP-SM/SM		110	120	Mohr-Coulomb	0	29
SM (2)		120	130	Mohr-Coulomb	0	30
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.714
Janbu simplified	1.501
Spencer	1.724
Corps of Engineers #1	1.711

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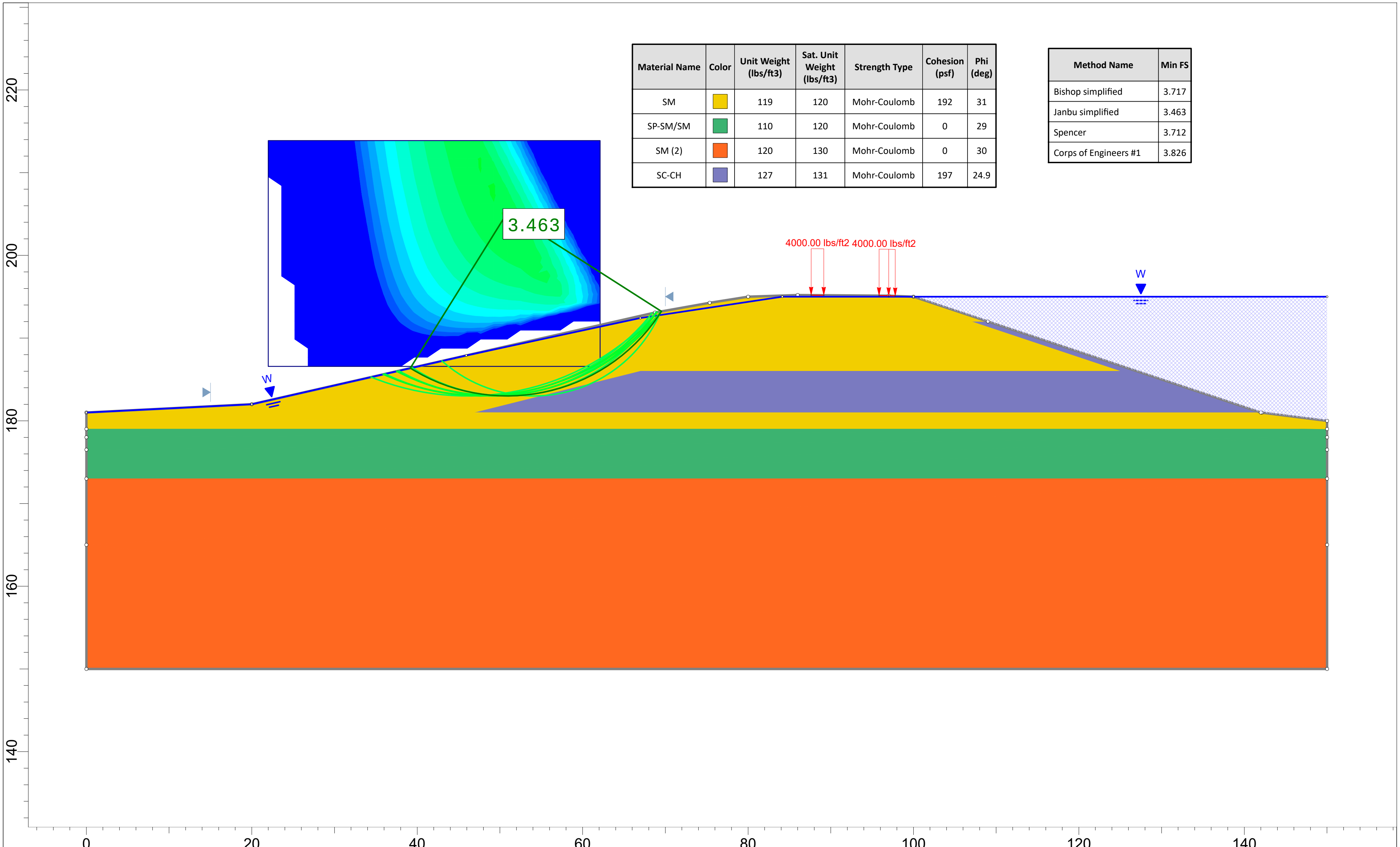
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-4		
Analysis Description	Max Water Elevations		
Drawn By ES/TK	*Scale* 1:227	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B4 Max Water Elevation.slmd



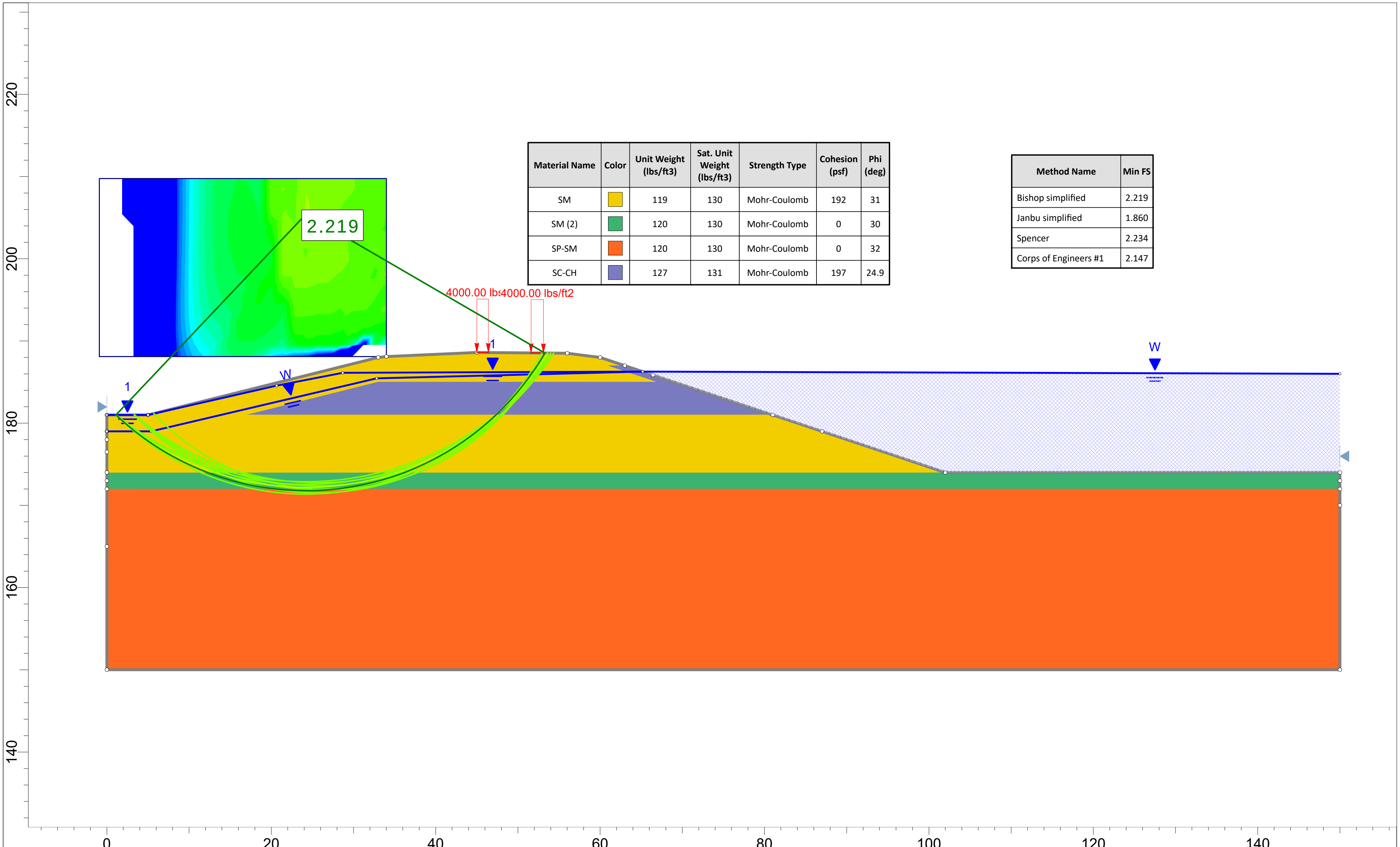
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SP-SM/SM		110	120	Mohr-Coulomb	0	29
SM (2)		120	130	Mohr-Coulomb	0	30
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	3.717
Janbu simplified	3.463
Spencer	3.712
Corps of Engineers #1	3.826

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-4
Analysis Description	Max Water Elevations
Drawn By	ES/TK
Scale	1:193
Company	Universal Engineering Sciences
Date	
File Name	GRU B4 Max Water Elevation Surface.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	2.219
Janbu simplified	1.860
Spencer	2.234
Corps of Engineers #1	2.147

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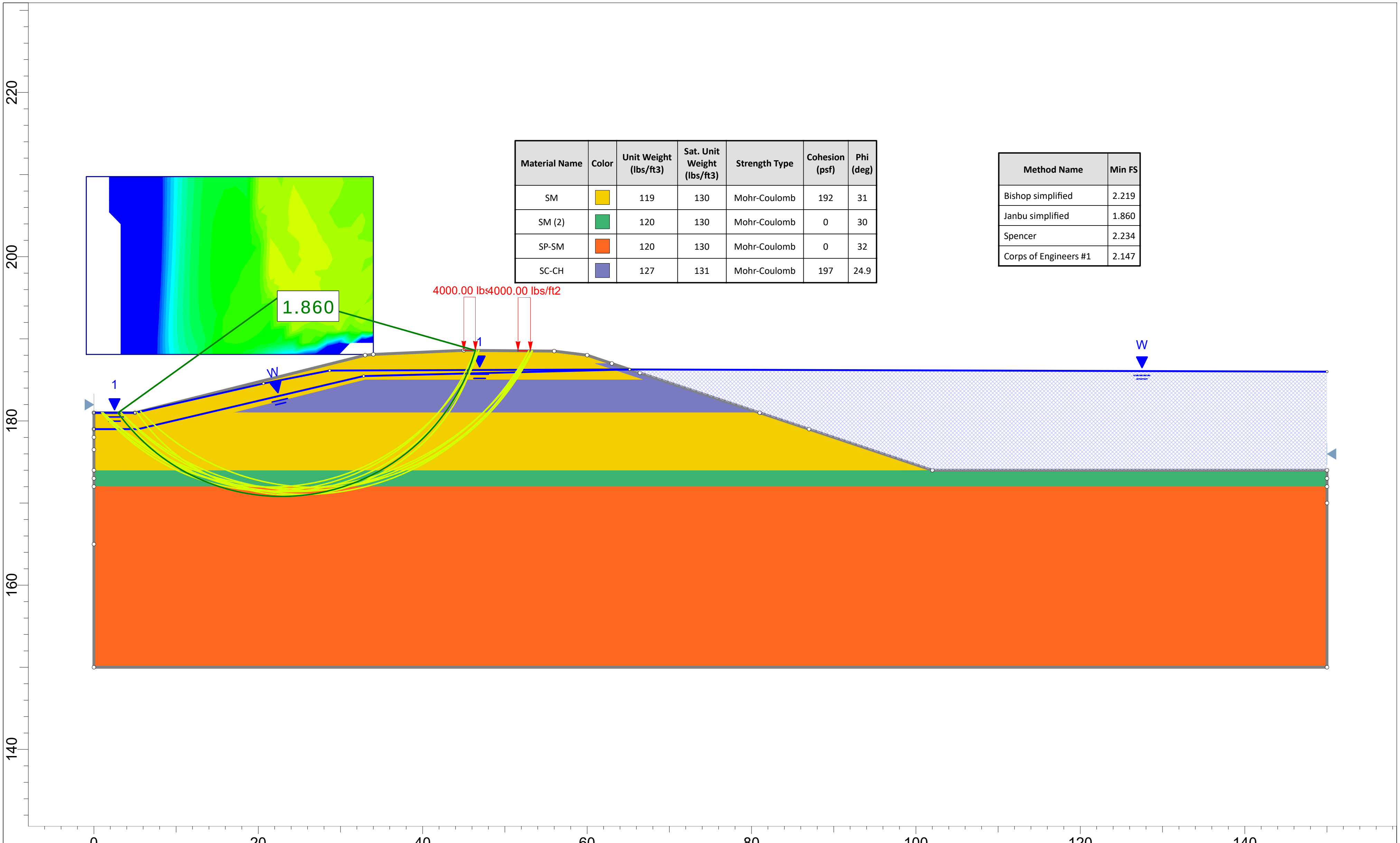
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-5
Analysis Description	Max Operating Levels
Drawn By	ES/TK
Scale	1:194
Company	Universal Engineering Sciences
Date	
File Name	GRU B5 - Max Operating Level.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	2.219
Janbu simplified	1.860
Spencer	2.234
Corps of Engineers #1	2.147

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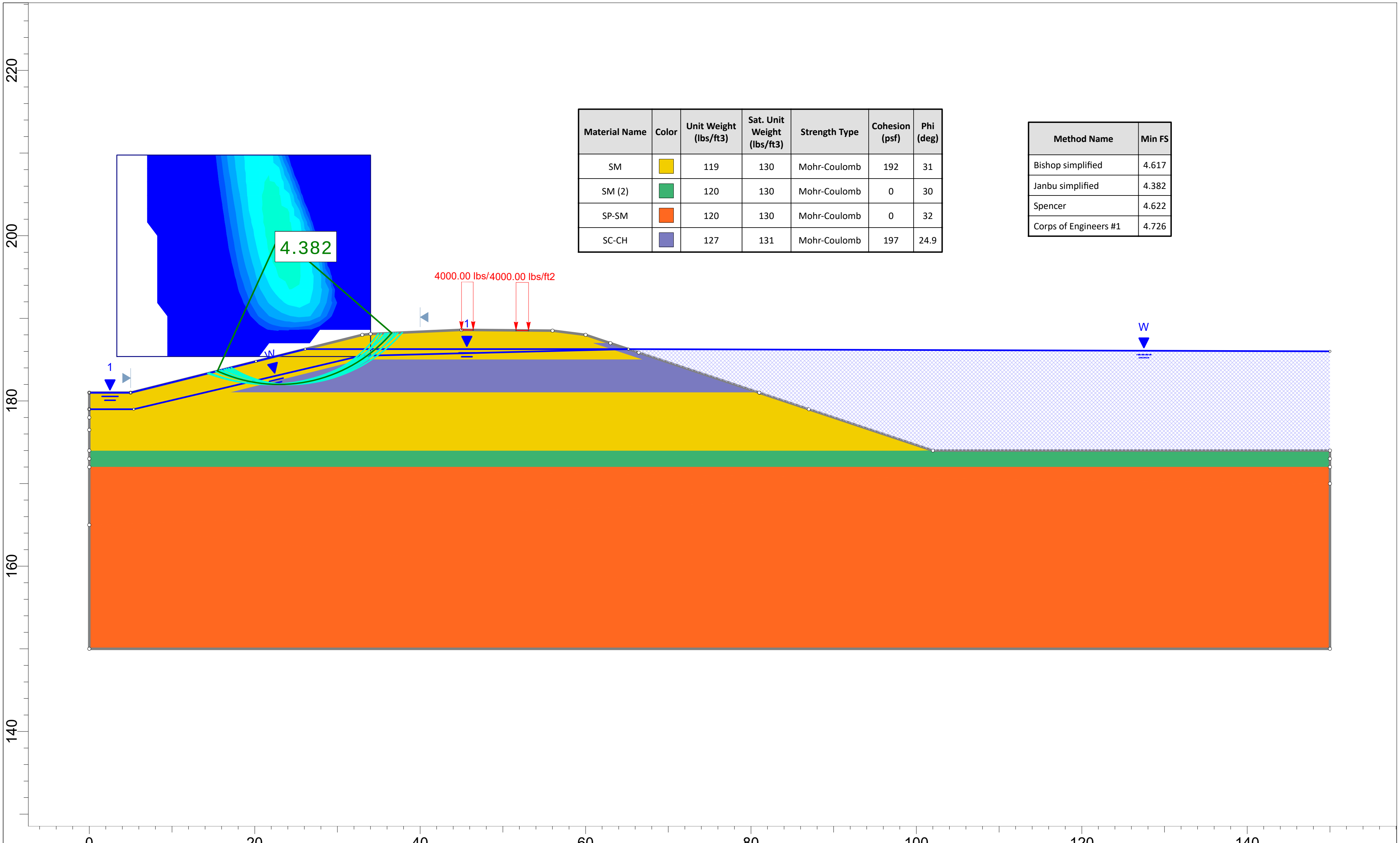
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-5
Analysis Description	Max Operating Levels
Drawn By	ES/TK
Scale	1:194
Company	Universal Engineering Sciences
Date	
File Name	GRU B5 - Max Operating Level.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	4.617
Janbu simplified	4.382
Spencer	4.622
Corps of Engineers #1	4.726

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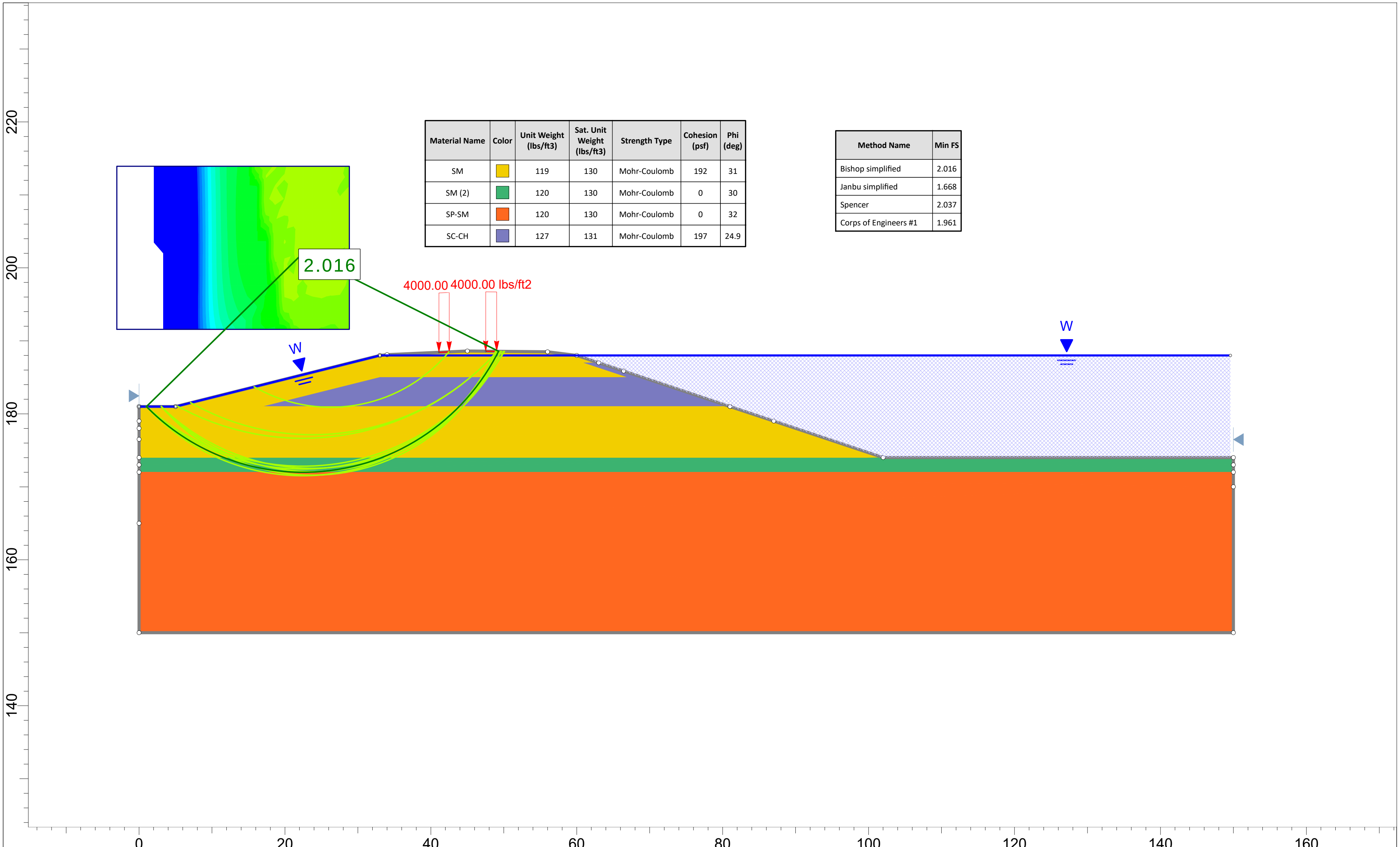
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-5
Analysis Description	Max Operating Levels
Drawn By	ES/TK
Scale	1:193
Company	Universal Engineering Sciences
Date	
File Name	GRU B5 - Max Operating Level Surface.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	2.016
Janbu simplified	1.668
Spencer	2.037
Corps of Engineers #1	1.961

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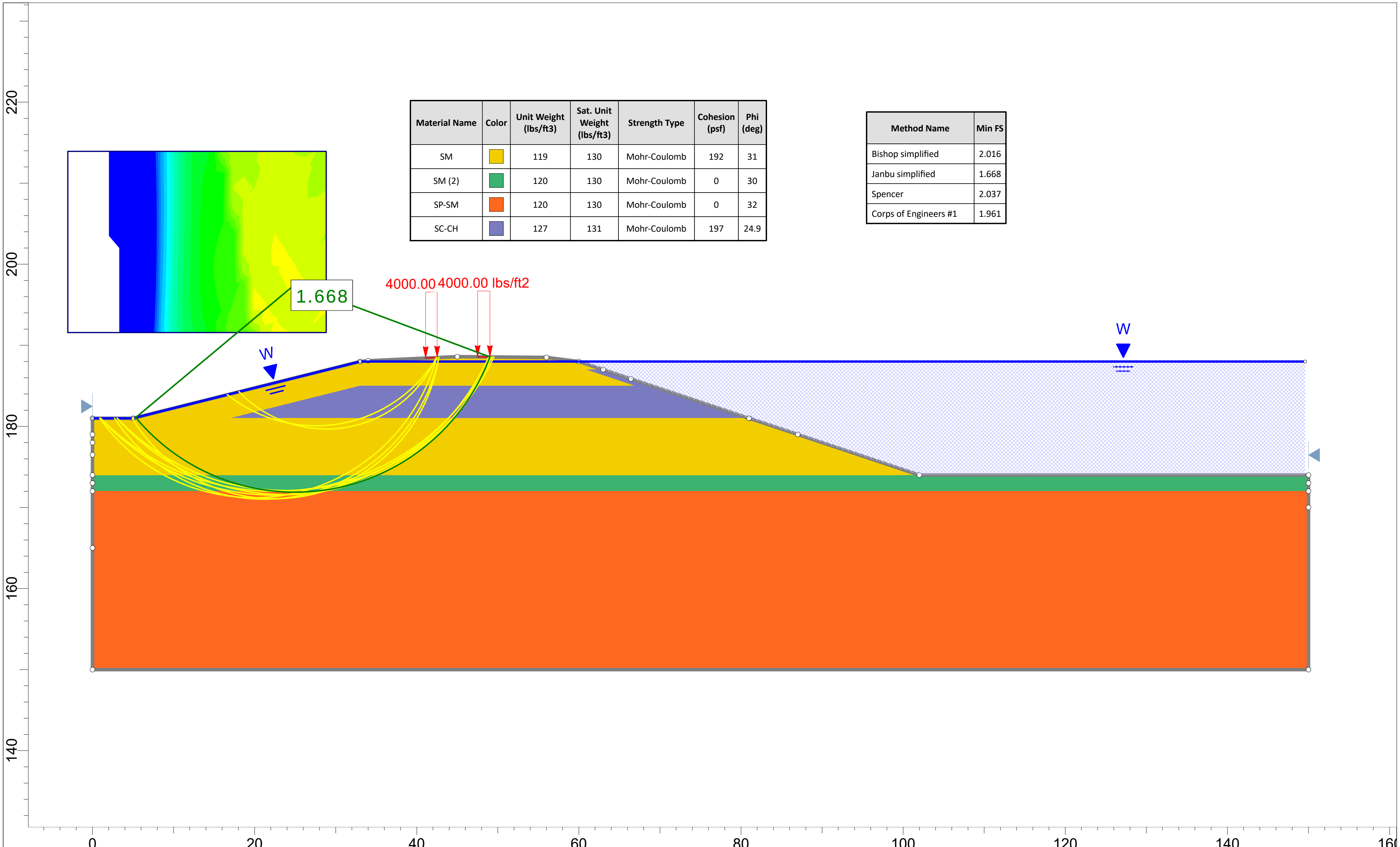
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-5
Analysis Description	Max Water Elevation
Drawn By	ES/TK
Scale	1:218
Company	Universal Engineering Sciences
Date	
File Name	GRU B5 MAx Water Elevation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	2.016
Janbu simplified	1.668
Spencer	2.037
Corps of Engineers #1	1.961

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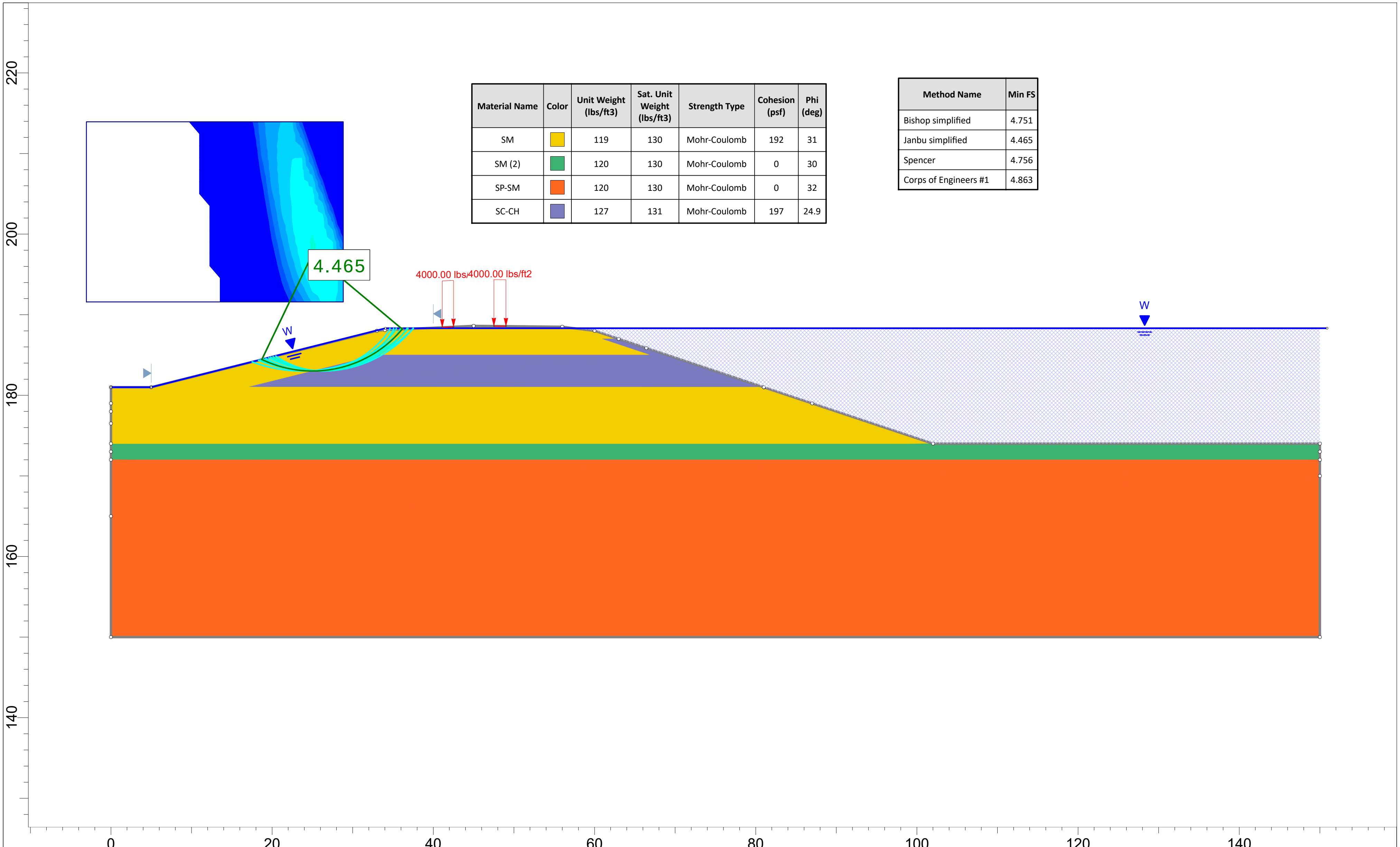
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-5		
Analysis Description	Max Water Elevation		
Drawn By	ES/TK	*Scale* 1:197	*Company* Universal Engineering Sciences
Date		*File Name*	GRU B5 MAx Water Elevation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	4.751
Janbu simplified	4.465
Spencer	4.756
Corps of Engineers #1	4.863

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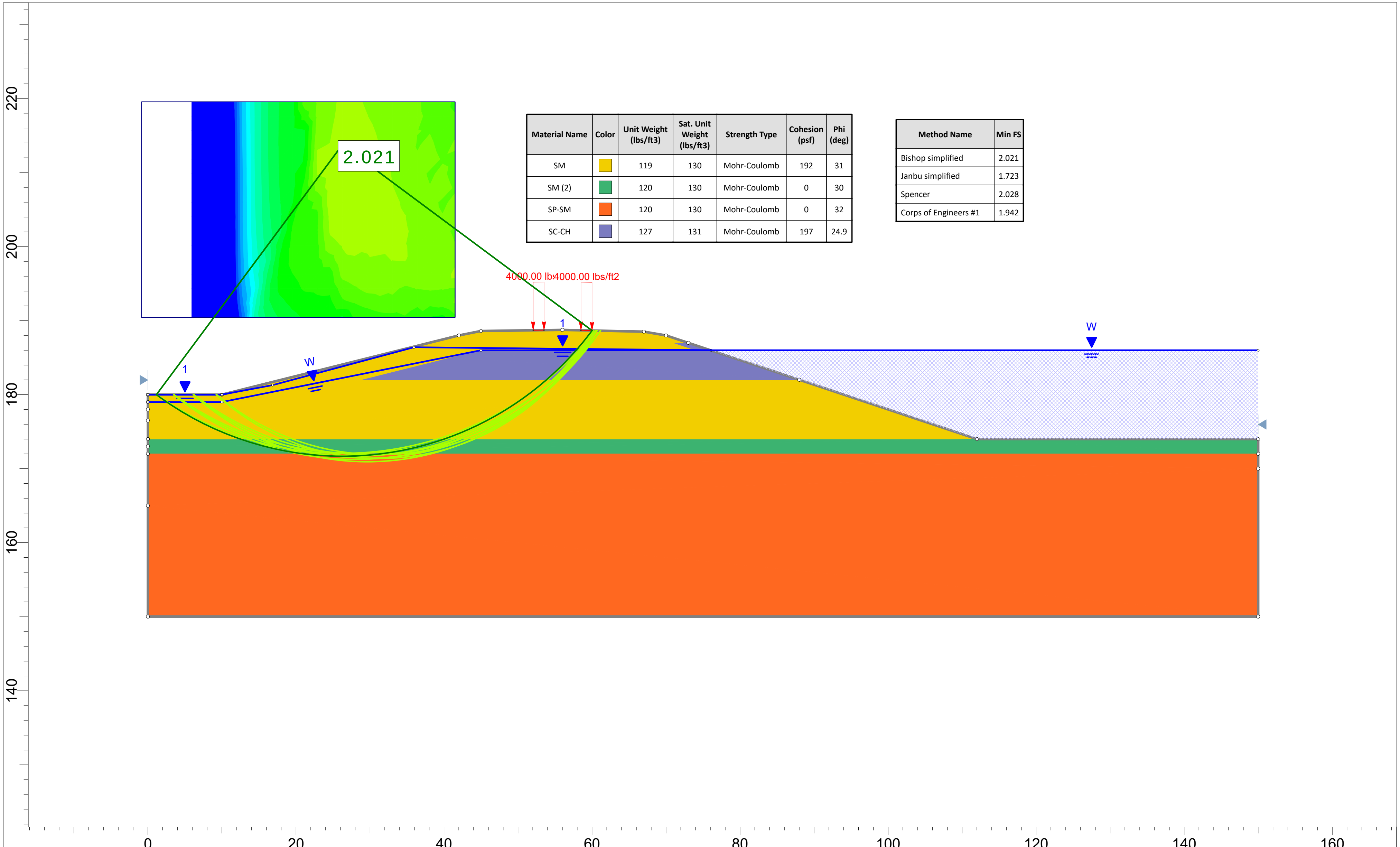
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-5
Analysis Description	Max Water Elevation
Drawn By	ES/TK
Scale	1:198
Company	Universal Engineering Sciences
Date	
File Name	GRU B5 MAx Water Elevation Surface.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	2.021
Janbu simplified	1.723
Spencer	2.028
Corps of Engineers #1	1.942

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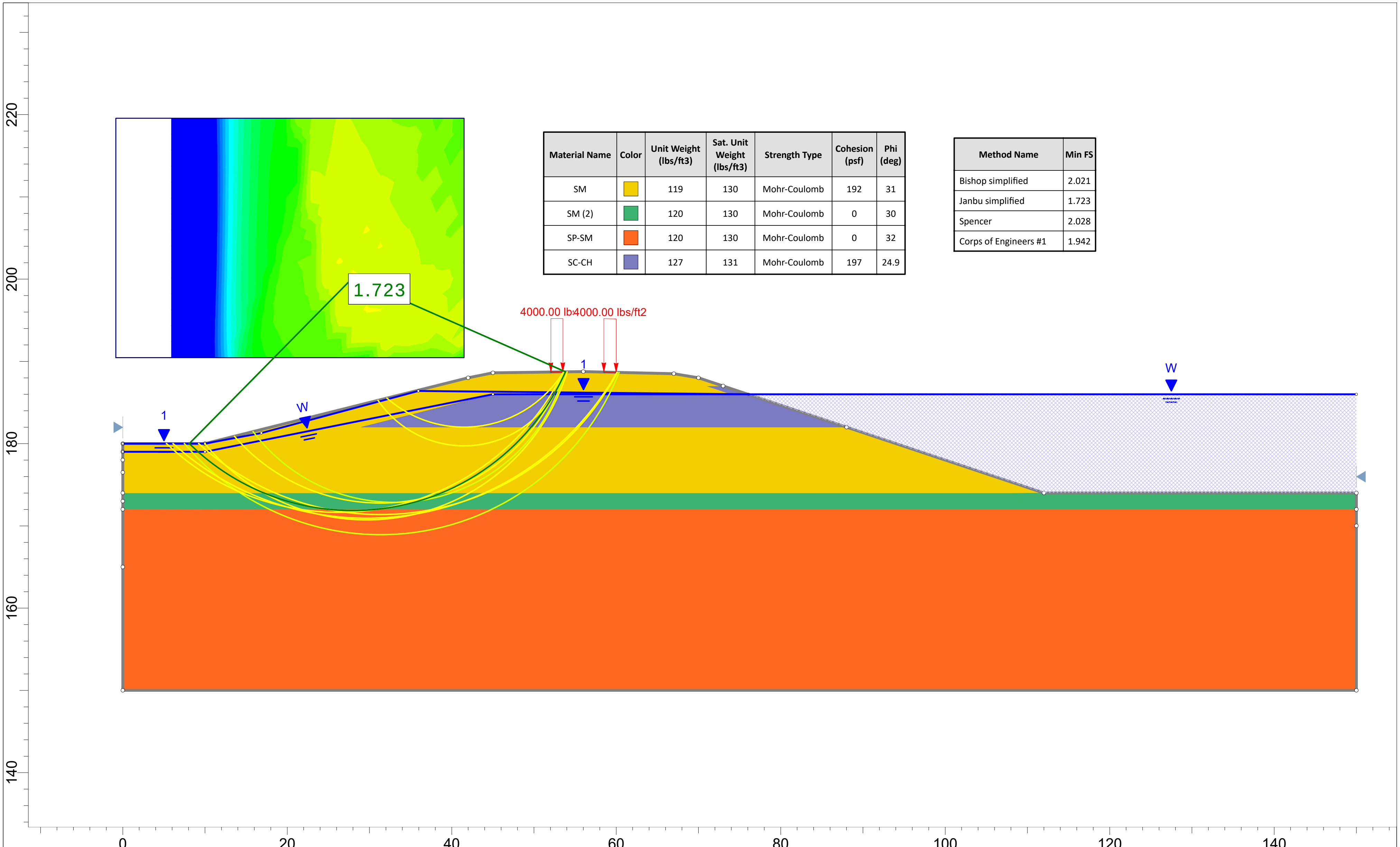
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-6
Analysis Description	Max Operating Levels
Drawn By	ES/TK
Scale	1:215
Company	Universal Engineering Sciences
Date	
File Name	GRU B6 - Max Operating Level.slmd



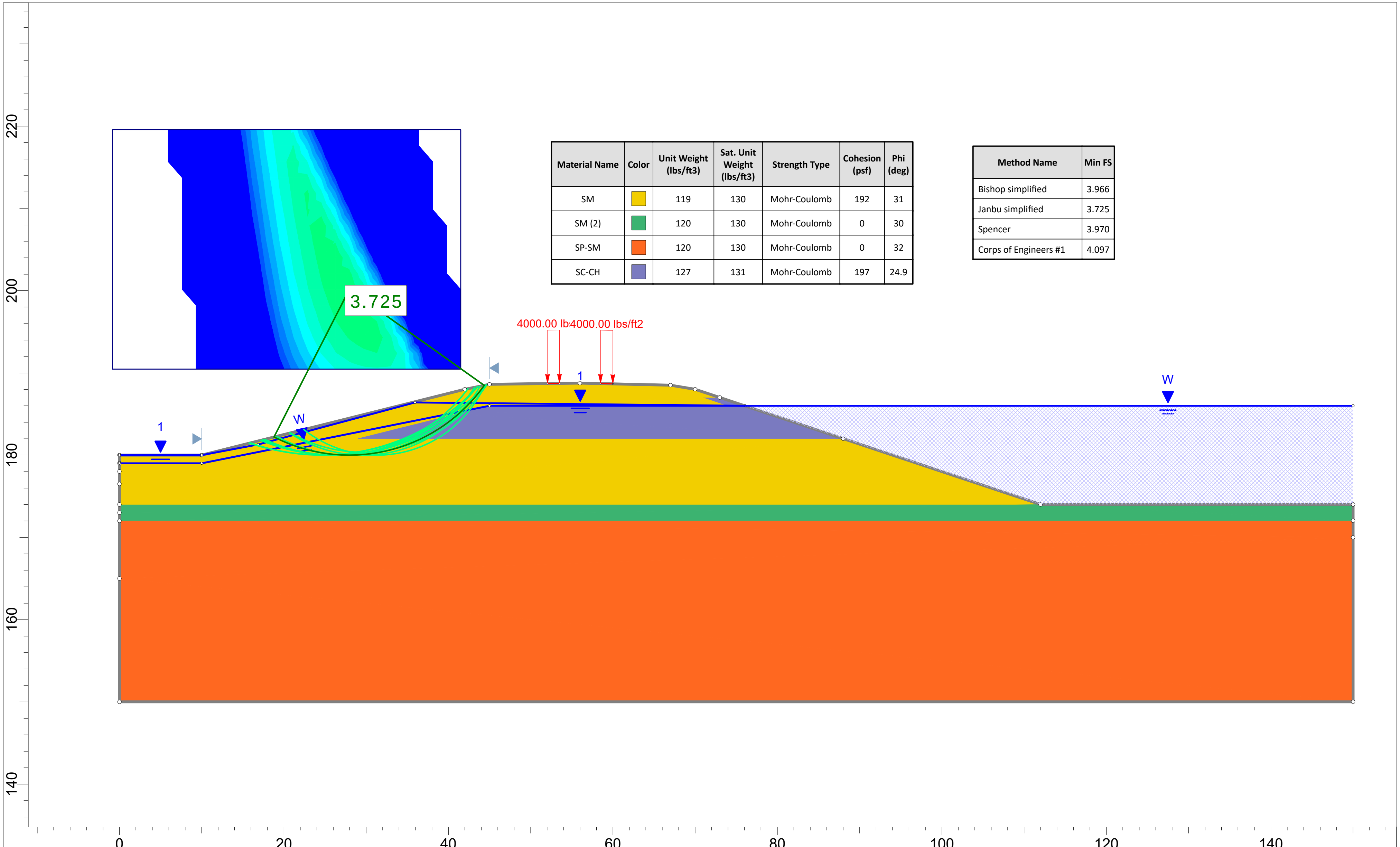
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	2.021
Janbu simplified	1.723
Spencer	2.028
Corps of Engineers #1	1.942

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-6		
Analysis Description	Max Operating Levels		
Drawn By	ES/TK	Scale	1:194
Company	Universal Engineering Sciences		
Date		File Name	GRU B6 - Max Operating Level.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	3.966
Janbu simplified	3.725
Spencer	3.970
Corps of Engineers #1	4.097

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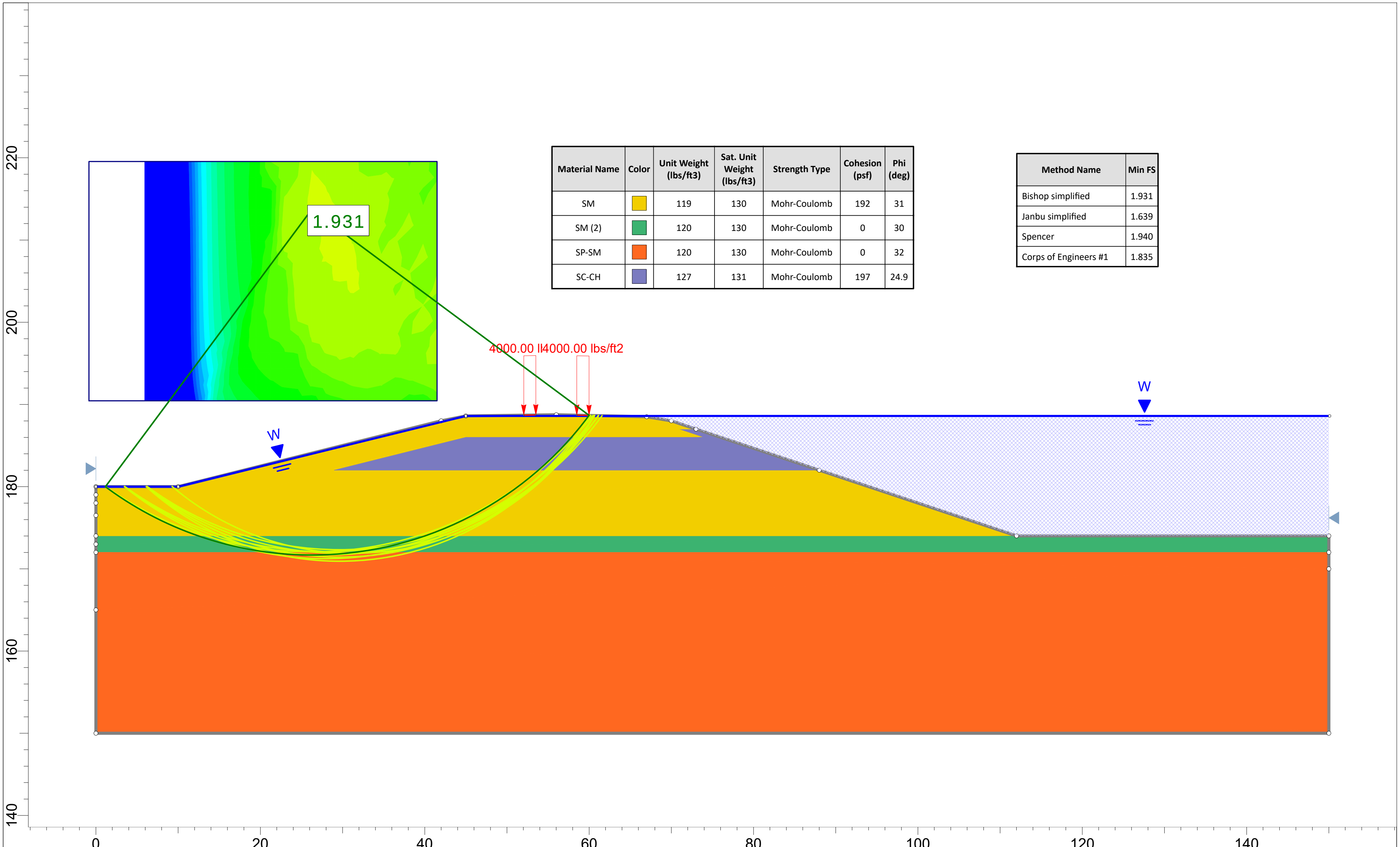
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-6
Analysis Description	Max Operating Levels
Drawn By	ES/TK
Scale	1:194
Company	Universal Engineering Sciences
Date	
File Name	GRU B6 - Max Operating Level Surface.slmd



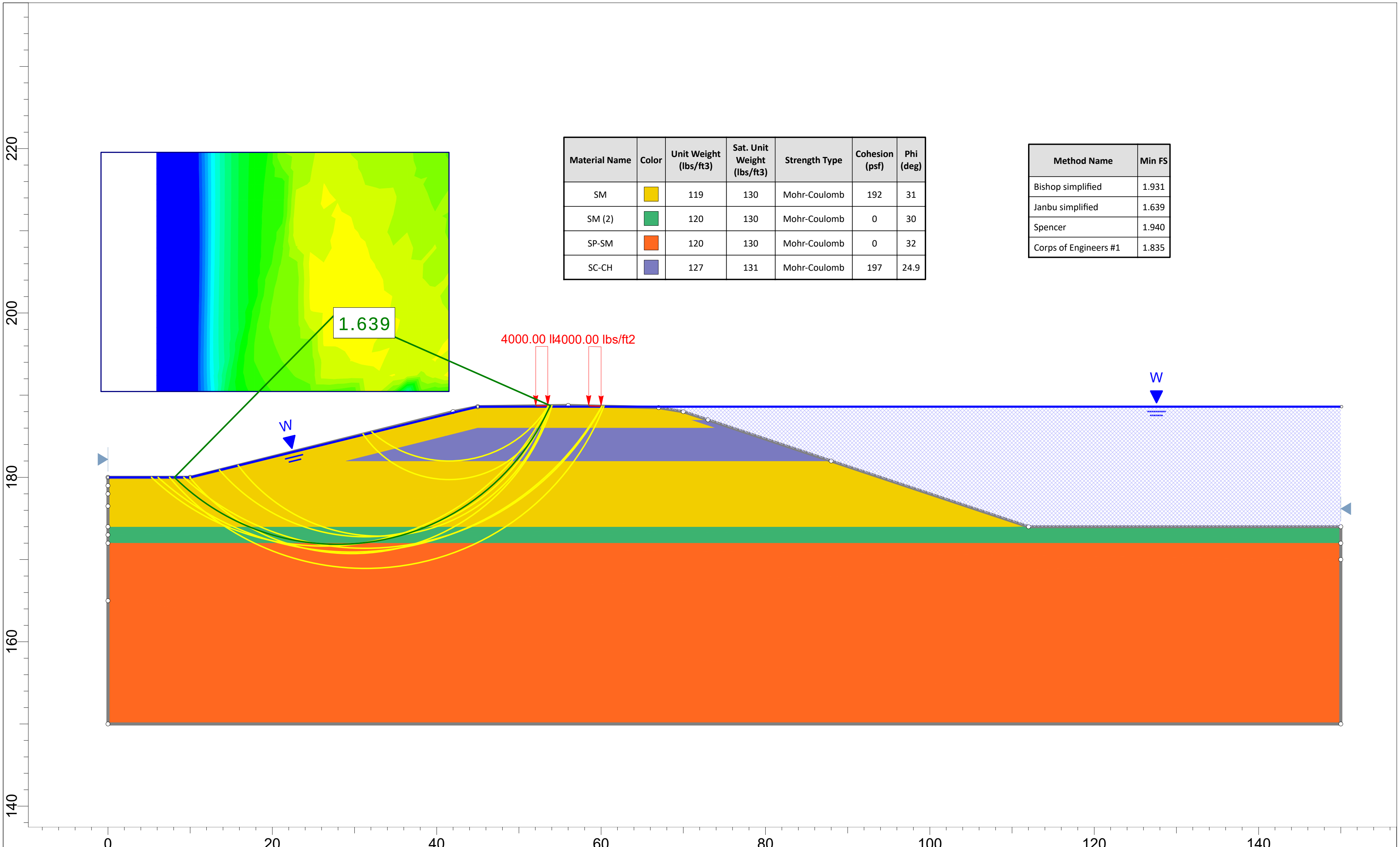
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.931
Janbu simplified	1.639
Spencer	1.940
Corps of Engineers #1	1.835

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-6		
Analysis Description	Max Water Elevation		
Drawn By ES/TK	*Scale* 1:194	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B6 Max Water Elevation.slmd



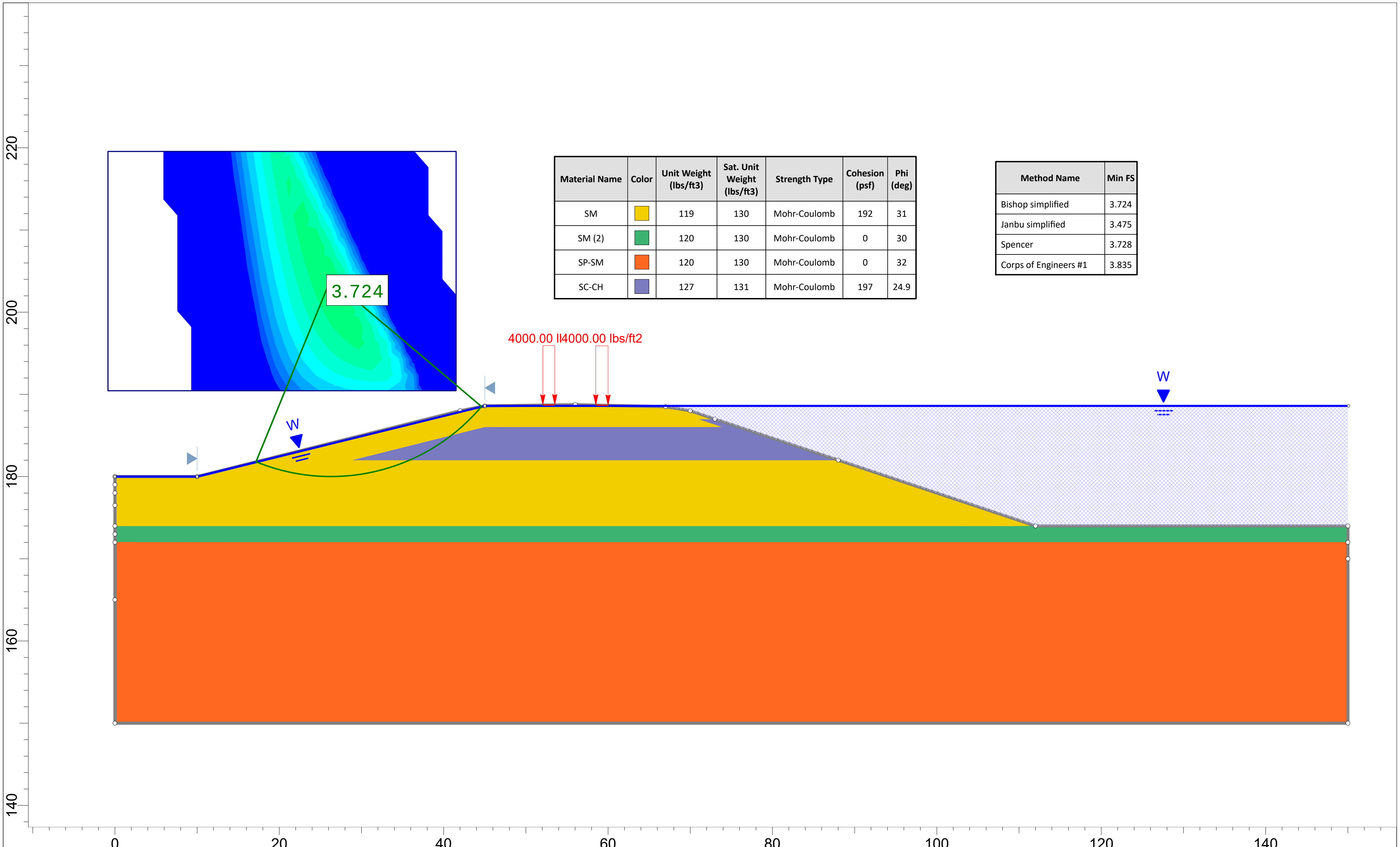
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.931
Janbu simplified	1.639
Spencer	1.940
Corps of Engineers #1	1.835

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-6
Analysis Description	Max Water Elevation
Drawn By	ES/TK
Scale	1:194
Company	Universal Engineering Sciences
Date	
File Name	GRU B6 Max Water Elevation.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	3.724
Janbu simplified	3.475
Spencer	3.728
Corps of Engineers #1	3.835

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-6
Analysis Description	Max Water Elevation
Drawn By	ES/TK
Scale	1:194
Company	Universal Engineering Sciences
Date	
File Name	GRU B6 Max Water Elevation Surface.slmd

SLOPE STABILITY ANALYSIS

Soil Parameters

Soil strength parameters were obtained from laboratory testing performed on representative samples taken from the project site. Below is a summary of the soil materials properties and strength parameters for the layer units at the DGS process ponds project site.

Medium dense Silty Sand Ỹr=119 pcf			
Analysis	Type	Unit	Value
Un-Drained	Cohesion Intercept	PSF	192
Lab Testing Triaxial Test	Friction angle	Degree	31

Medium dense Very Clayey Sand Ỹr=127 pcf			
Analysis	Type	Unit	Value
Un-Drained	Cohesion Intercept	PSF	197
Lab Testing Triaxial Test	Friction angle	Degree	24.9

Medium dense Silty Sand * Ỹr=118 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	175
Lab Testing Direct Shear Test	Friction angle	Degree	31.1

Medium dense Silty-Clayey Sand * Ỹr=120 pcf			
Analysis	Type	Unit	Value
Undrained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	30

Loose Sand with silt Ỹr=110 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	29

Medium dense Sand with silt Ỹr=120 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	32

Medium dense Silty Sand Ỹr=120 pcf			
Analysis	Type	Unit	Value
Drained	Cohesion Intercept	PSF	0
FHWA manual	Friction angle	Degree	30

Static Safety Factor/Maximum Surcharge Pool Loading Condition(Top of Embankment)					
Section/Boring	Process Pond	Pond Liquid Elevation (ft, NGVD)	Global-Bishop	Global - Jambu	Surface
B-1	Ash Cell #1	195	1.704	1.511	2.916
B-2	Ash Cell #2	195	1.867	1.643	4.618
B-3	Ash Cell #2	195	1.734	1.536	3.222
B-4	Ash Cell #2	195	1.714	1.501	3.463
B-5	Pump Back Cell #1	188	2.016	1.668	4.465
B-6	Pump Back Cell #1	188	1.931	1.639	3.724

Static Safety Factor/Long-Term, Maximum Storage Pool Loading Condition(Max Operating levels)					
Section/Boring	Process Pond	Pond Liquid Elevation (ft, NGVD)	Global-Bishop	Global - Jambu	Surface
B-1	Ash Cell #1	193	2.034	1.784	3.967
B-2	Ash Cell #2	193	1.890	1.665	3.777
B-3	Ash Cell #2	193	2.046	1.779	4.219
B-4	Ash Cell #2	193	1.763	1.542	3.730
B-5	Pump Back Cell #1	186	2.219	1.860	4.382
B-6	Pump Back Cell #1	186	2.021	1.723	3.725

APPENDIX E

SEISMIC STABILITY ANALYSIS

ATC Hazards by Location

Search Information

Coordinates: 29.76573923, -82.39221458

Elevation: 194 ft

Timestamp: 2021-01-13T21:09:10.666Z

Hazard Type: Seismic

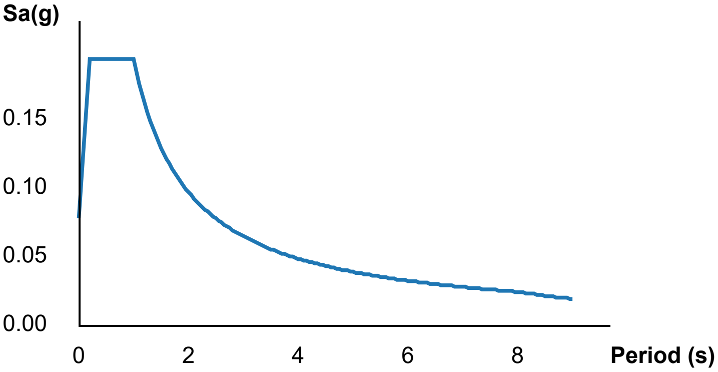
Reference Document: NEHRP-2015

Risk Category: II

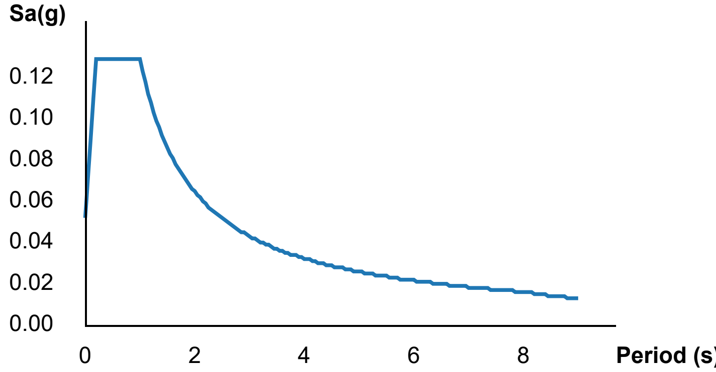
Site Class: E

Map data ©2021 Imagery ©2021 , Landsat / Copernicus, Maxar Technologies, U.S. Geological Survey

MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.078	MCE_R ground motion (period=0.2s)
S_1	0.046	MCE_R ground motion (period=1.0s)
S_{MS}	0.188	Site-modified spectral acceleration value
S_{M1}	0.194	Site-modified spectral acceleration value
S_{DS}	0.126	Numeric seismic design value at 0.2s SA
S_{D1}	0.129	Numeric seismic design value at 1.0s SA

▾Additional Information

Name	Value	Description
SDC	B	Seismic design category
F_a	2.4	Site amplification factor at 0.2s
F_v	4.2	Site amplification factor at 1.0s
CR_S	0.914	Coefficient of risk (0.2s)

CR_1	0.89	Coefficient of risk (1.0s)
PGA	0.037	MCE_G peak ground acceleration
F_{PGA}	2.4	Site amplification factor at PGA
PGA_M	0.09	Site modified peak ground acceleration
T_L	8	Long-period transition period (s)
SsRT	0.078	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.086	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.046	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.052	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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GRU Deerhaven Impoundment

Latitude, Longitude: 29.76573923, -82.39221458

Date	1/13/2021, 3:58:00 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	E - Soft Clay Soil

Type	Value	Description
S_S	0.078	MCE_R ground motion. (for 0.2 second period)
S_1	0.046	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.188	Site-modified spectral acceleration value
S_{M1}	0.194	Site-modified spectral acceleration value
S_{DS}	0.126	Numeric seismic design value at 0.2 second SA
S_{D1}	0.129	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	B	Seismic design category
F_a	2.4	Site amplification factor at 0.2 second
F_v	4.2	Site amplification factor at 1.0 second
PGA	0.037	MCE_G peak ground acceleration
F_{PGA}	2.4	Site amplification factor at PGA
PGA_M	0.09	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	0.078	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.086	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.046	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.052	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.914	Mapped value of the risk coefficient at short periods
C_{R1}	0.89	Mapped value of the risk coefficient at a period of 1 s

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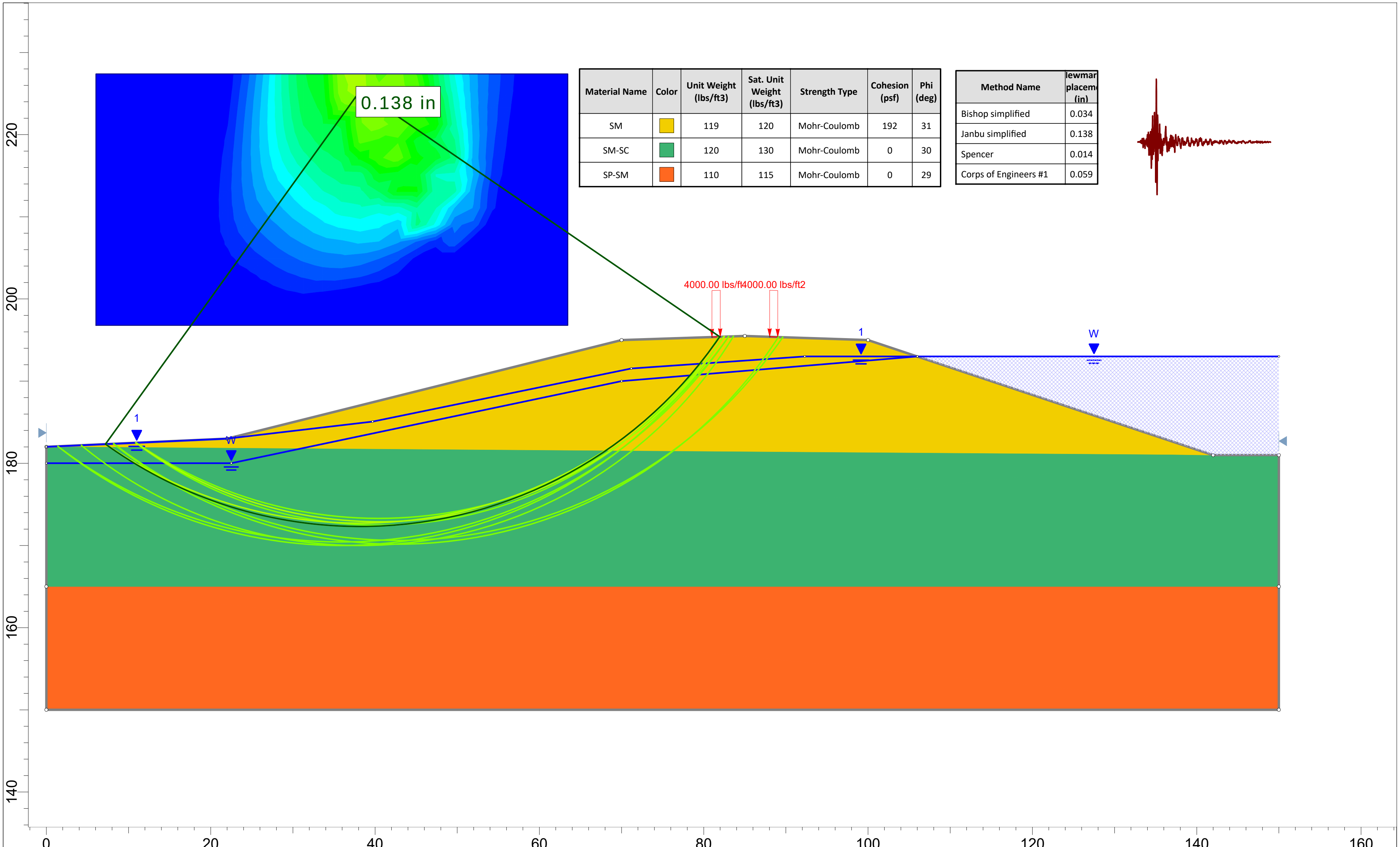


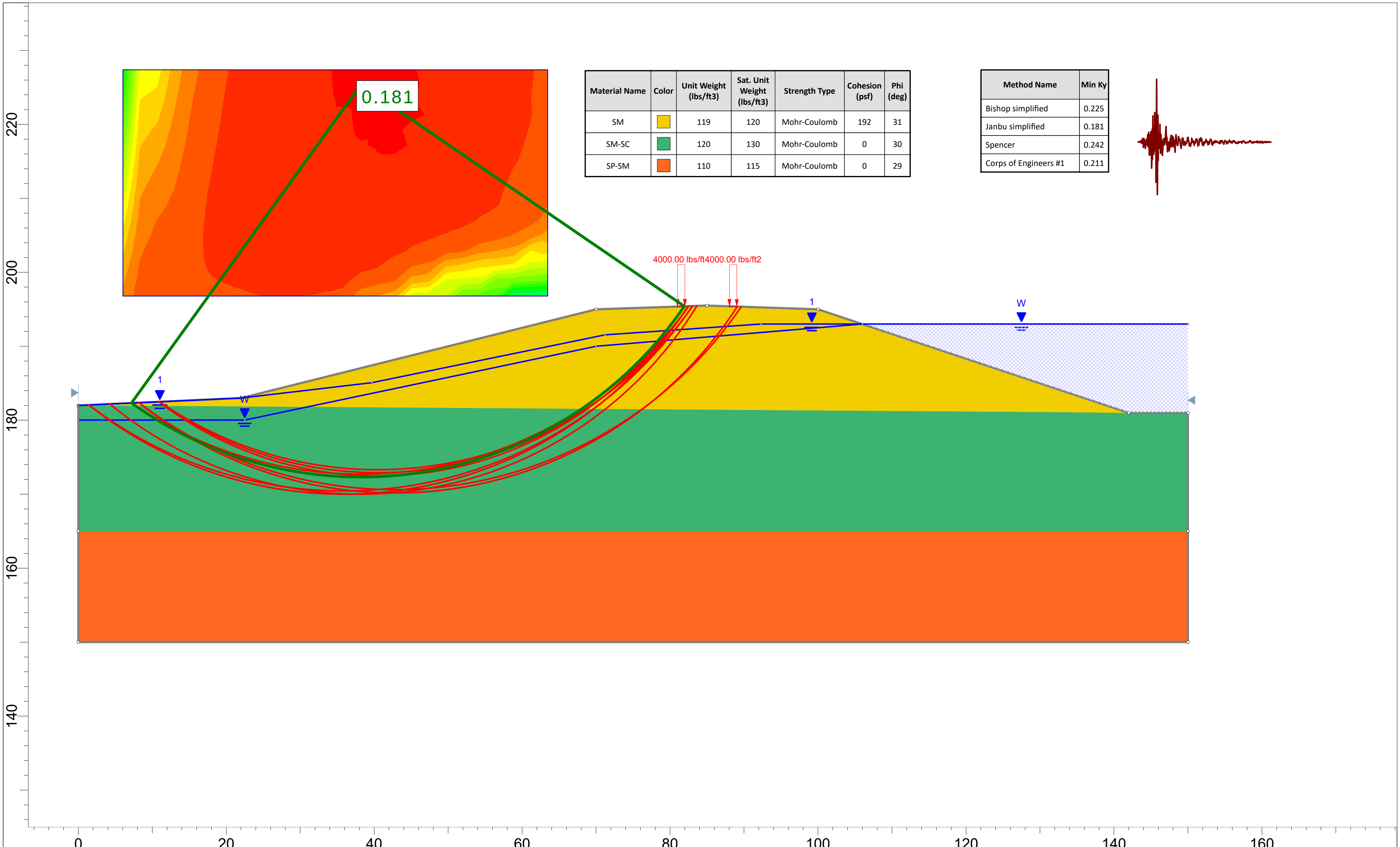
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	115	Mohr-Coulomb	0	29

Method Name	lewmar placem (in)
Bishop simplified	0.034
Janbu simplified	0.138
Spencer	0.014
Corps of Engineers #1	0.059

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-1
Analysis Description	Max Operating Levels
Drawn By	ES/TK
Scale	1:194
Company	Universal Engineering Sciences
Date	
File Name	GRU B1 Max Operating Level Seismic.slmd



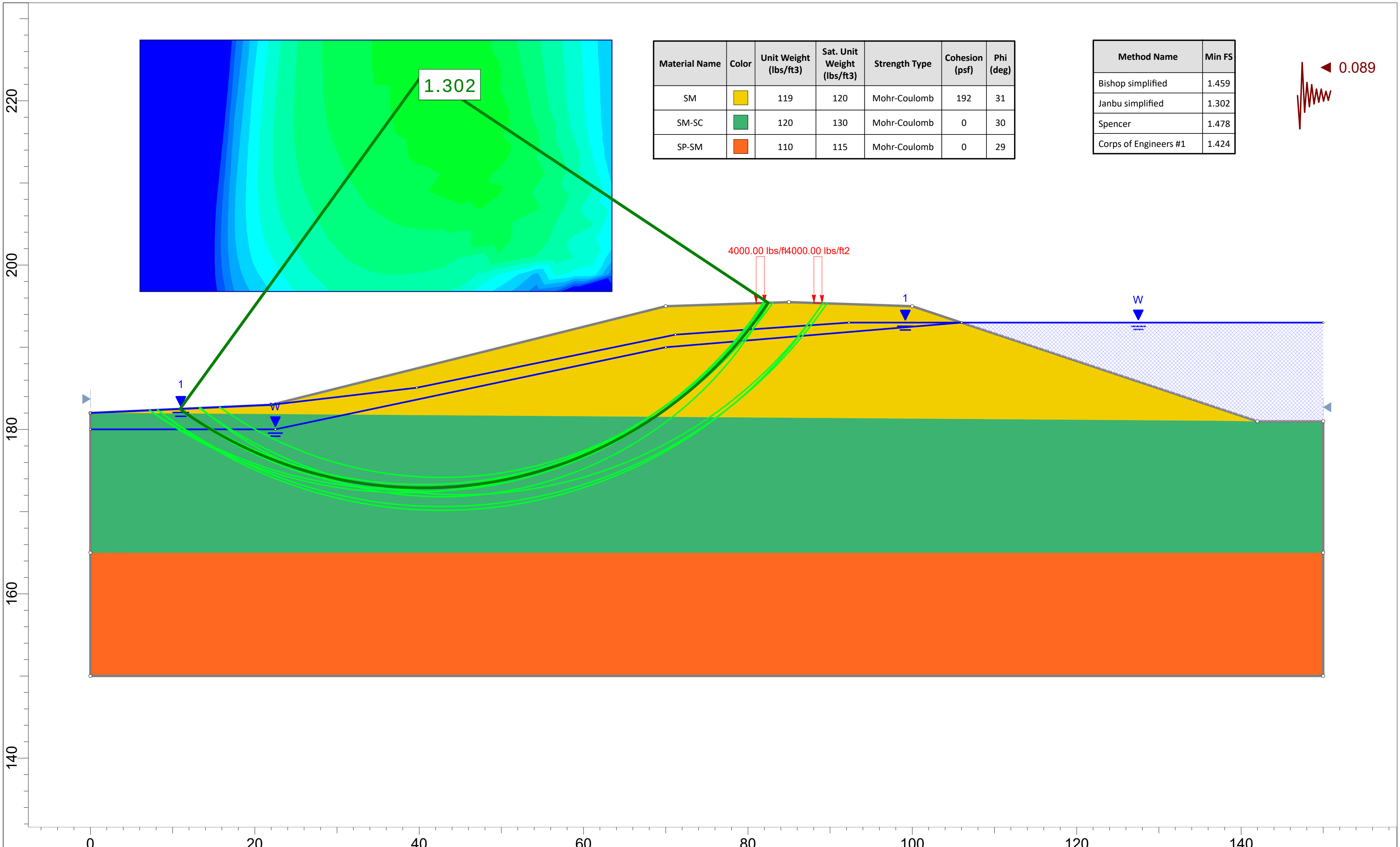
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	115	Mohr-Coulomb	0	29

Method Name	Min Ky
Bishop simplified	0.225
Janbu simplified	0.181
Spencer	0.242
Corps of Engineers #1	0.211

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-1		
Analysis Description	Max Operating Levels		
Drawn By ES/TK	*Scale* 1:215	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B1 Max Operating Level Seismic.slmd



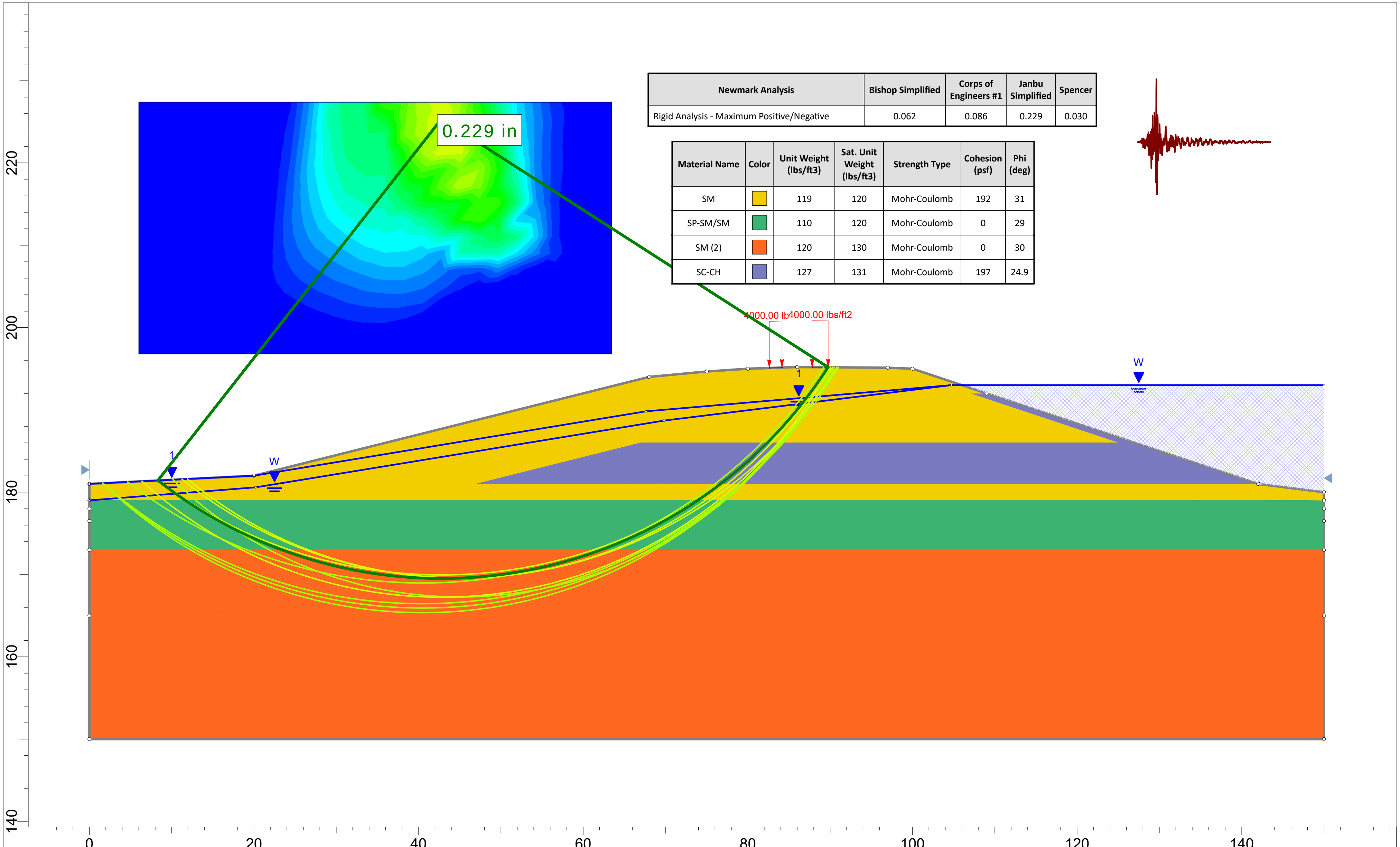
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SM-SC		120	130	Mohr-Coulomb	0	30
SP-SM		110	115	Mohr-Coulomb	0	29

Method Name	Min FS
Bishop simplified	1.459
Janbu simplified	1.302
Spencer	1.478
Corps of Engineers #1	1.424

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-1		
Analysis Description	Max Operating Levels		
Drawn By ES/TK	*Scale* 1:194	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B1 Max Operating Level Seismic.slmd



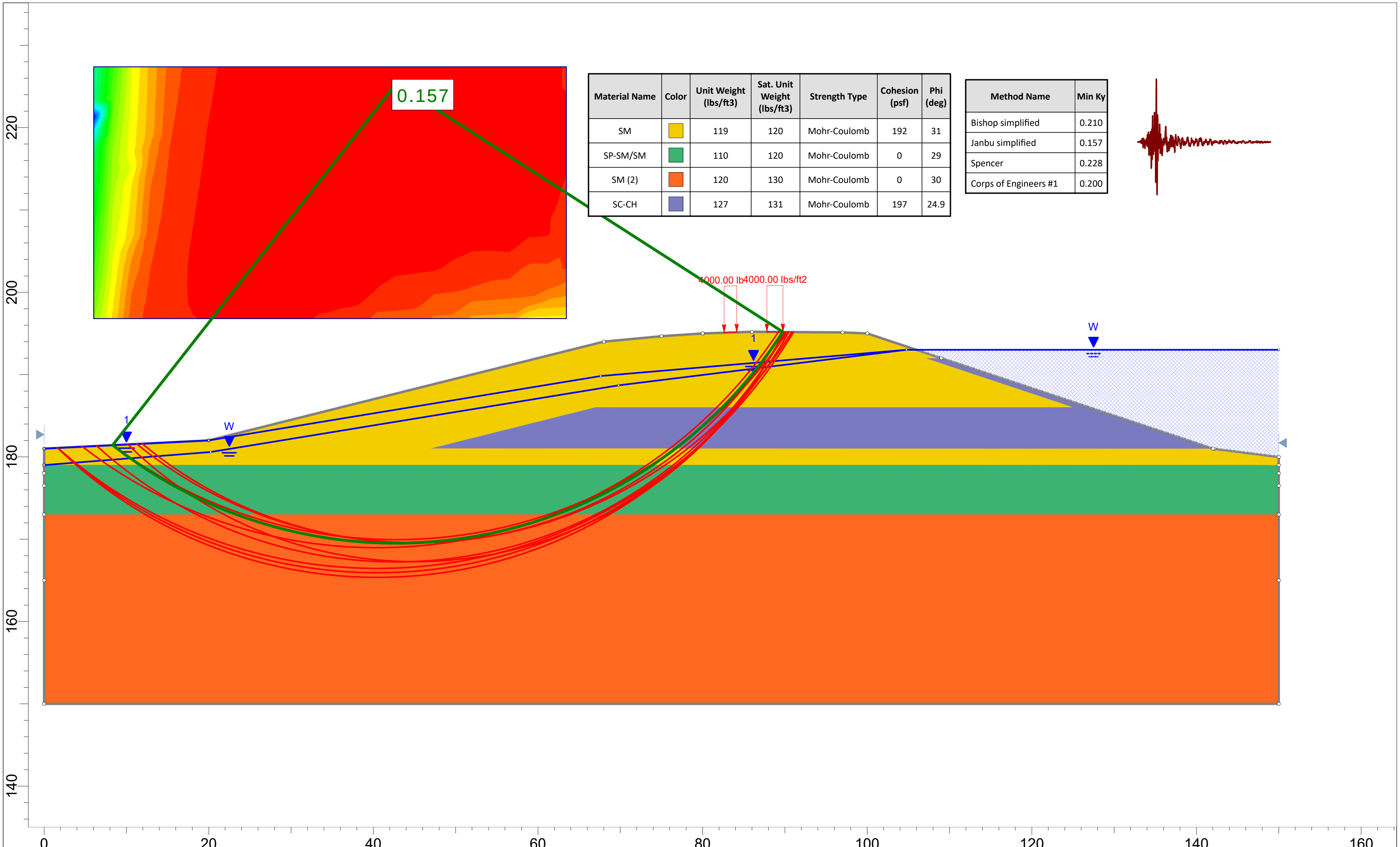
Newmark Analysis	Bishop Simplified	Corps of Engineers #1	Janbu Simplified	Spencer
Rigid Analysis - Maximum Positive/Negative	0.062	0.086	0.229	0.030

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SP-SM/SM		110	120	Mohr-Coulomb	0	29
SM (2)		120	130	Mohr-Coulomb	0	30
SC-CH		127	131	Mohr-Coulomb	197	24.9

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-4
Analysis Description	Max Operating Levels
Drawn By	ES/TK
Scale	1:194
Company	Universal Engineering Sciences
Date	
File Name	GRU B4 - Max Operating Level Seismic.slmd



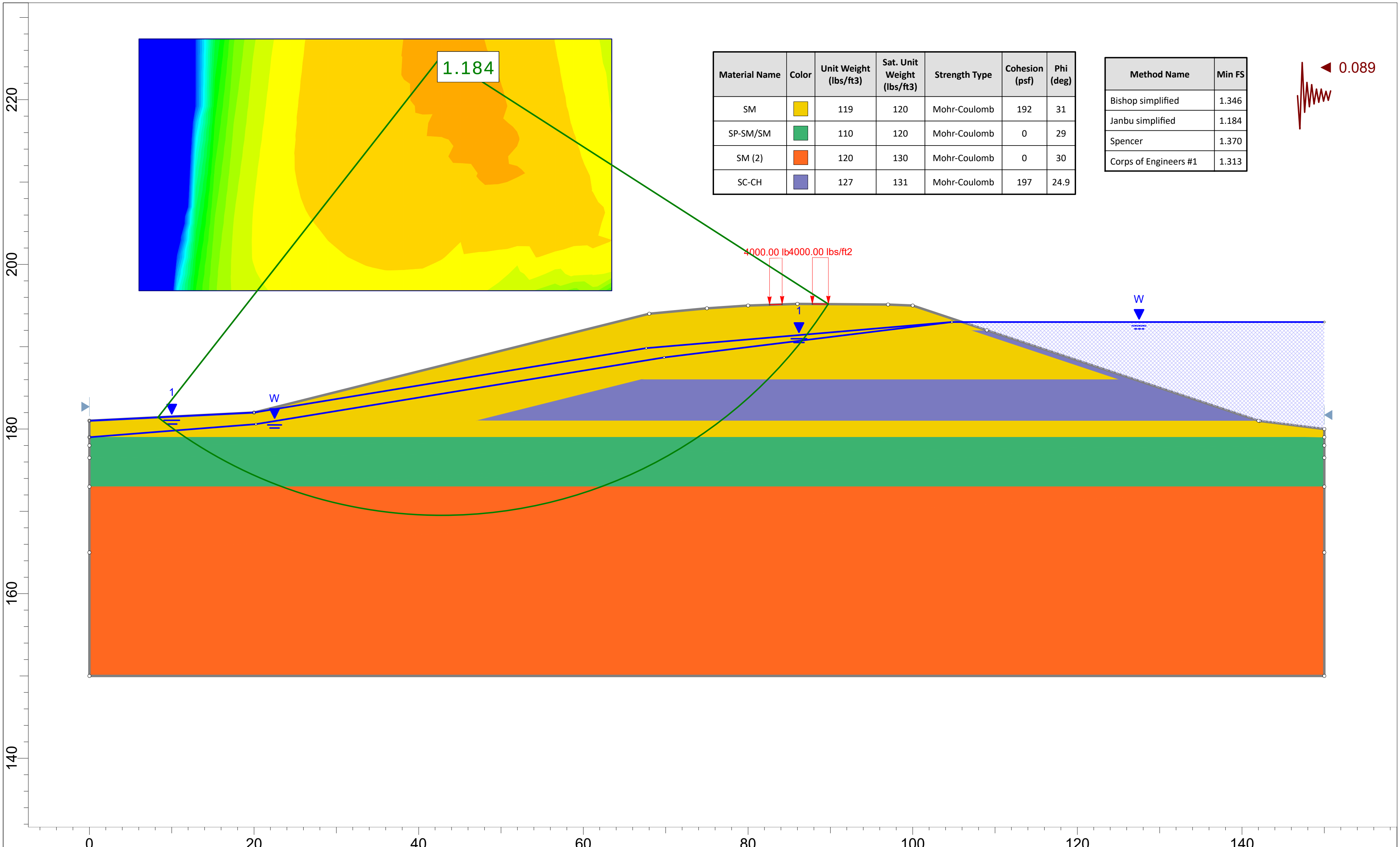
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SP-SM/SM		110	120	Mohr-Coulomb	0	29
SM (2)		120	130	Mohr-Coulomb	0	30
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min Ky
Bishop simplified	0.210
Janbu simplified	0.157
Spencer	0.228
Corps of Engineers #1	0.200

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-4
Analysis Description	Max Operating Levels
Drawn By	ES/TK
Scale	1:194
Company	Universal Engineering Sciences
Date	
File Name	GRU B4 - Max Operating Level Seismic.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	120	Mohr-Coulomb	192	31
SP-SM/SM		110	120	Mohr-Coulomb	0	29
SM (2)		120	130	Mohr-Coulomb	0	30
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.346
Janbu simplified	1.184
Spencer	1.370
Corps of Engineers #1	1.313

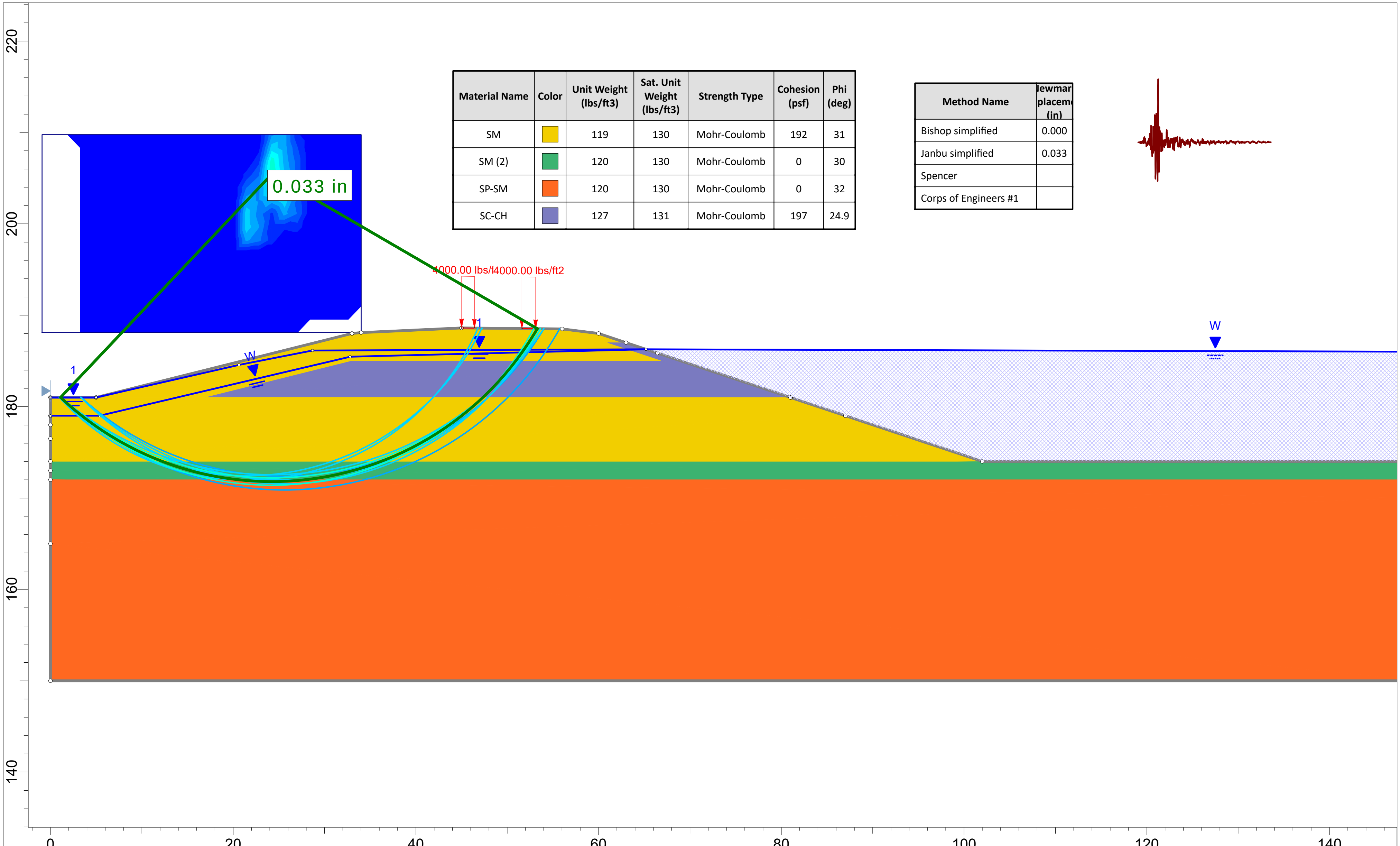
rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-4		
Analysis Description	Max Operating Levels		
Drawn By	ES/TK	*Scale* 1:194	*Company* Universal Engineering Sciences
Date		*File Name*	GRU B4 - Max Operating Level Seismic.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	lewmar placem (in)
Bishop simplified	0.000
Janbu simplified	0.033
Spencer	
Corps of Engineers #1	



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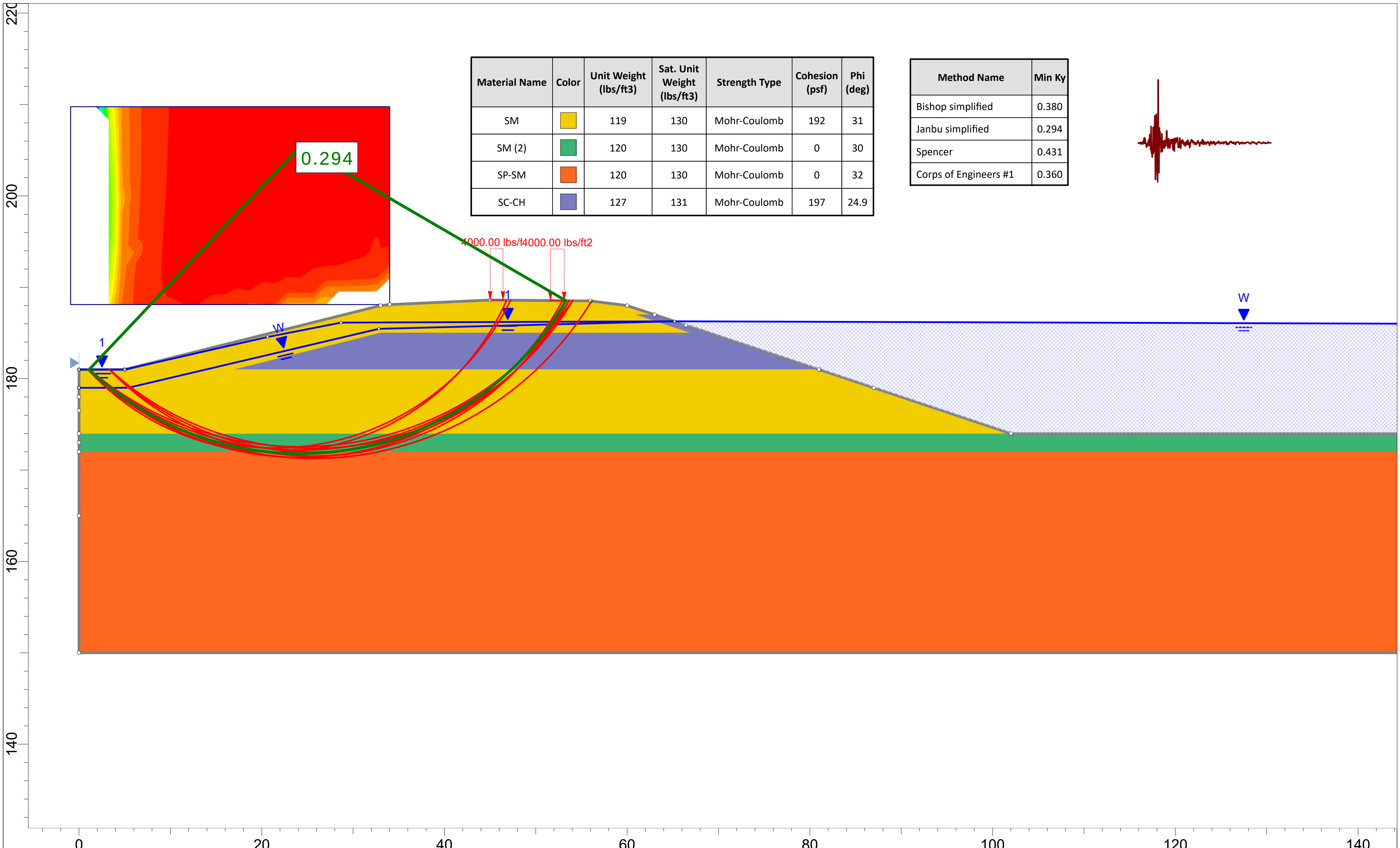
SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-5		
Analysis Description	Max Operating Levels		
Drawn By	ES/TK	*Scale* 1:174	*Company* Universal Engineering Sciences
Date		*File Name*	GRU B5 - Max Operating Level Seismic.slmd



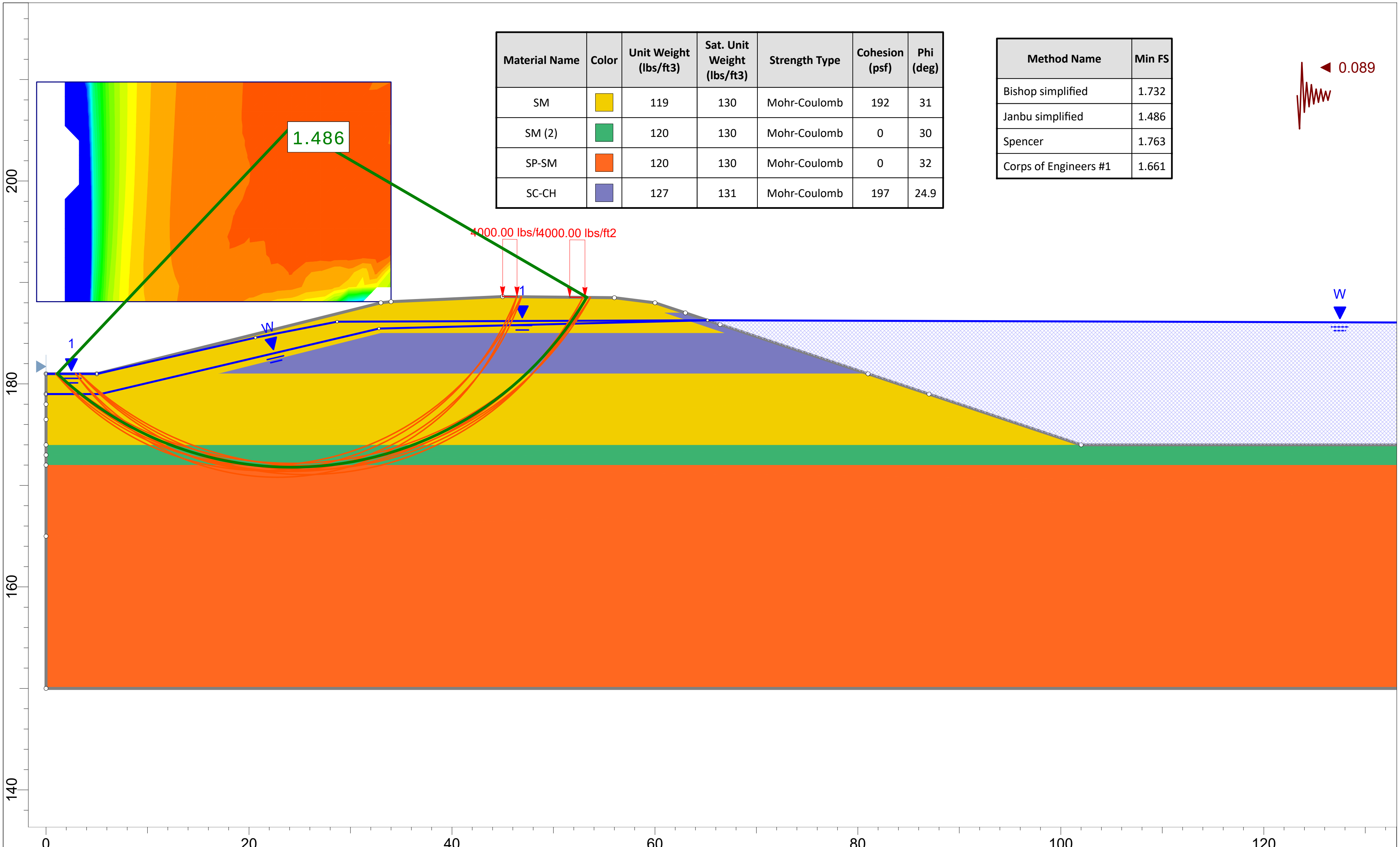
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min Ky
Bishop simplified	0.380
Janbu simplified	0.294
Spencer	0.431
Corps of Engineers #1	0.360

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-5		
Analysis Description	Max Operating Levels		
Drawn By ES/TK	*Scale* 1:174	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B5 - Max Operating Level Seismic.slmd



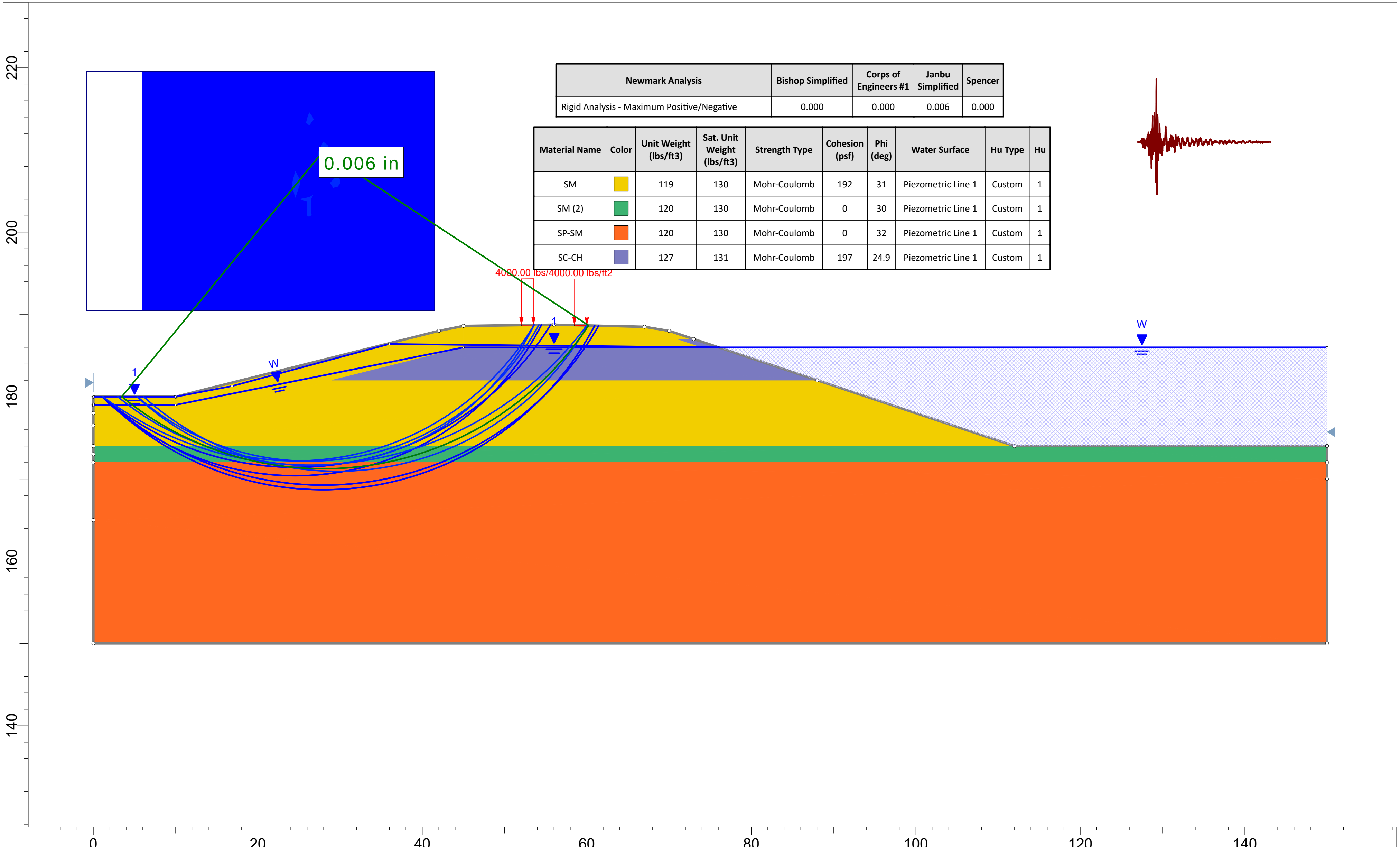
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.732
Janbu simplified	1.486
Spencer	1.763
Corps of Engineers #1	1.661

rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-5
Analysis Description	Max Operating Levels
Drawn By	ES/TK
Scale	1:157
Company	Universal Engineering Sciences
Date	
File Name	GRU B5 - Max Operating Level Seismic.slmd



Newmark Analysis	Bishop Simplified	Corps of Engineers #1	Janbu Simplified	Spencer
Rigid Analysis - Maximum Positive/Negative	0.000	0.000	0.006	0.000

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
SM		119	130	Mohr-Coulomb	192	31	Piezometric Line 1	Custom	1
SM (2)		120	130	Mohr-Coulomb	0	30	Piezometric Line 1	Custom	1
SP-SM		120	130	Mohr-Coulomb	0	32	Piezometric Line 1	Custom	1
SC-CH		127	131	Mohr-Coulomb	197	24.9	Piezometric Line 1	Custom	1

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SLIDEINTERPRET 8.032

Project GRU Process Pond Embankment Section B-6

Analysis Description Max Operating Levels

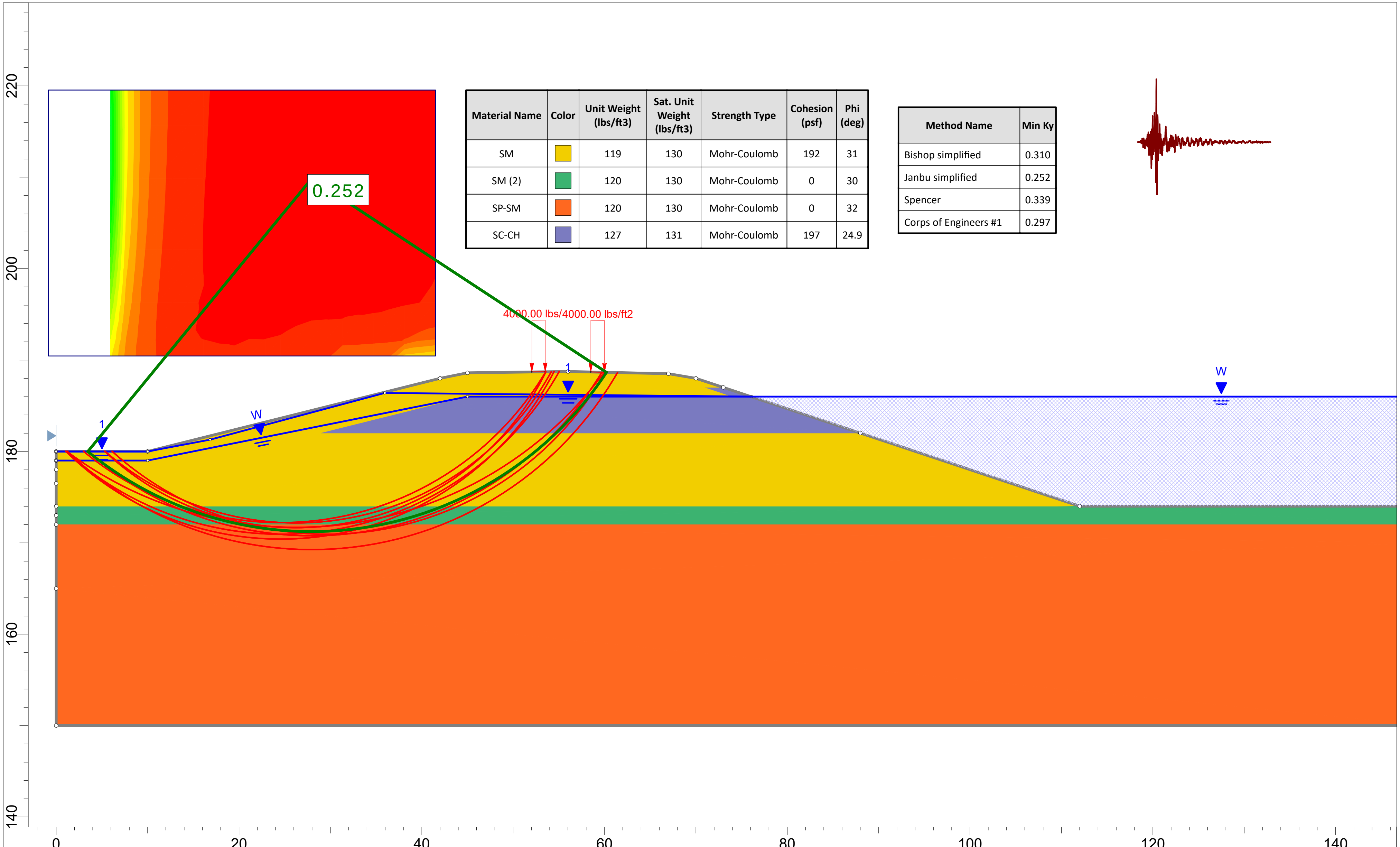
Drawn By ES/TK

Scale 1:194

Company Universal Engineering Sciences

Date

File Name GRU B6 - Max Operating Level Seismic.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min Ky
Bishop simplified	0.310
Janbu simplified	0.252
Spencer	0.339
Corps of Engineers #1	0.297

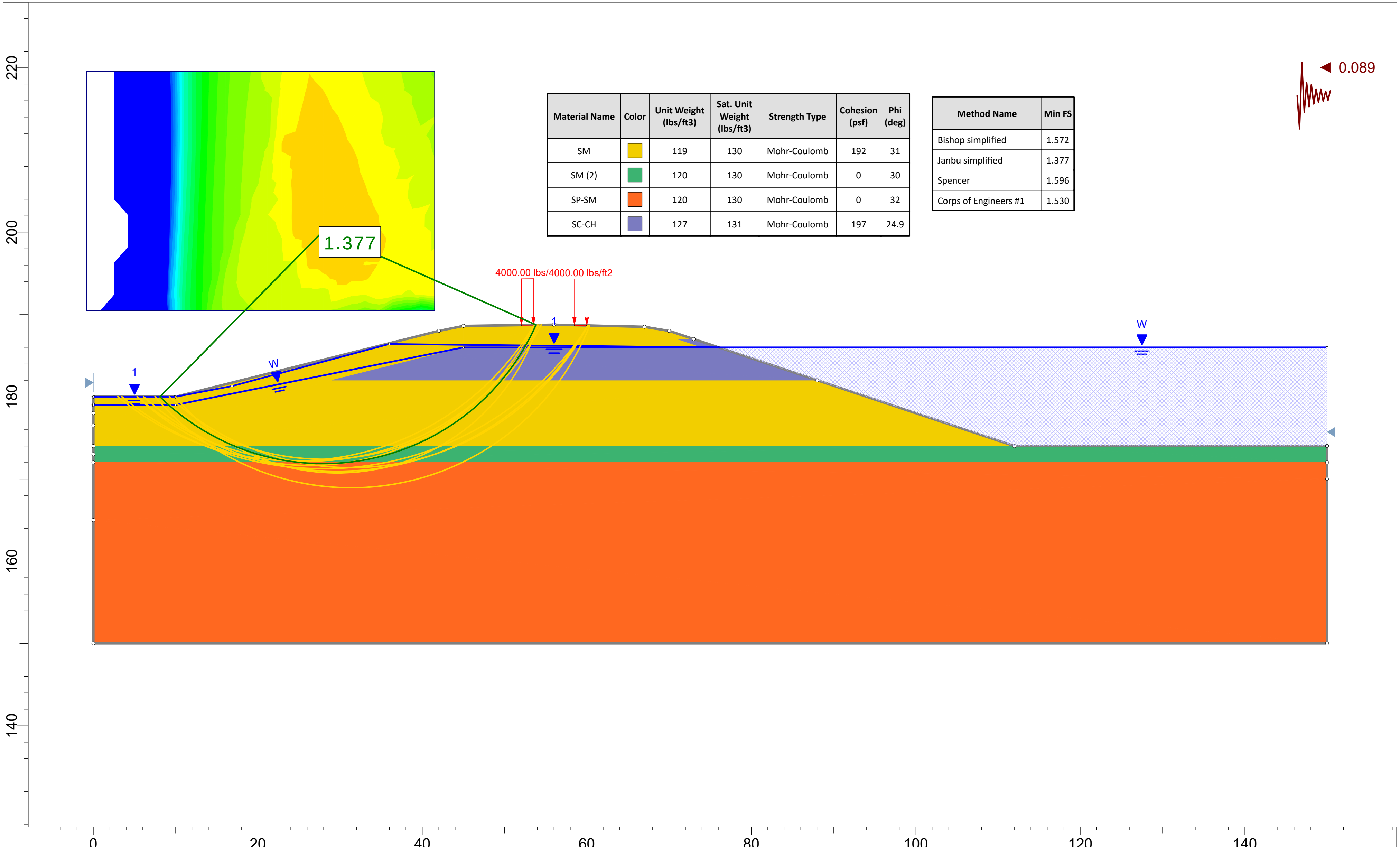
rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-6		
Analysis Description	Max Operating Levels		
Drawn By ES/TK	*Scale* 1:174	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B6 - Max Operating Level Seismic.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
SM		119	130	Mohr-Coulomb	192	31
SM (2)		120	130	Mohr-Coulomb	0	30
SP-SM		120	130	Mohr-Coulomb	0	32
SC-CH		127	131	Mohr-Coulomb	197	24.9

Method Name	Min FS
Bishop simplified	1.572
Janbu simplified	1.377
Spencer	1.596
Corps of Engineers #1	1.530



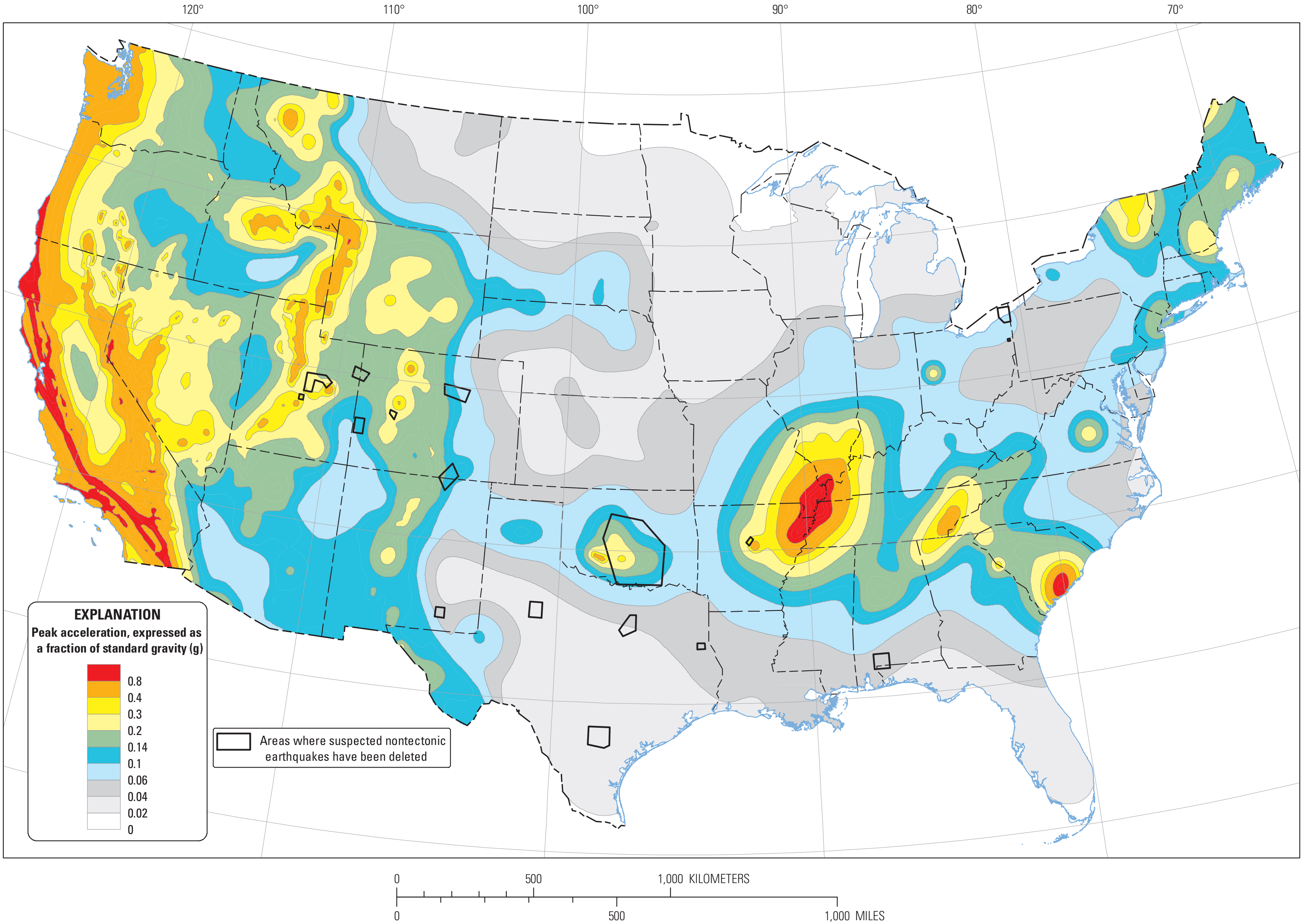
rocscience

SLIDEINTERPRET 8.032

Project	GRU Process Pond Embankment Section B-6		
Analysis Description	Max Operating Levels		
Drawn By ES/TK	*Scale* 1:194	*Company*	Universal Engineering Sciences
Date		*File Name*	GRU B6 - Max Operating Level Seismic.slmd

APPENDIX F

LIQUEFACTION POTENTIAL



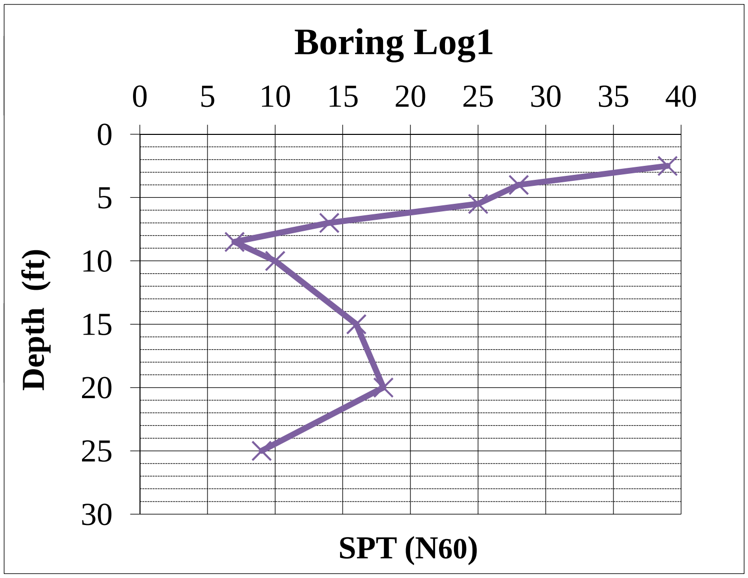
Two-percent probability of exceedance in 50 years map of peak ground acceleration

LIQUEFACTION POTENTIAL

Pek Bedrock Acceleration =	0.02 g	Fig 1	USGS National Seismic Hazard Maps
Maximum maginitude=	7.3	Fig 2/3.3	USGS Seismic Sources Zones in Contiguos States
Level Site Stratigraphy			Boring Logs
Soil Properties			

Zones of Concerns

	Depth	SPT	N60
SM	2.5	10	39
SP-SM	4	10	28
SP-SM	5.5	11	25
SP-SM	7	7	14
SM	8.5	4	7
SM	10	6	10
SC	15	11	16
SC	20	14	18
SC	25	7	9



Boring Log 1

N<30 Zone of Concerns

Saturated

Compute CSR required to liqueafy Strata

Determine Initial Ϭo and Ϭo'

WAter level at 3.75

	Depth;	Sat Un Wt	Dry Un Wt	Sub Un Wt	Ϭo	Ϭo'	Navg	N60
0	3	120	115	57.5	345	345	10	39
3	8	115	110	52.5	895	607.5	9	22
8	14	120	115	57.5	1585	952.5	5	9
14	23	125	120	62.5	2665	1515	13	17
23	25	115	110	52.5	2885	1620	7	9

Depth	Ϭo'	Fig 5.4 Cn	Navg	N60
3	345	1.6	10	39
8	607.5	1.5	9	22
14	952.5	1.3	5	9
23	1515	1.1	13	17
25	1620	1	7	9

Determine CSR

Depth	N60	Fig 5.5 CSR	15% -200	
3	39	0.5		
8	22	0.32	acceleration base	0.02
14	9	0.12	acceleration ground surface	0.02
23	17	0.22		
25	9	0.13		

Corrected CSR Factor

Depth	CSR	Fig 5.6 Km	Fig 5.7 Kl	CSRL
3	0.5	1.04	1.03	0.54
8	0.32	1.04	1.03	0.34
14	0.12	1.04	1.03	0.13
23	0.22	1.04	1.03	0.24
25	0.13	1.04	1.03	0.14

Stress Reduction factor

	Fig 5.3 rd
3	0.98
8	0.97
14	0.95
23	0.92
25	0.9

Required CSR Fig 4.6

a= 0.02 g

$$CSR_{EQ} = 0.65\ (a_{max}/g)\ r_d\ (_o/_o')$$

Depth	CSR req	CSRL	FS
3	0.01	0.54	42.04
8	0.02	0.34	18.45
14	0.02	0.13	6.25
23	0.02	0.24	11.20
25	0.02	0.14	6.68

No Liqueafaction Occurs

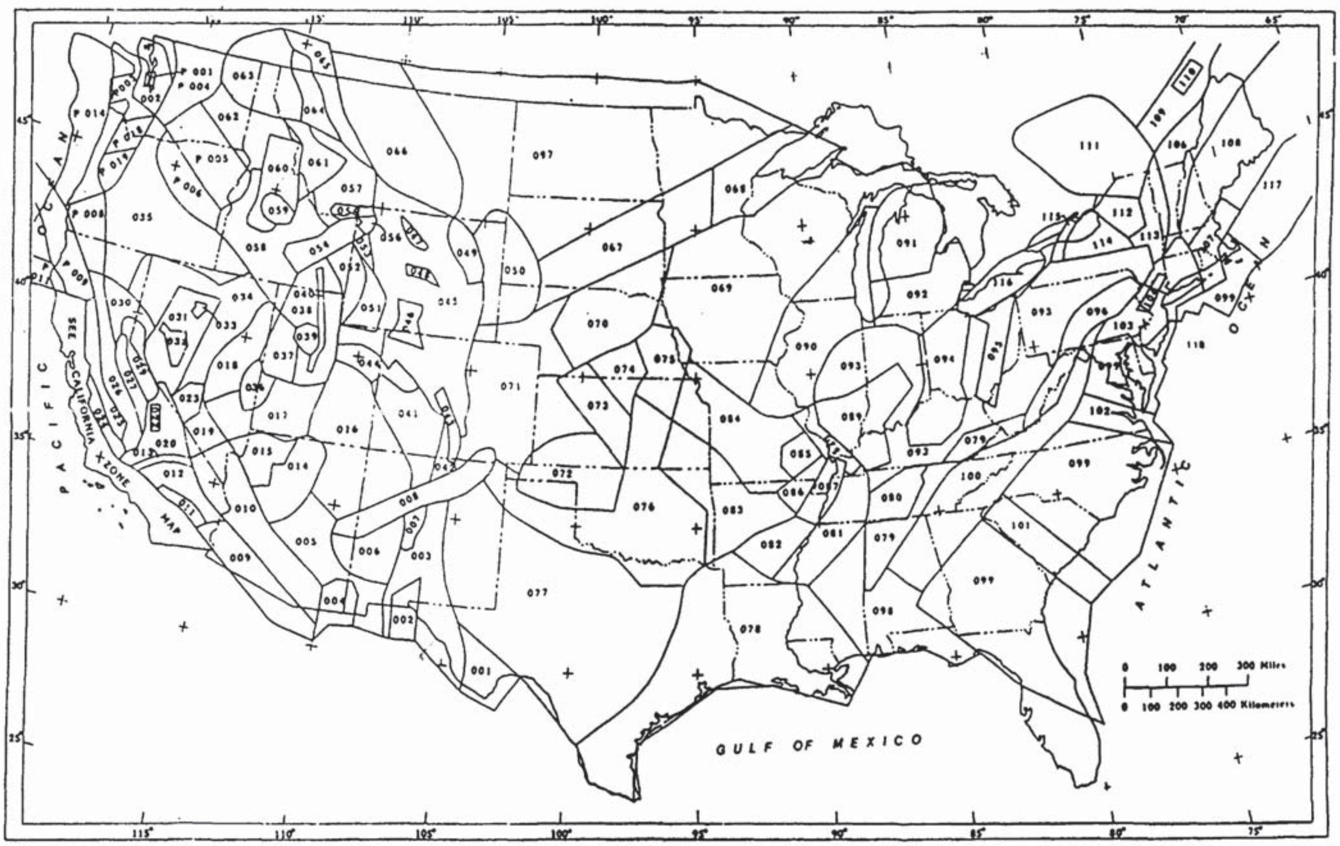


Figure 3.3 Seismic Source Zones in the Contiguous United States (USGS, 1982).

Table 3.1: **Parameters for Seismic Source Zones (USGS, 1982).**

Zone No.*	No. of Modified Mercalli Maximum Intensity V's per year	b	Maximum Magnitude M**
p001	0.11010	-0.40	7.3
p002	0.43510	-0.40	7.3
p003	0.12440	-0.54	7.3
p004	0.34840	-0.62	7.3
p005	0.12390	-0.62	7.3
p006	0.02831	-0.62	7.3
p008	0.01642	-0.42	7.3
p009	0.20850	-0.28	7.9
p010	0.45200	-0.28	7.9
p011	0.96370	-0.28	7.9
p012	0.37090	-0.28	7.9
p013	0.69020	-0.28	7.9
p014	0.10940	-0.42	7.3
p015	0.34480	-0.42	7.3
p016	0.04926	-0.42	7.3
p017	0.87860	-0.28	7.9
p018	0.18810	-0.54	7.3
p019	0.04090	-0.54	7.3
c001	0.62770	-0.42	7.3
c002	0.15700	-0.42	7.3
c003	0.31960	-0.42	7.3
c004	0.31960	-0.42	7.3
c005	0.04843	-0.42	6.1
c006	0.15700	-0.42	7.3
c007	0.15700	-0.42	7.3
c008	0.04740	-0.42	6.1
c009	0.04843	-0.42	6.1
c010	0.18190	-0.42	6.1
c011	0.77010	-0.42	7.3
c012	0.19050	-0.42	7.3
c013	0.35840	-0.42	7.3
c014	0.91990	-0.66	7.9
c015	1.49200	-0.45	7.9
c016	0.22560	-0.51	7.9
c017	0.02760	-0.48	7.3
c018	1.09200	-0.49	7.3
c019	0.31980	-0.42	6.7
c020	0.19280	-0.42	6.1
c021	0.10880	-0.42	6.1
c022	0.02422	-0.42	6.1
c023	0.11650	-0.37	7.9
c024,	1.97000	-0.43	8.5
c025	0.05085	-0.55	7.3
c026	0.09145	-0.55	7.3

Table 3.1: (continued)

Zone No.*	No. of Modified Mercalli Maximum Intensity V's per year	b	Maximum Magnitude M**
c027	0.03437	-0.37	7.3
c028	0.13010	-0.37	7.3
c029	0.02350	-0.37	7.3
c030	0.03630	-0.42	6.7
c031	0.47580	-0.51	6.7
c032	0.55190	-0.45	7.9
c033	0.23070	-0.37	7.9
c034	0.67120	-0.51	7.9
c035	0.02325	-0.60	7.3
c036	0.35220	-0.59	6.7
c037	0.81950	-0.51	6.1
c038	0.82680	-0.54	7.9
c039	0.35810	-0.45	7.9
c040	0.15820	-0.42	6.1
c041	0.08448	-0.37	7.9
001	0.22700	-0.73	7.3
002	0.03600	-0.73	7.3
003	0.08800	-0.73	6.1
004	0.22700	-0.54	7.3
005	0.09100	-0.73	7.3
006	0.13500	-0.73	7.3
007	0.41900	-0.73	7.3
008	0.21100	-0.73	6.1
009	0.19400	-0.54	6.1
010	0.20800	-0.54	7.3
011	0.55100	-0.64	7.3
012	0.34900	-0.64	7.3
013	0.05500	-0.64	7.3
014	0.49000	-0.73	7.3
015	0.01800	-0.73	6.7
016	0.14600	-0.73	6.1
017	0.69300	-0.59	7.3
018	0.26100	-0.54	7.3
019	0.11717	-0.54	7.3
020	1.84900	-0.64	7.3
022	0.19600	-0.64	6.1
023	0.15350	-0.54	7.3
024	0.27400	-0.64	7.3
025	0.16800	-0.64	6.1
026	0.47700	-0.64	6.1
027	0.11100	-0.64	5.5
029	1.31900	-0.64	7.3
030	0.58800	-0.64	7.3
031	1.82685	-0.54	7.3

Table 3.1: (continued)

Zone No.*	No. of Modified Mercalli Maximum Intensity V's per year	b	Maximum Magnitude M**
032	0.48114	-0.54	6.1
033	0.08557	-0.54	6.1
034	0.62380	-0.54	7.3
035	0.20070	-0.54	7.3
036	0.01800	-0.58	6.1
037	0.05100	-0.58	7.3
038	0.80600	-0.58	7.3
039	0.12000	-0.58	7.3
040	0.29100	-0.58	7.3
041	0.24400	-0.73	7.3
042	0.01800	-0.73	6.1
043	0.04600	-0.73	7.3
044	0.11300	-0.73	6.1
045	0.45600	-0.73	6.1
046	0.01274	-0.73	6.1
047	0.00427	-0.73	6.1
048	0.00329	-0.73	6.1
049	0.01663	-0.73	6.1
050	0.17000	-0.73	6.1
051	0.01706	-0.73	6.1
052	0.19000	-0.58	7.3
053	0.03600	-0.58	7.3
054	0.01800	-0.58	6.1
055	0.67300	-0.58	7.3
056	0.17700	-0.58	6.1
057	0.66200	-0.58	7.3
058	0.19800	-0.58	7.3
059	0.19200	-0.58	6.1
060	0.03600	-0.58	6.1
061	0.08900	-0.58	7.3
062	0.03600	-0.58	6.1
063	0.12900	-0.58	6.1
064	0.34400	-0.58	7.3
065	0.15200	-0.58	6.1
066	0.01800	-0.73	6.1
067	0.07715	-0.46	6.1
068	0.02894	-0.46	6.1
069	0.00588	-0.46	6.1
070	0.03552	-0.46	6.1
071	0.01176	-0.46	6.1
072	0.02026	-0.46	6.1
073	0.02353	-0.46	6.1
074	0.00270	-0.46	6.1
075	0.06510	-0.46	6.1

Table 3.1: (continued)

Zone No.*	No. of Modified Mercalli Maximum Intensity V's per year	b	Maximum Magnitude M**
076	0.14742	-0.46	6.1
077	0.03469	-0.46	6.1
078	0.04389	-0.46	6.1
079	0.03082	-0.46	6.1
080	0.02987	-0.46	6.1
081	0.02044	-0.46	6.1
082	0.03552	-0.46	6.1
083	0.00996	-0.46	6.1
084	0.04117	-0.46	6.1
085	0.03802	-0.46	6.1
086	0.04626	-0.46	6.1
087	0.29865	-0.46	8.5
088	0.09703	-0.46	6.1
089	0.15689	-0.46	6.1
090	0.06103	-0.46	6.1
091	0.00644	-0.46	6.1
092	0.02661	-0.46	6.1
093	0.02680	-0.46	6.1
094	0.10835	-0.46	6.1
095	0.05901	-0.46	6.1
096	0.02675	-0.46	6.1
097	0.01156	-0.46	6.1
098	0.01215	-0.46	6.1
099	0.24830	-0.50	7.3
100	0.42290	-0.50	7.3
101	0.18720	-0.50	7.3
102	0.09532	-0.50	7.3
103	0.33150	-0.50	7.3
104	0.05544	-0.50	7.3
106	0.01952	-0.50	6.7
107	0.19100	-0.50	7.3
108	0.29390	-0.50	6.7
109	0.10650	-0.50	7.9
110	0.30220	-0.50	7.9
111	0.32430	-0.50	7.9
112	0.01532	-0.50	6.7
113	0.07432	-0.50	6.7
114	0.00754	-0.50	6.7
115	0.05834	-0.50	7.3
116	0.06783	-0.50	6.7
117	0.03950	-0.50	7.3
118	0.01334	-0.50	7.3

*The zones are shown in Figure 3.2
**See text for definition of M

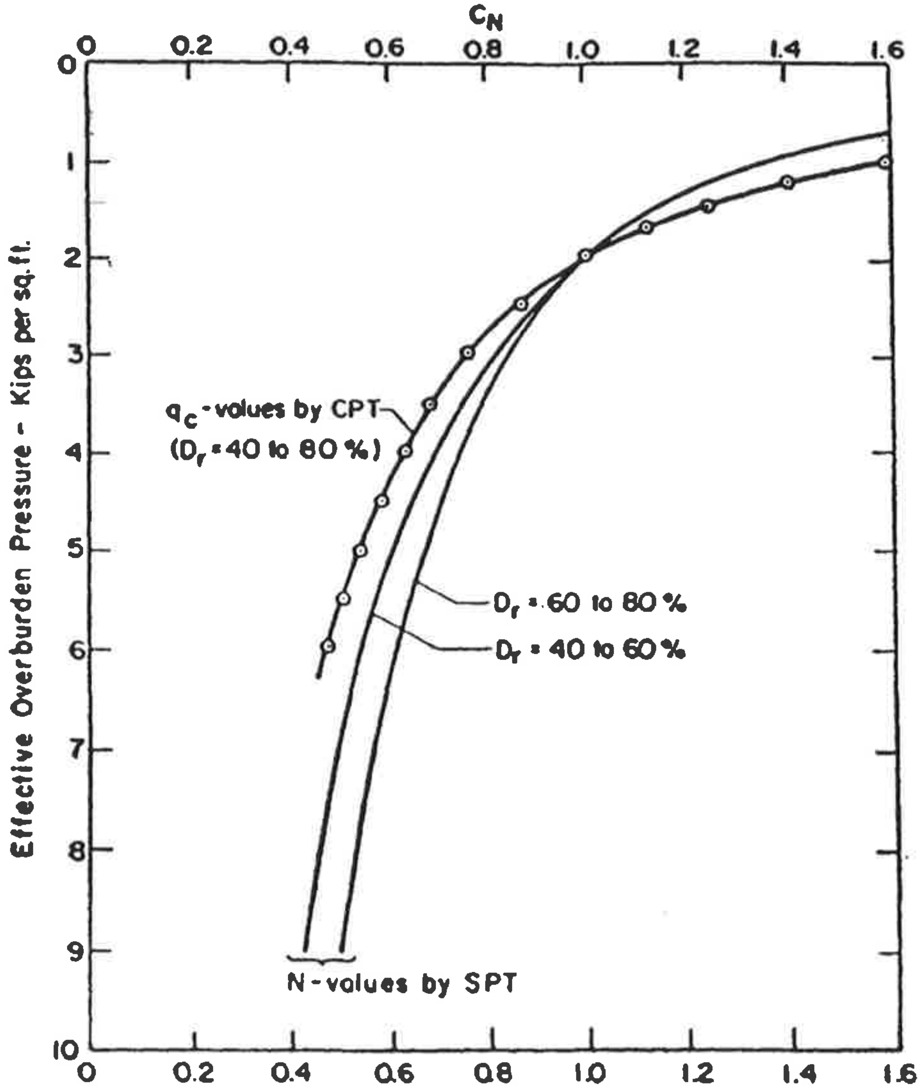


Figure 5.4 Correction Factor for the Effective Overburden Pressure, C_N (Seed et al., 1983).

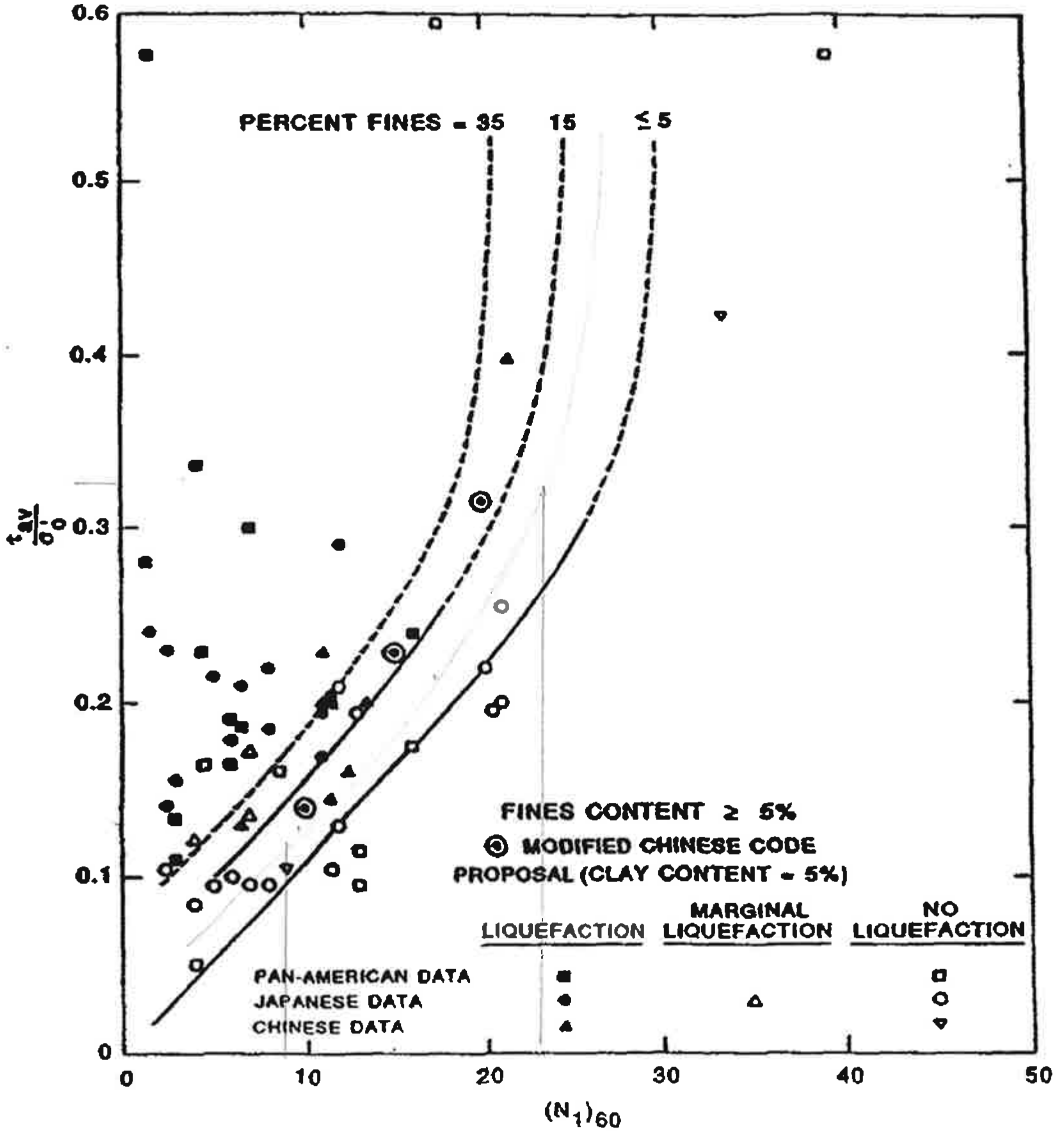


Figure 5.5 Relationships Between Stress Ratio Causing Liquefaction and $(N_1)_{60}$ Values for Sands for M 7.5 Earthquakes (Seed et al., 1985).

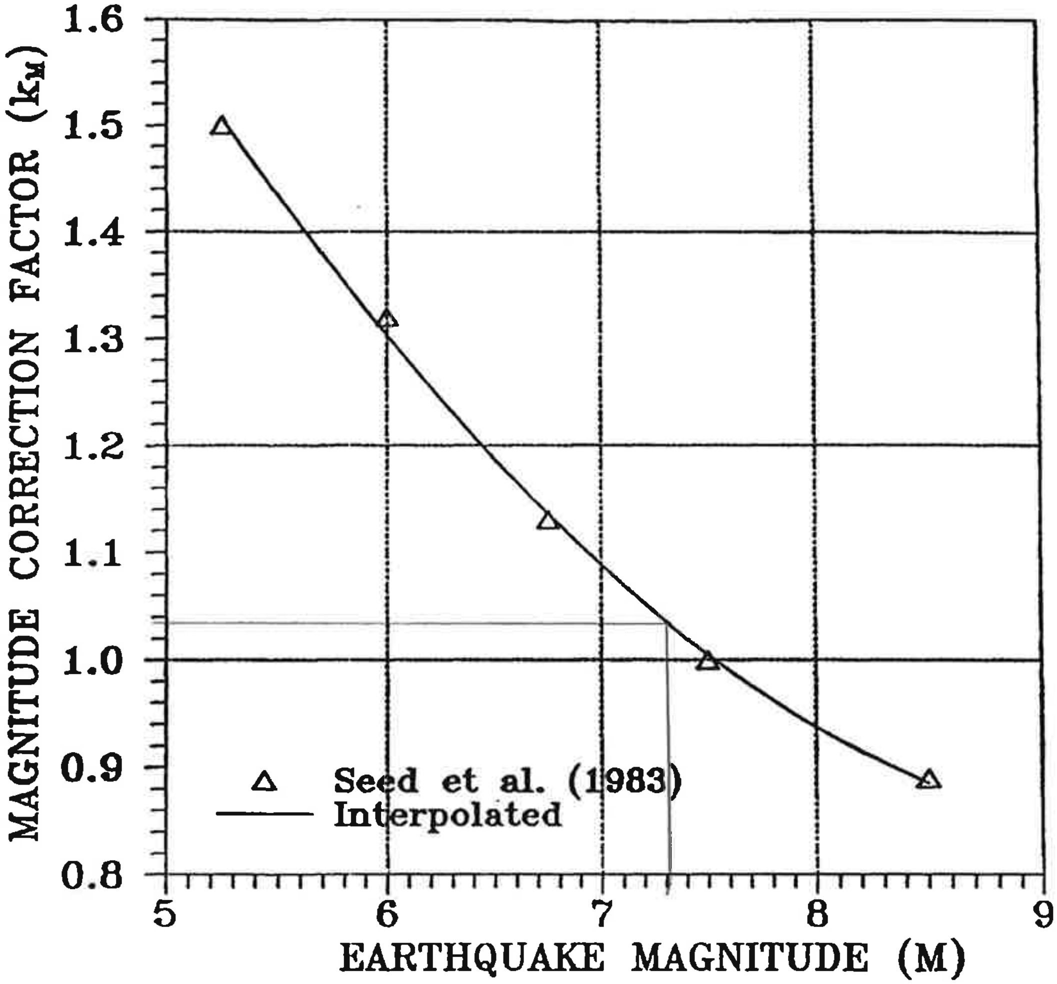


Figure 5.6 Curve for Estimation of Magnitude Correction Factor, k_M (after Seed et al., 1983).

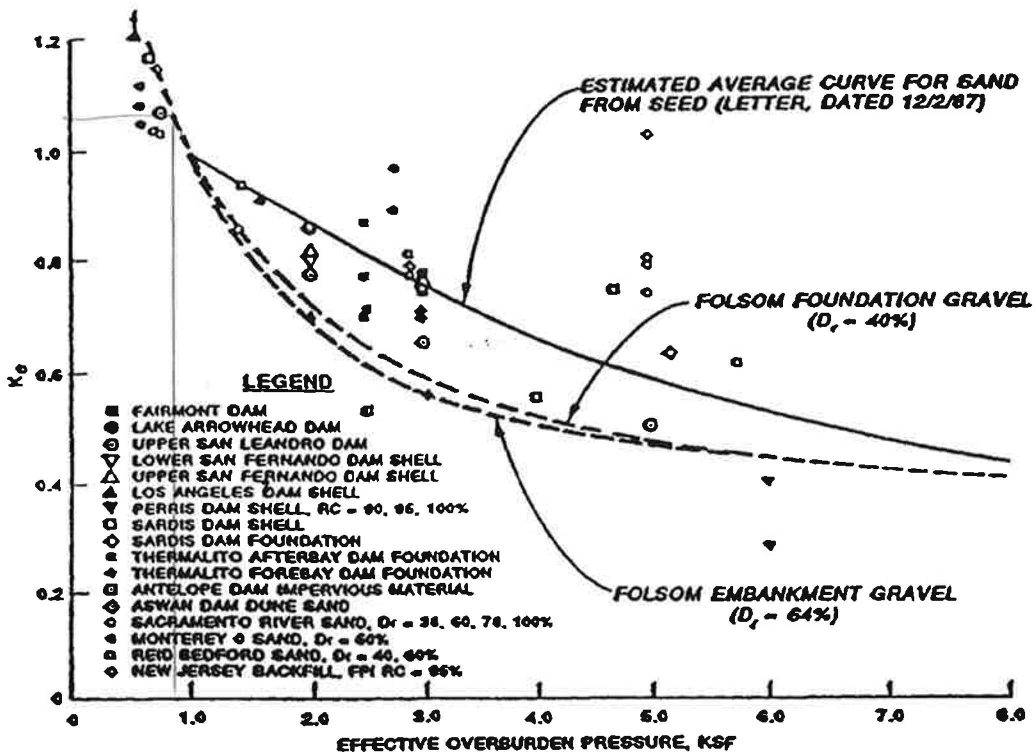


Figure 5.7 Curves for Estimation of Correction Factor k_σ (Harder 1988, and Hynes 1988, as Quoted in Marcuson et al., 1990)

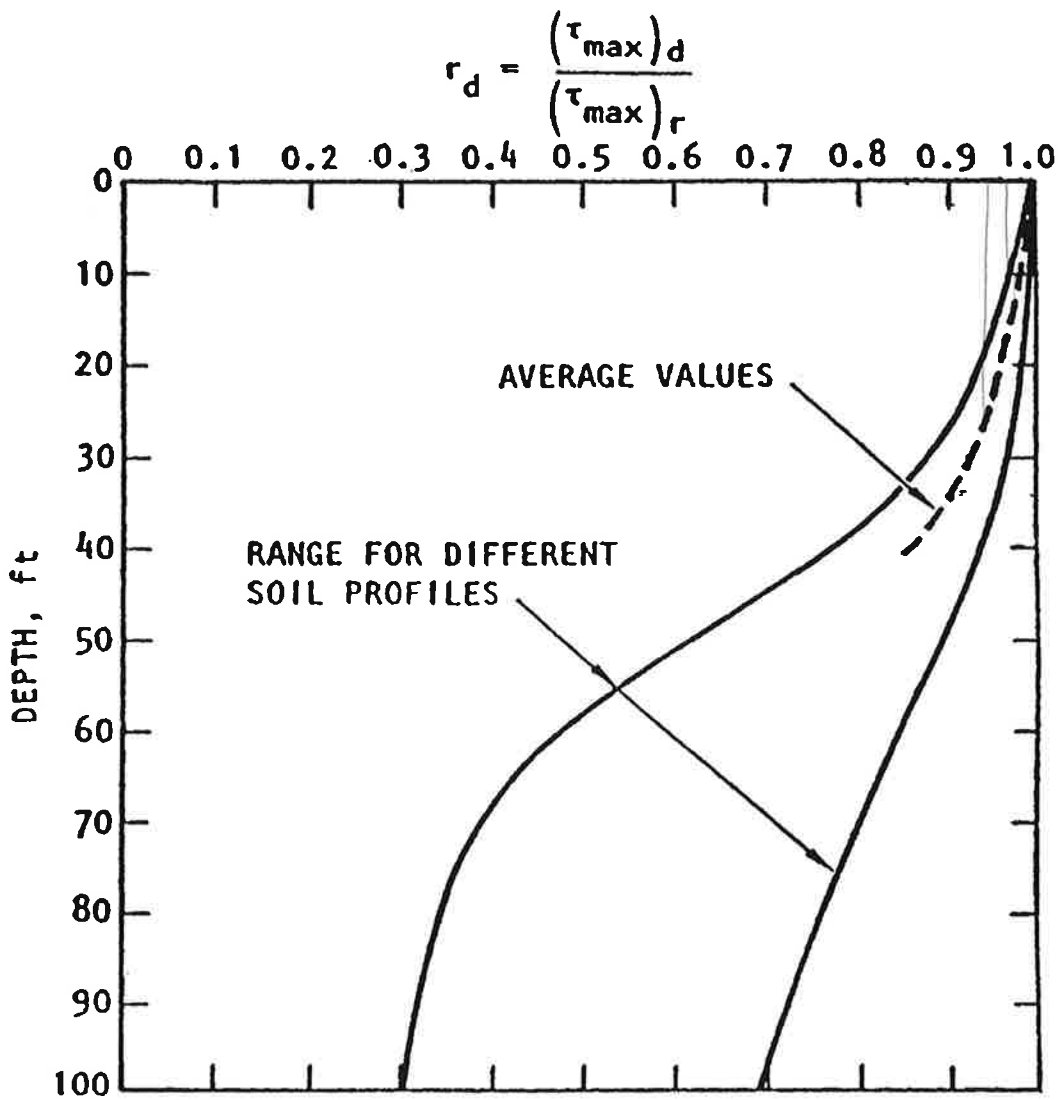


Figure 5.3 Stress Reduction Factor, r_d (Seed and Idriss, 1982).

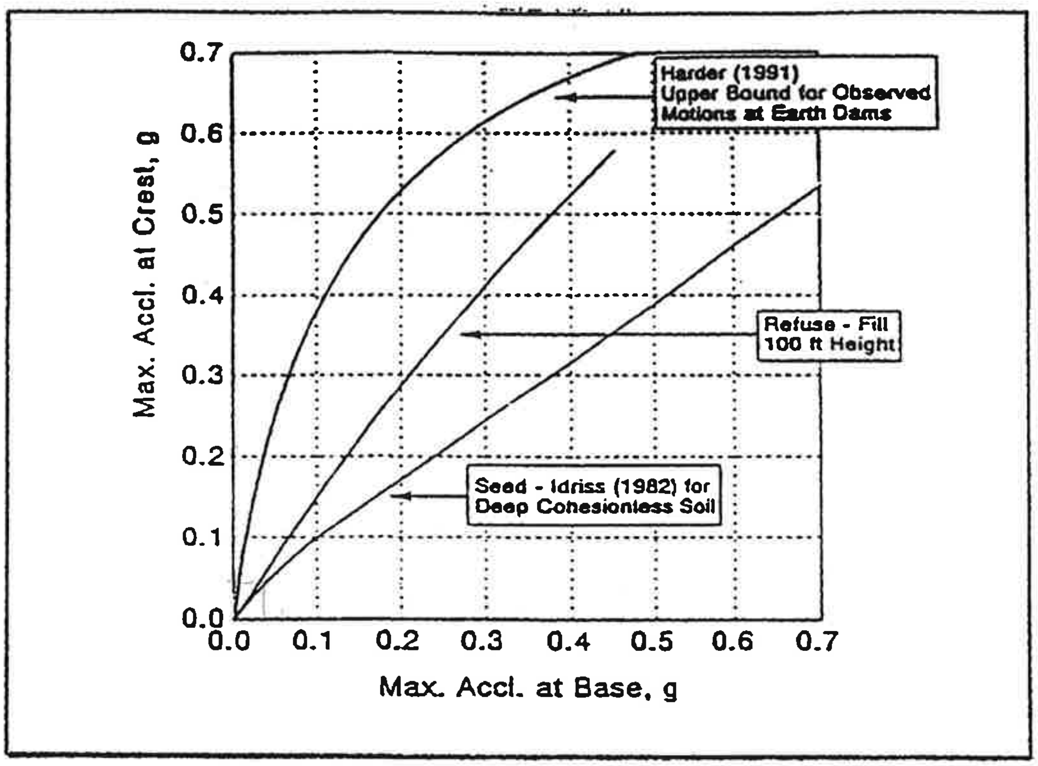


Figure 4.6 Approximate Relationship Between Maximum Accelerations at the Base and Crest for Various Ground Conditions (Singh and Sun, 1995)

APPENDIX G

GBC DOCUMENT
CONSTRAINTS AND RESTRICTIONS

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

CONSTRAINTS & RESTRICTIONS

The intent of this document is to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

WARRANTY

Universal Engineering Sciences has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices, and makes no other warranty either expressed or implied as to the professional advice provided in the report.

UNANTICIPATED SOIL CONDITIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations indicated on the Boring Location Plan. This report does not reflect any variations which may occur between these borings.

The nature and extent of variations between borings may not become known until excavation begins. If variations appear, we may have to re-evaluate our recommendations after performing on-site observations and noting the characteristics of any variations.

CHANGED CONDITIONS

We recommend that the specifications for the project require that the contractor immediately notify Universal Engineering Sciences, as well as the owner, when subsurface conditions are encountered that are different from those present in this report.

No claim by the contractor for any conditions differing from those anticipated in the plans, specifications, and those found in this report, should be allowed unless the contractor notifies the owner and Universal Engineering Sciences of such changed conditions. Further, we recommend that all foundation work and site improvements be observed by a representative of Universal Engineering Sciences to monitor field conditions and changes, to verify design assumptions and to evaluate and recommend any appropriate modifications to this report.

MISINTERPRETATION OF SOIL ENGINEERING REPORT

Universal Engineering Sciences is responsible for the conclusions and opinions contained within this report based upon the data relating only to the specific project and location discussed herein. If the conclusions or recommendations based upon the data presented are made by others, those conclusions or recommendations are not the responsibility of Universal Engineering Sciences.

CHANGED STRUCTURE OR LOCATION

This report was prepared in order to aid in the evaluation of this project and to assist the architect or engineer in the design of this project. If any changes in the design or location of the structure as outlined in this report are planned, or if any structures are included or added that are not discussed in the report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions modified or approved by Universal Engineering Sciences.

USE OF REPORT BY BIDDERS

Bidders who are examining the report prior to submission of a bid are cautioned that this report was prepared as an aid to the designers of the project and it may affect actual construction operations.

Bidders are urged to make their own soil borings, test pits, test caissons or other investigations to determine those conditions that may affect construction operations. Universal Engineering Sciences cannot be responsible for any interpretations made from this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which will affect construction operations.

STRATA CHANGES

Strata changes are indicated by a definite line on the boring logs which accompany this report. However, the actual change in the ground may be more gradual. Where changes occur between soil samples, the location of the change must necessarily be estimated using all available information and may not be shown at the exact depth.

OBSERVATIONS DURING DRILLING

Attempts are made to detect and/or identify occurrences during drilling and sampling, such as: water level, boulders, zones of lost circulation, relative ease or resistance to drilling progress, unusual sample recovery, variation of driving resistance, obstructions, etc.; however, lack of mention does not preclude their presence.

WATER LEVELS

Water level readings have been made in the drill holes during drilling and they indicate normally occurring conditions. Water levels may not have been stabilized at the last reading. This data has been reviewed and interpretations made in this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, tides, and other factors not evident at the time measurements were made and reported. Since the probability of such variations is anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based upon such assumptions of variations.

LOCATION OF BURIED OBJECTS

All users of this report are cautioned that there was no requirement for Universal Engineering Sciences to attempt to locate any man-made buried objects during the course of this exploration and that no attempt was made by Universal Engineering Sciences to locate any such buried objects. Universal Engineering Sciences cannot be responsible for any buried man-made objects which are subsequently encountered during construction that are not discussed within the text of this report.

TIME

This report reflects the soil conditions at the time of exploration. If the report is not used in a reasonable amount of time, significant changes to the site may occur and additional reviews may be required.

UNIVERSAL
ENGINEERING SCIENCES

Universal Engineering Sciences, LLC
GENERAL CONDITIONS

SECTION 1: RESPONSIBILITIES 1.1 *Universal Engineering Sciences, LLC*, and its subsidiaries and affiliated companies ("UES"), is responsible for providing the services described under the Scope of Services. The term "UES" as used herein includes all of UES's agents, employees, professional staff, and subcontractors. **1.2** The Client or a duly authorized representative is responsible for providing UES with a clear understanding of the project nature and scope. The Client shall supply UES with sufficient and adequate information, including, but not limited to, maps, site plans, reports, surveys, plans and specifications, and designs, to allow UES to properly complete the specified services. The Client shall also communicate changes in the nature and scope of the project as soon as possible during performance of the work so that the changes can be incorporated into the work product. **1.3** The Client acknowledges that UES's responsibilities in providing the services described under the Scope of Services section is limited to those services described therein, and the Client hereby assumes any collateral or affiliated duties necessitated by or for those services. Such duties may include, but are not limited to, reporting requirements imposed by any third party such as federal, state, or local entities, the provision of any required notices to any third party, or the securing of necessary permits or permissions from any third parties required for UES's provision of the services so described, unless otherwise agreed upon by both parties in writing.

SECTION 2: STANDARD OF CARE 2.1 Services performed by UES under this Agreement will be conducted in a manner consistent with the level of care and skill ordinarily exercised by members of UES's profession practicing contemporaneously under similar conditions in the locality of the project. No other warranty, express or implied, is made. **2.2** Execution of this document by UES is not a representation that UES has visited the site, become generally familiar with local conditions under which the work is to be performed, or correlated personal observations with the requirements of the Scope of Services. It is the Client's responsibility to provide UES with all information necessary for UES to provide the services described under the Scope of Services, and the Client assumes all liability for information not provided to UES that may affect the quality or sufficiency of the services so described.

SECTION 3: SITE ACCESS AND SITE CONDITIONS 3.1 Client will grant or obtain free access to the site for all equipment and personnel necessary for UES to perform the work set forth in this Agreement. The Client will notify any possessors of the project site that Client has granted UES free access to the site. UES will take reasonable precautions to minimize damage to the site, but it is understood by Client that, in the normal course of work, some damage may occur, and the correction of such damage is not part of this Agreement unless so specified in the Scope of Services. **3.2** The Client is responsible for the accuracy of locations for all subterranean structures and utilities. UES will take reasonable precautions to avoid known subterranean structures, and the Client waives any claim against UES, and agrees to defend, indemnify, and hold UES harmless from any claim or liability for injury or loss, including costs of defense, arising from damage done to subterranean structures and utilities not identified or accurately located. In addition, Client agrees to compensate UES for any time spent or expenses incurred by UES in defense of any such claim with compensation to be based upon UES's prevailing fee schedule and expense reimbursement policy.

SECTION 4: BILLING AND PAYMENT 4.1 UES will submit invoices to Client monthly or upon completion of services. Invoices will show charges for different personnel and expense classifications. **4.2** Payment is due 30 days after presentation of invoice and is past due 31 days from invoice date. Client agrees to pay a finance charge of one and one-half percent (1 ½ %) per month, or the maximum rate allowed by law, on past due accounts. **4.3** If UES incurs any expenses to collect overdue billings on invoices, the sums paid by UES for reasonable attorneys' fees, court costs, UES's time, UES's expenses, and interest will be due and owing by the Client.

SECTION 5: OWNERSHIP AND USE OF DOCUMENTS 5.1 All reports, boring logs, field data, field notes, laboratory test data, calculations, estimates, and other documents prepared by UES, as instruments of service, shall remain the property of UES. Neither Client nor any other entity shall change or modify UES's instruments of service. **5.2** Client agrees that all reports and other work furnished to the Client or his agents, which are not paid for, will be returned upon demand and will not be used by the Client for any purpose. **5.3** UES will retain all pertinent records relating to the services performed for a period of five years following submission of the report or completion of the Scope of Services, during which period the records will be made available to the Client in a reasonable time and manner. **5.4** All reports, boring logs, field data, field notes, laboratory test data, calculations, estimates, and other documents prepared by UES, are prepared for the sole and exclusive use of Client, and may not be given to any other entity, or used or relied upon by any other entity, without the express written consent of UES. Client is the only entity to which UES owes any duty or duties, in contract or tort, pursuant to or under this Agreement.

SECTION 6: DISCOVERY OF UNANTICIPATED HAZARDOUS MATERIALS 6.1 Client represents that a reasonable effort has been made to inform UES of known or suspected hazardous materials on or near the project site. **6.2** Under this agreement, the term hazardous materials include hazardous materials, hazardous wastes, hazardous substances (40 CFR 261.31, 261.32, 261.33), petroleum products, polychlorinated biphenyls, asbestos, and any other material defined by the U.S. EPA as a hazardous material. **6.3** Hazardous materials may exist at a site where there is no reason to believe they are present. The discovery of unanticipated hazardous materials constitutes a changed condition mandating a renegotiation of the scope of work. The discovery of unanticipated hazardous materials may make it necessary for UES to take immediate measures to protect health and safety. Client agrees to compensate UES for any equipment decontamination or other costs incident to the discovery of unanticipated hazardous materials. **6.4** UES will notify Client when unanticipated hazardous materials or suspected hazardous materials are encountered. Client will make any disclosures required by law to the appropriate governing agencies. Client will hold UES harmless for all consequences of disclosures made by UES which are required by governing law. In the event the project site is not owned by Client, Client it is the Client's responsibility to inform the property owner of the discovery of unanticipated hazardous materials or suspected hazardous materials. **6.5** Notwithstanding any other provision of the Agreement, Client waives any claim against UES, and to the maximum extent permitted by law, agrees to defend, indemnify, and save UES harmless from any claim, liability, and/or defense costs for injury or loss arising from UES's discovery of unanticipated hazardous materials or suspected hazardous materials including any costs created by delay of the project and any cost associated with possible reduction of the property's value. Client will be responsible for ultimate disposal of any samples secured by UES which are found to be contaminated.

SECTION 7: RISK ALLOCATION 7.1 Client agrees that UES's liability for any damage on account of any breach of contract, error, omission, or professional negligence will be limited to a sum not to exceed $50,000 or UES's fee, whichever is greater. If Client prefers to have higher limits on contractual or professional liability, UES agrees to increase the limits up to a maximum of $1,000,000.00 upon Client's written request at the time of accepting UES's proposal provided that Client agrees to pay an additional consideration of four percent of the total fee, or $400.00, whichever is greater. If Client prefers a $2,000,000.00 limit on contractual or professional liability, UES agrees to increase the limits up to a maximum of $2,000,000.00 upon Client's written request at the time of accepting UES's proposal provided that Client agrees to pay an additional consideration of four percent of the total fee, or $800.00, whichever is greater. The additional charge for the higher liability limits is because of the greater risk assumed and is not strictly a charge for additional professional liability insurance. **7.2** Client shall not be liable to UES and UES shall not be liable to Client for any incidental, special, or consequential damages (including lost profits, loss of use, and lost savings) incurred by either party due to the fault of the other, regardless of the nature of the fault, or whether it was committed by Client or UES, their employees, agents, or subcontractors; or whether such liability arises in breach of contract or warranty, tort (including negligence), statutory, or any other cause of action. **7.3** As used in this Agreement, the terms "claim" or "claims" mean any claim in contract, tort, or statute alleging negligence, errors, omissions, strict liability, statutory liability, breach of contract, breach of warranty, negligent misrepresentation, or any other act giving rise to liability.

SECTION 8: INSURANCE 8.1 UES represents it and its agents, staff and consultants employed by UES, is and are protected by worker's compensation insurance and that UES has such coverage under public liability and property damage insurance policies which UES deems to be adequate. Certificates for all such policies of insurance shall be provided to Client upon request in writing. Within the limits and conditions of such insurance, UES agrees to indemnify and save Client harmless from and against loss, damage, or liability arising from negligent acts by UES, its agents, staff, and consultants employed by it. UES shall not be responsible for any loss, damage or liability beyond the amounts, limits, and conditions of such insurance or the limits described in Section 7, whichever is less. The Client agrees to defend, indemnify, and save UES harmless for loss, damage or liability arising from acts by Client, Client's agents, staff, and others employed by Client. **8.2** Under no circumstances will UES indemnify Client from or for Client's own actions, negligence, or breaches of contract. **8.3**

To the extent damages are covered by property insurance, Client and UES waive all rights against each other and against the contractors, consultants, agents, and employees of the other for damages, except such rights as they may have to the proceeds of such insurance.

SECTION 9: DISPUTE RESOLUTION **9.1** All claims, disputes, and other matters in controversy between UES and Client arising out of or in any way related to this Agreement will be submitted to mediation or non-binding arbitration, before and as a condition precedent to other remedies provided by law. **9.2** If a dispute arises and that dispute is not resolved by mediation or non-binding arbitration, then: (a) the claim will be brought in the state or federal courts having jurisdiction where the UES office which provided the service is located; and (b) the prevailing party will be entitled to recovery of all reasonable costs incurred, including staff time, court costs, attorneys' fees, expert witness fees, and other claim related expenses.

SECTION 10: TERMINATION **10.1** This agreement may be terminated by either party upon seven (7) days written notice in the event of substantial failure by the other party to perform in accordance with the terms hereof, or in the case of a force majeure event such as terrorism, act of war, public health or other emergency. Such termination shall not be effective if such substantial failure or force majeure has been remedied before expiration of the period specified in the written notice. In the event of termination, UES shall be paid for services performed to the termination notice date plus reasonable termination expenses. **10.2** In the event of termination, or suspension for more than three (3) months, prior to completion of all reports contemplated by the Agreement, UES may complete such analyses and records as are necessary to complete its files and may also complete a report on the services performed to the date of notice of termination or suspension. The expense of termination or suspension shall include all direct costs of UES in completing such analyses, records, and reports.

SECTION 11: REVIEWS, INSPECTIONS, TESTING, AND OBSERVATIONS **11.1** Plan review, private provider inspections, and building inspections are performed for the purpose of observing compliance with applicable building codes. Threshold inspections are performed for the purpose of observing compliance with an approved threshold inspection plan. Construction materials testing ("CMT") is performed to document compliance of certain materials or components with applicable testing standards. UES's performance of plan reviews, private provider inspections, building inspections, threshold inspections, or CMT, or UES's presence on the site of Client's project while performing any of the foregoing activities, is not a representation or warranty by UES that Client's project is free of errors in either design or construction. **11.2** If UES is retained to provide construction monitoring or observation, UES will report to Client any observed work which, in UES's opinion, does not conform to the plans and specifications provided to UES. UES shall have no authority to reject or terminate the work of any agent or contractor of Client. No action, statements, or communications of UES, or UES's site representative, can be construed as modifying any agreement between Client and others. UES's performance of construction monitoring or observation is not a representation or warranty by UES that Client's project is free of errors in either design or construction. **11.3** Neither the activities of UES pursuant to this Agreement, nor the presence of UES or its employees, representatives, or subcontractors on the project site, shall be construed to impose upon UES any responsibility for means or methods of work performance, superintendence, sequencing of construction, or safety conditions at the project site. Client acknowledges that Client or its contractor is solely responsible for project jobsite safety. **11.4** Client is responsible for scheduling all inspections and CMT activities of UES. All testing and inspection services will be performed on a will-call basis. UES will not be responsible for tests and inspections that are not performed due to Client's failure to schedule UES's services on the project, or for any claims or damages arising from tests and inspections that are not scheduled or performed.

SECTION 12: ENVIRONMENTAL ASSESSMENTS Client acknowledges that an Environmental Site Assessment ("ESA") is conducted solely to permit UES to render a professional opinion about the likelihood or extent of regulated contaminants being present on, in, or beneath the site in question at the time services were conducted. No matter how thorough an ESA study may be, findings derived from the study are limited and UES cannot know or state for a fact that a site is unaffected by reportable quantities of regulated contaminants as a result of conducting the ESA study. Even if UES states that reportable quantities of regulated contaminants are not present, Client still bears the risk that such contaminants may be present or may migrate to the site after the ESA study is complete.

SECTION 13: SUBSURFACE EXPLORATIONS **13.1** Client acknowledges that subsurface conditions may vary from those observed at locations where borings, surveys, samples, or other explorations are made, and that site conditions may change with time. Data, interpretations, and recommendations by UES will be based solely on information available to UES at the time of service. UES is responsible for those data, interpretations, and recommendations, but will not be responsible for other parties' interpretations or use of the information developed or provided by UES. **13.2** Subsurface explorations may result in unavoidable cross-contamination of certain subsurface areas, as when a probe or boring device moves through a contaminated zone and links it to an aquifer, underground stream, or other hydrous body not previously contaminated. UES is unable to eliminate totally cross-contamination risk despite use of due care. Since subsurface explorations may be an essential element of UES's services indicated herein, Client shall, to the fullest extent permitted by law, waive any claim against UES, and indemnify, defend, and hold UES harmless from any claim or liability for injury or loss arising from cross-contamination allegedly caused by UES's subsurface explorations. In addition, Client agrees to compensate UES for any time spent or expenses incurred by UES in defense of any such claim with compensation to be based upon UES's prevailing fee schedule and expense reimbursement policy.

SECTION 14: SOLICITATION OF EMPLOYEES Client agrees not to hire UES's employees except through UES. In the event Client hires a UES employee within one year following any project through which Client had contact with said employee, Client shall pay UES an amount equal to one-half of the employee's annualized salary, as liquidated damages, without UES waiving other remedies it may have.

SECTION 15: ASSIGNS Neither Client nor UES may delegate, assign, sublet, or transfer its duties or interest in this Agreement without the written consent of the other party.

SECTION 16: GOVERNING LAW AND SURVIVAL **16.1** This Agreement shall be governed by and construed in accordance with the laws of the jurisdiction in which the UES office performing the services hereunder is located. **16.2** In any of the provisions of this Agreement are held illegal, invalid, or unenforceable, the enforceability of the remaining provisions will not be impaired and will survive. Limitations of liability and indemnities will survive termination of this agreement for any cause.

SECTION 17: INTEGRATION CLAUSE **17.1** This Agreement represents and contains the entire and only agreement and understanding among the parties with respect to the subject matter of this Agreement, and supersedes any and all prior and contemporaneous oral and written agreements, understandings, representations, inducements, promises, warranties, and conditions among the parties. No agreement, understanding, representation, inducement, promise, warranty, or condition of any kind with respect to the subject matter of this Agreement shall be relied upon by the parties unless expressly incorporated herein. **17.2** This Agreement may not be amended or modified except by an agreement in writing signed by the party against whom the enforcement of any modification or amendment is sought.

SECTION 18: WAIVER OF JURY TRIAL Both Client and UES waive trial by jury in any action arising out of or related to this Agreement.

SECTION 19: INDIVIDUAL LIABILTY PURSUANT TO FLORIDA STAT. 558.0035, AN INDIVIDUAL EMPLOYEE OR AGENT OF UES MAY NOT BE HELD INDIVIDUALLY LIABLE FOR NEGLIGENCE.