Memorandum

Environmental Resources Management

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To:	Erin McDonnell, P.E.
Company:	Oregon Department of Environmental Quality Northwest Region 2020 SW 4th Avenue, Suite 400 Portland, Oregon 97201
From:	Brendan Robinson, ERM
Project Number:	0283866
Date:	4 May 2015
Subject:	Groundwater Barrier Wall Conceptual Design and Setback Memorandum

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ERM-West, Inc. (ERM) has prepared this *Groundwater Barrier Wall Conceptual Design and Setback Memorandum* on behalf of MMGL Corp. (MMGL) for Premier Edible Oils (PEO) property located at 10400 North Burgard Way in Portland, Oregon (the site). The site location is shown on Figure 1. This memorandum was prepared pursuant to the *Voluntary Agreement for Upland Remedial Investigation/Feasibility Study and Source Control Measures*, issued by the Oregon Department of Environmental Quality (ODEQ) and signed 6 March 2001 (ODEQ ECDVC-NWR-01-06) (Voluntary Agreement).

This memorandum presents the results of a geotechnical investigation and the conceptual design of a groundwater barrier wall (GWBW) component of the groundwater source control measure (GW SCM) at the site.

INTRODUCTION

A preliminary geotechnical investigation and engineering evaluation was performed to develop the conceptual design for the GWBW component of the GW SCM. Based on historical investigations and analyses performed to-date, a hanging slurry wall, in conjunction with an air sparging system, has been determined to be a feasible alternative for mitigating potential flow of light non-aqueous phase liquids (LNAPL) and dissolved phase contaminants in groundwater toward the Willamette River. This technical memorandum focuses on developing the GWBW conceptual design. The conceptual design of the sparging system will be presented under separate cover.

The observed extent of LNAPL is from the upland portion of the site and extends to the top of the riverbank (Figure 2). In order to maximize the portion of plume captured, the alignment of the GWBW should be as close to the crest of the riverbank as possible, while maintaining stable and safe conditions during and post-construction.

The objective of this evaluation was to identify the minimum practical offset of the slurry wall alignment from the existing top of bank based on stability and constructability of a slurry wall. It should be noted that the stability analysis presented herein is associated with the stability of the riverbank due to the construction of the slurry wall, and not the stability of the trench walls, as the slurry will support the trench walls.

An approximate offset of the slurry wall was initially estimated based on a preliminary stability analysis. The preliminary alignment was used to determine the approximate location of soil borings installed for the subsurface investigation. The preliminary analysis was revised to incorporate geotechnical field and laboratory data obtained during the subsurface investigation.

SITE CONDITIONS

The ground surface just upland of the riverbank crest is relatively flat, at an elevation between 30 and 32 feet North American Vertical Datum 1988 (NAVD88), and is comprised of an exposed soil and asphalt surface. Groundwater is approximately 20 feet below the upland ground surface at an elevation of approximately 10 feet NAVD88. Based on prior evaluations, the depth of the slurry wall, as considered herein, is assumed to be approximately 50 feet below the ground surface (bgs). The riverbank consists of steep slopes averaging approximately 2 horizontal to 1 vertical (2H:1V). The average water elevation in the river is approximately 8 to 10 feet NAVD88; however, the water level within the river fluctuates. Ordinary high water near the site is approximately 20.5 feet NAVD88. The alignment of the riverbank will require one significant bend in the GWBW.

GEOTECHNICAL EVALUATION

On 17 through 20 February 2015, ERM supervised the drilling of five borings (MR-1 though MR-5) at the site within the general area designated

for the GWBW (Figure 2). Soil borings were advanced by Cascade Drilling, Inc. (Cascade) of Portland, Oregon, using a CME-75 mud rotary drill rig. Soil borings were advanced to total depths of 51.5 to 52 feet bgs. Groundwater was encountered between 20 to 21.5 feet bgs during drilling activities.

Boring locations were spaced approximately 100 feet apart within the conceptual alignment corridor of the GWBW. The initial soil boring MR-1 was completed as a pilot boring to determine subsurface conditions and sampling interval depths for borings MR-2 through MR-5.

Split spoon soil samples were collected at approximate 5-foot intervals using standard penetration test (SPT) methods with a 140-pound hammer. SPT blow counts were recorded. Based on field observations, three strata were identified during drilling activities: upper sand, silt, and lower sand. In-situ soil samples were collected for geotechnical analysis using a Shelby tube sampler. A total of eight in-situ soil samples were collected from the three strata (three from an upper sand zone, three from intermittent silt layers, and two from a lower sand zone) and designated with their respective boring location and depth interval (e.g. MR-2-IS-10′). A total of eight bulk soil samples were collected (three from an upper sand zone, three from intermittent silt layers, and two from a lower sand zone) and designated with their respective boring location and depth interval (e.g. MR-2-BS-20-22′). Soil samples were field screened for volatile organic compounds (VOCs) using a photo-ionization detector (PID). Soil samples were logged using the Unified Soil Classification System. The subsurface materials are predominately poorly graded sand with some silt and clay observed between approximately 28 feet bgs and 37 feet bgs. Generally, the subsurface materials throughout the depth of the borings were characterized as medium to fine sand with limited fine-grained soils (i.e., silt and clay). After drilling and sampling activities were complete, borehole locations were backfilled with bentonite chips and were patched, if appropriate, to match surface conditions. Boring logs are provided in Appendix A.

LABORATORY ANALYSIS

A total of 16 samples, including bulk samples and Shelby tube samples, were collected and submitted to JLT Laboratories, Inc. in Canonsburg, Pennsylvania, for geotechnical analyses. Samples submitted for testing

were representative of the materials and depths observed in the borings. The laboratory tests performed included the following:

- Particle-size distribution analysis (ASTM International [ASTM] D-422) – sieve only for sand hydrometer was used for silts;
- Soil classification (ASTM D-2487);
- Density (ASTM D-2937);
- Moisture content (ASTM D-2216);
- Atterberg limits (ASTM D-4318); and
- Direct shear strength test (ASTM D-3080).

The laboratory test results are provided in Appendix B; a brief summary of the soil index data results are provided in Table 1 below.

Table 1 A Summary of Geotechnical Laboratory Results

Boring	Depth (ft)	Sample Type	Soil Classification	% Sand (particle size)	Moisture Content (%)	Residual Cohesion (lb/ft²)	Residual Friction Angle (˚)
MR-2	9-10	Shelby	SP	98.1	24.4	43	29.2
MR-2	20-22	Bulk	SP	95.1	26.3	--	--
MR-2	35-36	Shelby	ML	7.4	36.4	--	--
MR-2	40-42	Bulk	SM	83.6	30.9	--	--
MR-3	8-10	Bulk	SP	96.8	14.1	--	--
MR-3	17-18	Shelby	SP	98.5	27.3	44	27.9
MR-3	33-35	Bulk	SM	70.7	37.6	--	--
MR-3	41-42	Shelby	SP	98.8	26.0	279	25.2
MR-4	33-34	Shelby	ML	18.7	39.6	--	--
MR-4	36-38	Bulk	SP	98.6	24.1	--	--
MR-4	48-50	Bulk	SP	98	28.1	--	--
MR-4	50-51	Shelby	SP	99.1	27.5	172	26
MR-5	28-30	Bulk	SM	71.9	33.2	--	--
MR-5	30-31	Shelby	SP	98.2	32.8	76	28
MR-5	32-33	Shelby	ML	30.8	40.8	120	27.7
MR-5	35-37	Bulk	ML	21.9	46.6	--	--

The friction angle is generally consistent across the soils and depths ranging between 25 degrees and 29 degrees. However, cohesion varied between 43 pounds per square foot (psf) and 279 psf, with the lower values observed at shallower depths and higher values at lower depths. Based on SPT blow counts (presented on the soil boring logs in Appendix A), and correlating with the friction angles, the sandy materials are characterized as loose sand.

SLOPE STABILITY ANALYSIS

Based upon the geotechnical laboratory and field data, three soil layers were identified. In descending order, these layers consisted of the following:

- A layer of medium and fine sand material extending to a depth of 30 feet bgs.
- A layer of silt and silty sand material extending from a depth of 30 to 37 feet bgs.
- A layer of fine and medium sand material extending from a depth of 37 feet bgs to the bottom of slurry wall at 50 feet bgs.

Each of these layers of subsurface materials was assigned index properties, including unit weight (moist and saturated) and strength parameters, based on the data from the laboratory analysis. Properties of the slurry wall were estimated based on experience with similar materials. The index properties incorporated in the analysis are presented in Table 2 below.

Table 2 Index Properties

Material Description	Unit Weight (lb/ft^3)	Saturated Unit Weight (lb/ft^3)	Cohesion Intercept (lb/ft^2)	Internal Friction Angle (°)	Soil Type
Sand (top layer)	111	118	54	28	1
Silt and Silty Sand	110	115	113	28	2
Sand	117	125	184	26	3
Slurry Wall	110	120	2	0	4

The following scenarios were considered for stability analysis:

1. Stability of the slope under the existing conditions to verify the parameters that represent a stable slope.
2. Construction of the slurry wall, including the slurry trench and a surcharge load representing the slurry wall trenching machine located a certain distance up-gradient of the top of the bank to identify the minimum slurry wall offset from the bank.
3. Stability following construction of the slurry wall.

Both normal and rapid drawdown conditions were considered for the slurry wall scenarios. Rapid drawdown occurs when the water elevation within the river drops rapidly (i.e., after a storm) but the groundwater elevation remains elevated as it is slower to dissipate. In this scenario, the pore water from saturation of the slope cannot dissipate in the short term and excess pore water pressures exist within the embankment. This condition will reduce the stability of the embankment. Both rapid drawdown and normal river and groundwater conditions were evaluated. Rapid drawdown during slurry wall construction represents the critical condition. For the rapid drawdown condition, the water level in the river was initially considered 10 feet above the normal river water level, to an elevation of 20 feet above mean sea level, then quickly drawn down to normal level. This surface water elevation represents the high water level based on field observation as well as from measurement recorded at United States Geological Survey tidal gauge (ID#14211720) located in the vicinity of the site.

ERM employed STABL 3.0 slope stability software to configure and perform multiple stability analyses for each scenario based on soil parameters and the corresponding geometry. Both rotational and sliding block failures were analyzed. Multiple analyses were conducted to identify the minimum factor of safety acceptable while allowing the closest approach of the slurry wall to the crest of the riverbank. The stability analyses are presented in Appendix C.

Results of Stability Analyses

As indicated above, both deep-seated rotational failure and veneer (sliding block) failure mechanisms were considered within the stability analyses. It was determined that rotational failure was the critical evaluation (i.e., resulted in the lowest factor of safety) for all the scenarios described above.

Under the first scenario, the general stability of the riverbank with no construction loads and normal groundwater conditions was evaluated. It is noted that the factor of safety for the existing riverbank under normal groundwater conditions was less than 1.5, an established industry standard, but greater than 1.0 (imminent failure). Model output for this scenario is presented as Appendix C.1 and C.2 (normal groundwater and rapid-drawdown conditions, respectively)

For the second scenario, it was determined that the outboard edge of the slurry wall should be located a minimum of 20 feet up-gradient (i.e., inland) of the crest of the riverbank. With this minimum requirement, the centerline of a 3-foot wide slurry wall should be 21.5 feet from the crest of the riverbank. When the slurry wall is located 20 feet inland of the crest of the riverbank it is outside of the critical failure surface. Model output for this scenario is presented as Appendix C.3 and C.4 (normal groundwater and rapid-drawdown conditions, respectively).

For the third scenario, the stability of the riverbank following construction of the slurry wall was evaluated. Since the proposed slurry wall alignment is located just beyond the critical failure surface, the long-term stability of the slurry wall does not significantly vary the factor of safety when compared to the existing conditions. Model output for this scenario is presented as Appendix C.5 and C.6 (normal groundwater and rapid drawdown conditions, respectively).

The stability analyses scenarios are summarized in Table 3 below.

Table 3 Stability Analyses Scenarios

	Scenario	**Model Summary** (Normal groundwater conditions)	**Model Summary** (Rapid drawdown conditions)	**Appendix Location of Output** (Normal groundwater conditions)	**Appendix Location of Output** (Rapid drawdown conditions)
1	Existing riverbank	• No construction load • No slurry wall • Critical Factor of Safety = 1.33	• No construction load • No slurry wall • Critical Factor of Safety = 0.98	C.1	C.2
2	During Construction	• Construction load • Slurry wall offset =20 feet • Critical Factor of Safety = 1.33	• Construction load • Slurry wall offset =20 ft • Critical Factor of Safety = 0.98	C.3	C.4
3	Post Construction	• No construction load • Slurry wall offset =20 feet • Critical Factor of Safety = 1.33	• No construction load • Slurry wall offset =20 ft • Critical Factor of Safety = 0.98	C.5	C.6

Slurry Wall Construction

Conventional slurry wall construction requires multiple steps including the excavation of the trench, preparing the slurry, pumping slurry into the trench to hold the trench open, mixing the low permeability backfill (i.e., soil-bentonite backfill) in a designated mixing area, placing the backfill into the trench, and various quality control tests for each stage. A large working area is required for the preparation of the slurry and mixing the backfill. Due to the flowable nature of the backfill, the mixing area is generally sloppy and requires controls to prevent erosion and backfill from unintentionally flowing or falling into the trench. The excavation and backfilling of the trench is largely dependent on the equipment operator's proficiency. The trench slopes at either end should be maintained to enable proper placement of backfill and prevent collapse or buckling of the existing materials. If the excavation and backfilling of the trench is not conducted appropriately, sand lenses or permeable "windows" could be trapped within the slurry wall that enable groundwater flow to more easily pass through the barrier. Refer to Appendix D for a photograph of conventional slurry wall construction.

The primary site-specific constraints include sandy materials which have a higher potential for wall instability, the proximity of the slurry wall to the crest of the riverbank, and a bend located within the area of higher concentrations of contaminants. Maintaining wall stability during construction is dependent on the contractor's excavation techniques and achieving a slurry mix that is sufficient to maintain the open trench.

The construction methodology will affect the reliability and performance of the bend in the wall. There are various construction methods being considered based on discussions with the contractors. The considerations for each construction technique include proximity to the 20-foot top of bank offset at the bend, uncertainty regarding wall stability during construction, and cost. Various slurry wall construction options and their effect on the wall alignment are presented below. It should be noted that the final design should not dictate the means and methods for wall construction; rather, the following descriptions of various methods are for reference purposes as they relate to wall alignment, uncertainties in construction, and cost.

1. **Lead-in/Exit Trench Beyond Turning Point:** A conventional technique to accommodate a turn in a slurry wall is to construct a wall segment, relocate the equipment, and construction of a separate wall segment that intersects at the turning point. To achieve the full depth at the

intersection point, an exit trench for the initial wall segment continues beyond the turning point, and a lead-in trench for the second wall segment begins beyond the turning point. In this manner, an "X" is formed with the intersection of the walls forming the turning point. This method is not considered an acceptable approach at the site, as the lead-in and exit trenches would extend down the riverbank. Construction of a trench in the riverbank reduces the maximum elevation of the slurry and increases potential for slurry to discharge into the river.

2. **Sweeping Bend:** An excavator can accommodate a sweeping bend with a radius between 100 and 150 feet. As a result, the wall alignment at the site would be approximately 18 feet further inland from the turning point and gradually transition to the tangential intersection with the straight wall segment approximately 70 feet from the turning point. Consequently, the wall alignment would concede up to 18 feet further inland to make the bend, as shown on Figure 2. This method allows for continuous trenching without repositioning/relocating the equipment. Further, there is no additional risk or uncertainty associated with constructing the bend relative to the straight-wall segments.

3. **Auger Mixing at Turning Point:** Conventional slurry wall construction will be used for the straight segments up to approximately 50 to 70 feet from the turning point. The equipment will need to be repositioned/relocated to install each segment. Mobilization of in-situ auger soil mixing equipment will be required to construct the turning point. Overlapping auger-mixed soil-bentonite holes would be implemented to achieve a continuous GWBW, including the turn at the designated 20-foot offset from the top of riverbank. In-situ mixing is a proven technology to achieve the objectives of the project. Since the blending of materials is performed in-place (i.e., does not require excavation of a trench and separate backfilling of the trench), this approach is more controlled with less risk of potential wall instability or collapse. However, it is a different process with separate equipment, crews, and quality control measures. The mobilization and use of separate equipment will increase the project cost.

4. **Vertical Trench End Wall at Turning Point:** An alternative technique that has been suggested consists of constructing intersecting vertical endwalls at the turning point. Initially a lead-in trench along one of the line segments would terminate with a vertical endwall at the turning point. The equipment would then be repositioned/relocated to

construct a similar lead-in trench with a vertical endwall at the turning point. The vertical endwall trenches would intersect at the turning point to create the bend. The equipment would be repositioned multiple times to complete the wall. This approach would achieve the intended 20-foot offset from the riverbank. However, there is uncertainty regarding the constructability and performance of the slurry wall with this construction technique regarding the ability to excavate a vertical end wall and ensure it remains stable. There is a potential that a wedge of existing material would remain in the bottom of the trench. If the wedge is removed, the operator must take extreme care to not over excavate the bottom and undercut the intersection point, thereby, creating a reverse slope that will inevitably collapse. There is also a potential that the size of the turning point would increase due to erosion of sands during excavation (i.e., intersecting vertical walls) and/or backfilling. Additionally, soil-bentonite backfill would need to flow around the turning point, potentially inducing erosion of the wall. This method will increase costs relative to the sweeping bend approach. This approach will achieve the designated setback along the bend; however, the uncertainties add inherent risk with additional cost and quality control requirements to ensure successful implementation of this approach.

5. **One-Pass Trenching:** One-pass trenching (OPT) is an alternative technology to conventional slurry wall construction. OPT uses specialized equipment with a large cutting bar (i.e., resembles a large chainsaw) to cut the trench and mix the existing soils with bentonite simultaneously. Bentonite is placed loose at the top of the trench, and bentonite slurry is also pumped through the cutting bar to inject the reagent at depth. Mixing is performed in-situ; therefore, an open trench does not need to be maintained with slurry, and there is less concern associated with wall collapse or instability. OPT also does not require the space or controls needed for mixing, as OPT can be utilized in space-constrained areas. Additionally, OPT has a tight turning radius, which is approximately 40 feet. The most significant limiting factor is the presence of obstructions, such as boulders, concrete foundations, or other impediments. Obstructions were not observed during installation of the geotechnical borings or historical monitoring well installation in the vicinity of the wall alignment. As a result, OPT is a viable technology that can achieve the designated setback. The cost is slightly higher than the sweeping bend option. However, it is competitive with the other conventional slurry wall methods described above. Refer to Appendix D for a photograph of OPT.

CONCLUSION

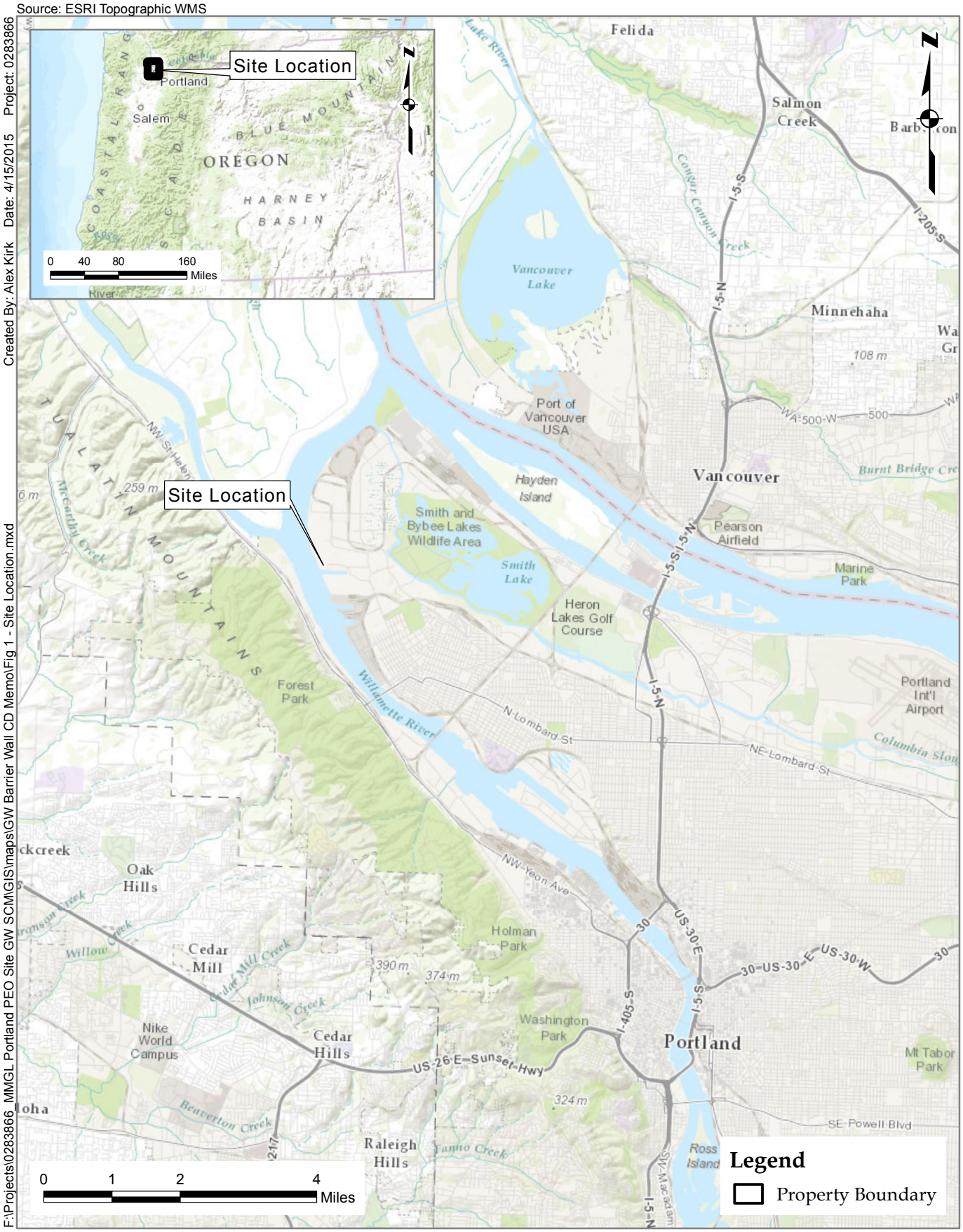
Slurry wall construction has inherent risks and uncertainties, particularly with sandy soils and constructing bends. Wall collapse or sand "windows" are the primary concerns with slurry wall construction. Many of the uncertainties can be managed with an experienced operator and quality control activities. Based on this preliminary geotechnical assessment, the outboard limit of the slurry wall should be offset from the crest of the riverbank by a minimum of 20 feet (for a 3-foot wide slurry wall, the centerline would be 21.5 feet from the crest). The bend can be constructed using conventional slurry wall technology, with an alternative to achieve a bend that is closer to the designated offset. In general, construction costs increase with a bend that is closer to the designated offset. OPT is a feasible alternative construction technology for installing the GWBW.

RECOMMENDATIONS

Prior to preparation of a final GWBW design, further soil and groundwater samples should be collected from the proposed alignment area. Samples will be collected in the areas of known LNAPL and dissolved phase impact and used for slurry compatibility and mix design testing. Results of the slurry compatibility testing will be used in the final design specifications. Additionally, other design elements such as the wall depth and length should be evaluated and presented in the final design specifications.

Figures

Source: ESRI Topographic WMS

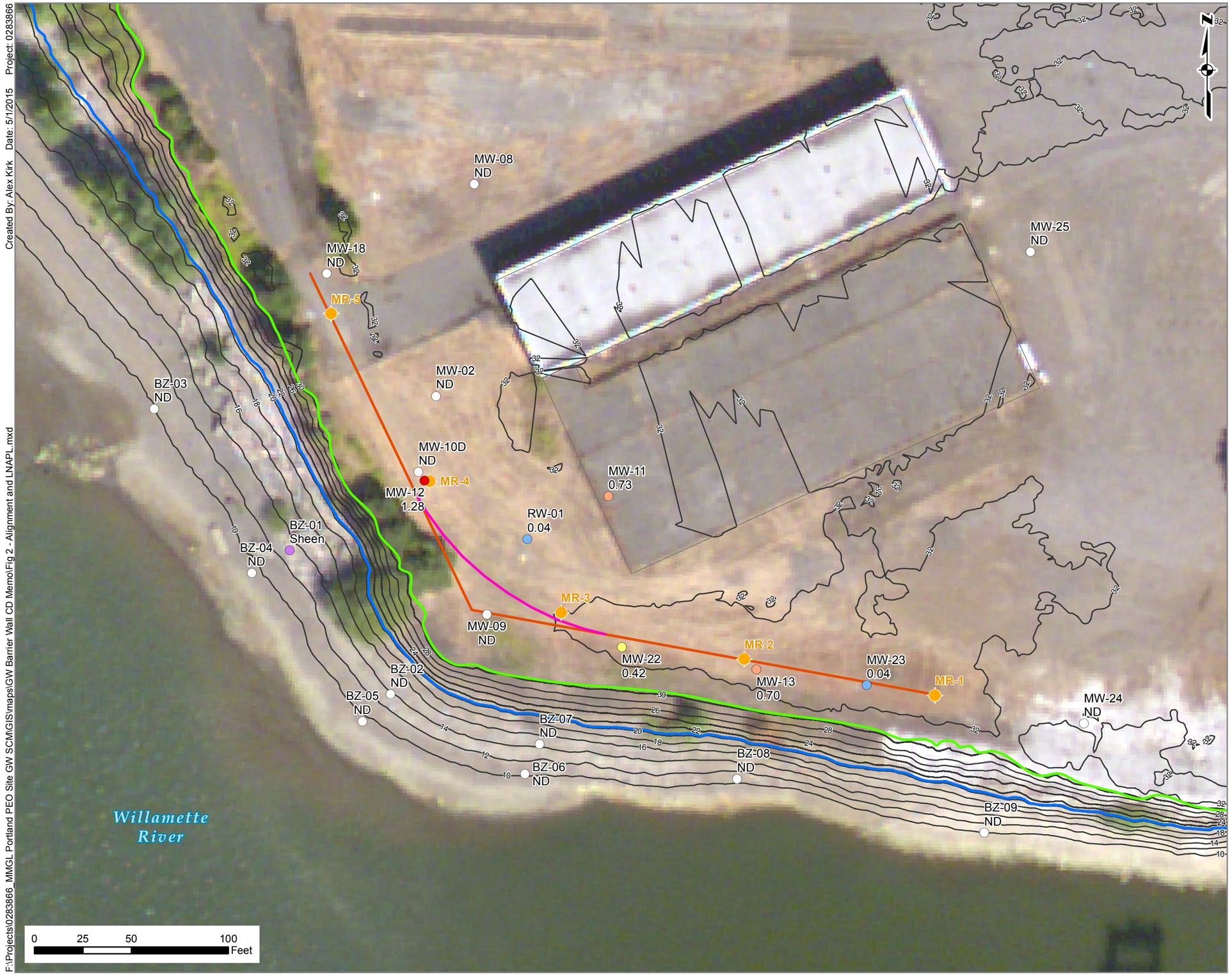


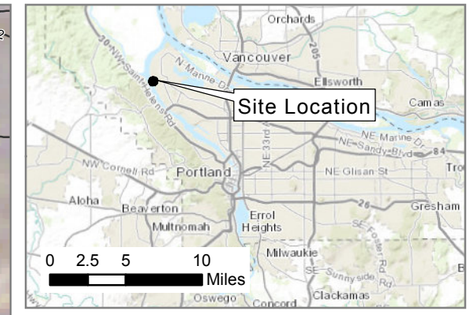
Created By: Alex Kirk Date: 4/15/2015 Project: 0283866

F:\Projects\0283866_MMGL Portland PEO Site GW SCM\GIS\maps\GW Barrier Wall CD Memo\Fig 1 - Site Location.mxd

Environmental Resources Management
1001 SW 5th St, Suite 1010
Portland, Oregon 97204

Figure 1
Site Location
Groundwater Barrier Wall Conceptual Design Memorandum
Southern PEO Site
Portland, Oregon





Legend

- Geotechnical Borings

August 2012 LNAPL Thickness

- ND
- Sheen
- 0.01-0.25 ft
- 0.25 - 0.50 ft
- 0.50 - 1.0 ft
- > 1.0 ft
- Proposed Alignment of Slurry Wall
- Wall Offset for Continuous Construction
- Top of Bank
- Ordinary High Water (20.5 ft NAVD88)
- USACE 2010 LiDAR Contours (2 ft)

Notes:
LNAPL: Light Non-Aqueous Phase Liquids
ND: Not Detected
LNAPL Thickness given in feet
Aerial Imagery dated 7/7/2012

Figure 2
Groundwater Source Control Measure
Groundwater Barrier Wall
Conceptual Design Memorandum
Southern PEO Site
Portland, Oregon

Environmental Resources Management
1001 SW 5th St, Suite 1010
Portland, Oregon 97204

ERM

Created By: Alex Kirk Date: 5/1/2015 Project: 0283866
F:\Projects\0283866_MMGL Portland PEO Site GW SCM\GIS\maps\GW Barrier Wall CD Memo\Fig 2 - Alignment and LNAPL.mxd

Appendix A
Boring Logs

ERM-West, Inc.
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Telephone: 503-488-5282

MR-1

CLIENT MMGL
PROJECT NAME PEO Portland Subsurface Investigation
PROJECT NUMBER 0283866
PROJECT LOCATION 10400 N. Burgard Way, Portland Oregon
DATE STARTED 2/16/15 **COMPLETED** 2/17/15
GROUND ELEVATION **HOLE SIZE** 3'-7/8"
CONTRACTOR Cascade Drilling
GROUND WATER LEVELS:
EQUIPMENT CME 75 Mud Rotary Drill Rig with 140 lb hammer
AT TIME OF DRILLING 21.50 ft
LOGGED BY J. Dauphinais **CHECKED BY** K. Ewing
AT END OF DRILLING ---
NOTES Boring cleared to 5 feet below ground surface using a vacuum truck and air lift.
AFTER DRILLING ---

DEPTH (ft)	SAMPLE IDENTIFICATION	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
0			ML		TOPSOIL SILT (ML): dark brown (10YR3/3), soft, moist. (1.5)	
			GW		POORLY GRADED SANDY GRAVEL (GW): brown (10YR 4/3), medium dense, 15% fine grain sand, with cobbles, moist. (2.0)	
			SP		POORLY GRADED SAND (SP): dark brown (10YR 3/3), loose, fine to medium grain, 5% fines, cobbles, moist.	
		5-4-5 (9)			5% fines, no cobbles.	
10		5-5-7 (12)				
		4-4-4 (8)			black (10YR 2/1), loose, fine to medium grain, moderate hydrocarbon odor, possible staining, 5% fines, moist.	8.1
20		3-3-4 (7)			no recovery 20-21.5 feet below ground surface.	
		5-6-5 (11)			very dark gray (10YR 3/1), loose, fine to medium grain, 5% fines, slight hydrocarbon odor, wet.	18.7
		4-4-4 (8)	SM		very dark gray (10YR 3/1), loose, fine to medium grain, 10% fines, moist. (25.5) SILTY SAND (SM): dark brown (10YR 2/2), loose, 30% fines, moist. (26.0)	
			SP		POORLY GRADED SAND (SP): dark brown (10YR 2/2), loose, 10% fines, moist.	
30		2-2-2 (4)			very dark brown (10YR 3/3), loose, fine to medium grain, 10% fines, moderate hydrocarbon odor, moist. (31.0)	
			ML		SILT (ML): very dark brown (10YR 3/3), soft, moderate hydrocarbon odor, 10% fine grain sand, moist. (33.0)	
			CL		CLAY (CL): no visual observation based on driller indication. (33.5)	
			SP		SAND (SP): no visual observation based on driller indication. (35.0)	
		1-1-0 (1)	ML		CLAYEY SILT (ML): very dark gray (10YR 3/1), soft, low plastic, slight hrydrocarbon odor, moist. (36.5)	
40		7-7-7 (14)			POORLY GRADED SAND (SP): black (10YR 2/1), loose, fine to medium grain, slight hydrocarbon odor, trace fines, moist.	
		8-7-6 (13)	SP		moderate hydrocarbon odor.	0.7
50		8-6-7 (13)			very dark gray (10YR 3.1), 5% to 10% trace fines, moist. (51.5)	0.6

Bottom of borehole at 51.5 feet.

GENERAL BH / TP / WELL - GINT STD US.GDT - 3/5/15 16:35 - F:\ERM\GINT\MMGL\MMGL PEO PORTLAND SI.GPJ

ERM-West, Inc.
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Portland, Oregon 97204
Telephone: 503-488-5282

MR-2

CLIENT MMGL
PROJECT NAME PEO Portland Subsurface Investigation
PROJECT NUMBER 0283866
PROJECT LOCATION 10400 N. Burgard Way, Portland Oregon
DATE STARTED 2/16/15 **COMPLETED** 2/18/15
GROUND ELEVATION **HOLE SIZE** 3'-7/8"
CONTRACTOR Cascade Drilling
GROUND WATER LEVELS:
EQUIPMENT CME 75 Mud Rotary Drill Rig with 140 lb hammer
AT TIME OF DRILLING 20.00 ft
LOGGED BY J. Dauphinais **CHECKED BY** K. Ewing
AT END OF DRILLING ---
NOTES Boring cleared to 5 feet below ground surface using a vacuum truck and air knife
AFTER DRILLING ---

DEPTH (ft)	SAMPLE IDENTIFICATION	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
0			ML		TOPSOIL SILT (ML): dark brown (10YR3/3), soft, moist. (1.5)	
			GW		POORLY GRADED SANDY GRAVEL (GW): brown (10YR 4/3), loose, 30% fine to medium grain sand, with concrete cobbles, moist. - (2.3)	
			SP		POORLY GRADED SAND (SP): dark brown (10YR 3/3), loose, fine to medium grain, 5% to 10% fines. -	
		4-6-7 (13)			trace fines, no hydrocarbon odor, moist. -	
10	MR-2-IS-10'					
		4-5-7 (12)			very dark gray (10YR 3/1), loose, fine to medium grain, moderate hydrocarbon odor, trace fines, moist. -	4.3
		3-4-5 (9)	SP		black (10YR 2/1), loose, fine to medium grain, trace fines, moderate hydrocarbon odor, wet. -	909
20					wet -	
	MR-2-BS-20-22'					
		5-3-5 (8)				33.2
30					(30.0)	
		3-4-6 (10)	ML		SILT (ML): very dark brown (10YR 3/3), soft, moderate hydrocarbon odor, 10% fine grain sand, wet. (30.5)	
			SM		SILTY SAND (SM): very dark brown (10YR 3/3), loose, moderate hydrocarbon odor, 10% fines, wet. - (31.0)	
			SP		POORLY GRADED SAND (SP): very dark brown (10YR 3/3), loose, moderate hydrocarbon odor, sheen on sample core water, 30% fines, wet. - (31.5)	0.5
	MR-2-IS-35'		SP		POORLY GRADED SAND (SP) -	
40						
	MR-2-BS-40-42'				(42.0)	
		0-4-6 (10)	SM		SILTY SAND (SM): dark grayish brown (10YR 4/2), very loose, 30% fine sand, wet. (42.5)	
					POORLY GRADED SAND (SP)	
		7-9-8 (17)	SP		POORLY GRADED SAND (SP): very dark gray (10YR 3/1), loose, fine to medium grain, moderate hydrocarbon odor, sheen on sample core water, 5% fines, wet.	
50						
		8-6-7 (13)			(51.5)	

Bottom of borehole at 51.5 feet.

GENERAL BH / TP / WELL - GINT STD US.GDT - 3/5/15 16:35 - F:\ERM\GINT\MMGL\MMGL PEO PORTLAND SI.GPJ

ERM-West, Inc.
1001 S.W. 5th Avenue, Suite 1010
Portland, Oregon 97204
Telephone: 503-488-5282

MR-3

CLIENT MMGL
PROJECT NAME PEO Portland Subsurface Investigation
PROJECT NUMBER 0283866
PROJECT LOCATION 10400 N. Burgard Way, Portland Oregon
DATE STARTED 2/16/15 **COMPLETED** 2/18/15
GROUND ELEVATION **HOLE SIZE** 3'-7/8"
CONTRACTOR Cascade Drilling
GROUND WATER LEVELS:
EQUIPMENT CME 75 Mud Rotary Drill Rig with 140 lb hammer
AT TIME OF DRILLING 20.00 ft
LOGGED BY J. Dauphinais **CHECKED BY** K. Ewing
AT END OF DRILLING ---
NOTES Boring cleared to 5 feet below ground surface using a vacuum truck and air knife
AFTER DRILLING ---

DEPTH (ft)	SAMPLE IDENTIFICATION	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
0			ML		0.8 TOPSOIL SILT (ML): dark brown (10YR3/3), soft, moist.	
			GW		2.5 POORLY GRADED SANDY GRAVEL (GW): dark brown (10YR 3/3), loose, 30% fine to medium grain sand, with cobbles, moist. POORLY GRADED SAND (SP): dark brown (10YR 3/3), loose, fine to medium grain, 10% fines, cobbles (3- to 5-inch diameter).	
			SP		dark yellow brown (10YR 3/4), loose, trace fines.	
10	MR-3-BS-8-10'					
		4-4-4 (8)			dark brown (10YR 3/3), trace gravel.	
		4-4-5 (9)			dark yellow brown (10YR 3/4), 5% fines, moist to wet. very dark gray (10YR 3/1), moderate hydrocarbon odor, sheen on sample core water, wet.	280
20	MR-3-IS-18-20'					
		2-4-4 (8)			black (10YR 2/1), 10% fines, moderate hydrocarbon odor, sheen on sample core water, wet.	188
		3-3-5 (8)			26.0 very dark gray (10YR 3/1), slight hydrocarbon odor.	6.3
			SM		26.5 SILTY SAND (SM)	
			SP		POORLY GRADED SAND (SP)	
30					30.0	
		1-3-5 (8)	SM		30.5 SILTY SAND (SM): very dark gray (10YR 3/1), very loose, fine grain sand, 30% fines, wet.	
			ML		31.0 SILT (ML): dark brown (10YR 3/3), soft, low plastic, 20% clay, trace fine sand, wet.	6.1
			SP		POORLY GRADED SAND (SP): very dark gray (10YR 3/1), loose, 10% fines, slight hydrocarbon odor, wet.	
	MR-3-BS-33-35'				34.0	
			ML		35.0 black (10YR 2/1), loose, fine to medium grain, 10% fines, slight hydrocarbon odor, wet.	
		0-1-2 (3)			CLAYEY SILT (ML): dark brown (10YR 3/3), soft, trace fine sand, moist.	7.7
					POORLY GRADED SAND (SP): very dark grayish brown (10YR 3/2), very loose, fine to medium grain, 10% fines, slight hydrocarbon odor, wet.	
40						
		9-7-8 (15)			very dark gray (10YR 3/1), 5% fines, slight hydrocarbon odor, sheen, wet.	2.4
	MR-3-IS-42'		SM		42.5 SILTY SAND (SM): dark grayish brown (10YR 4/2), very loose, 30% fine sand, wet.	
			SP			
		8-6-6 (12)			black (10YR 2/1), loose, fine to medium grain, trace fines, slight hydrocarbon odor, slight sheen, moist.	0.8
50						
		6-5-6 (11)			51.5	2.4

Bottom of borehole at 51.5 feet.

GENERAL BH / TP / WELL - GINT STD US.GDT - 3/5/15 16:35 - F:\ERM\GINT\MMGL\MMGL PEO PORTLAND SI.GPJ

ERM-West, Inc.
1001 S.W. 5th Avenue, Suite 1010
Portland, Oregon 97204
Telephone: 503-488-5282

MR-4

CLIENT MMGL
PROJECT NAME PEO Portland Subsurface Investigation
PROJECT NUMBER 0283866
PROJECT LOCATION 10400 N. Burgard Way, Portland Oregon
DATE STARTED 2/16/15 **COMPLETED** 2/19/15
GROUND ELEVATION **HOLE SIZE** 3'-7/8"
CONTRACTOR Cascade Drilling
GROUND WATER LEVELS:
EQUIPMENT CME 75 Mud Rotary Drill Rig with 140 lb hammer
AT TIME OF DRILLING 20.00 ft
LOGGED BY J. Dauphinais **CHECKED BY** K. Ewing
AT END OF DRILLING ---
NOTES Boring cleared to 5 feet below ground surface using a vacuum truck and air knife
AFTER DRILLING ---

DEPTH (ft)	SAMPLE IDENTIFICATION	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
0			ML		1.0 TOPSOIL SILT (ML): dark brown (10YR3/3)	
			GW		2.5 POORLY GRADED SANDY GRAVEL (GW): dark brown (10YR 3/3), loose, moist.	
			SP		POORLY GRADED SAND (SP): dark brown (10YR 3/3), loose, fine to medium grain, 10% fines, no hydrocarbon odor.	
		2-2-4 (6)			5% fines, moist.	
10		5-5-4 (9)				
		4-4-5 (9)			black (10YR 2/1), loose, fine grain, 20% fines, moderate hydrocarbon odor, sheen on water, wet.	108
20					20.0 ▽	
		2-4-5 (9)	SM		21.5 SILTY SAND (SM): very dark gray (10YR 3/1), loose, 20% fines, moderate hydrocarbon odor, sheen on sample core water, wet.	192
		5-4-6 (10)	SP		POORLY GRADED SAND (SP): black (10YR 2/1), loose, fine to medium grain, 10% fines, moderate hydrocarbon odor, sheen on water, wet.	26.9
30		5-4-4 (8)			very dark gray (10YR 3/1), slight hydrocarbon odor, sheen on water, wet.	27.6
					34.0	
	MR-4-IS-34'		ML		CLAYEY SILT (ML) 36.0	
	MR-4-BS-36-38'		SP		POORLY GRADED SAND (SP): very dark gray (10YR 3/3), loose, fine to medium grain, trace fines, slight hydrocarbon odor, no sheen, moist.	
40		6-4-3 (7)			10% fines.	5.1
		6-4-6 (10)				6.2
50	MR-4-BS-48-50'					
	MR-4-IS-50'				52.0	

Bottom of borehole at 52.0 feet.

GENERAL BH / TP / WELL - GINT STD US.GDT - 3/5/15 16:35 - F:\ERM\GINT\MMGL\MMGL PEO PORTLAND SI.GPJ

ERM-West, Inc.
1001 S.W. 5th Avenue, Suite 1010
Portland, Oregon 97204
Telephone: 503-488-5282

MR-5

CLIENT MMGL
PROJECT NAME PEO Portland Subsurface Investigation
PROJECT NUMBER 0283866
PROJECT LOCATION 10400 N. Burgard Way, Portland Oregon
DATE STARTED 2/16/15 **COMPLETED** 2/20/15
GROUND ELEVATION **HOLE SIZE** 3'-7/8"
CONTRACTOR Cascade Drilling
GROUND WATER LEVELS:
EQUIPMENT CME 75 Mud Rotary Drill Rig with 140 lb hammer
AT TIME OF DRILLING 20.00 ft
LOGGED BY J. Dauphinais **CHECKED BY** K. Ewing
AT END OF DRILLING ---
NOTES Boring cleared to 7.5 feet below ground surface using a vacuum truck and air knife.
AFTER DRILLING ---

DEPTH (ft)	SAMPLE IDENTIFICATION	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
0			GW	0.4 / 1.5	ASPHALT 5 inches thick	
					WELL GRADED SANDY GRAVEL (GW): dark brown (10YR 3/3), loose, fine to medium grain, no hydrocarbon odor, 30% sand, cobbles (5- inches to 1.5- feet in diameter) dry.	
			SP		POORLY GRADED SAND (SP): dark brown (10YR 3/3), loose, fine to medium grain, 10% fines, no hydrocarbon odor, moist.	
		1-1-2 (3)				
10		2-3-3 (6)			5% to 10% fines,	0.2
					very dark gray (10YR 3/1), 5% fines, wet.	192
20		6-4-5 (9)			10% fines, slight hydrocarbon odor, sheen on water, wet.	2.6
					moist.	
30	MR-5-BS-28-30'					
	MR-5-IS-31'					
	MR-5-IS-33'					
	MR-5-BS-35-37'			35.0		
			ML	37.0	CLAYEY SILT (ML): dark gray (10YR 4/1), soft, low plastic, trace fine sand, slight hydrocarbon odor, moist.	
40		7-8-5 (13)	SP		POORLY GRADED SAND (SP): very dark gray (10YR 3/1), loose, fine to medium grain, 10% fines, slight hydrocarbon odor, sheen on water, wet.	5.2
		7-7-7 (14)			no sheen.	
50		6-6-4 (10)		51.5	20% fines.	4.2

Bottom of borehole at 51.5 feet.

GENERAL BH / TP / WELL - GINT STD US.GDT - 3/5/15 16:35 - F:\ERM\GINT\MMGL\MMGL PEO PORTLAND SI.GPJ

Appendix B
Laboratory Test Results

JLT LABORATORIES, INC.
GEOTECHNICAL, GEOSYNTHETIC AND MATERIALS TESTING AND RESEARCH

March 9, 2015
15LS3165.01

ERM, Inc.
1001 SW 5th Ave
Suite 1010
Portland, OR 97204

Attn: Kathryn Ewing

RE: GEOTECHNICAL TEST RESULTS
MMGL PEO PORTLAND
PROJECT ID: 0283866

Dear Ms. Ewing:

Submitted herein are the results of Moisture Content, Sieve, Hydrometer, Atterberg Limits, Classification, Direct Shear and Tube Density performed on eight (8) bag samples and eight (8) Shelby Tubes from the above referenced project. All testing was performed per ASTM Standards while subject to JLT's internal QA/QC and data validation procedures.

We appreciate the opportunity to provide our services and look forward to working with you again. Should you have any questions, comments or require additional information, please do not hesitate to call. Thank you.

Sincerely,

JLT LABORATORIES, INC.

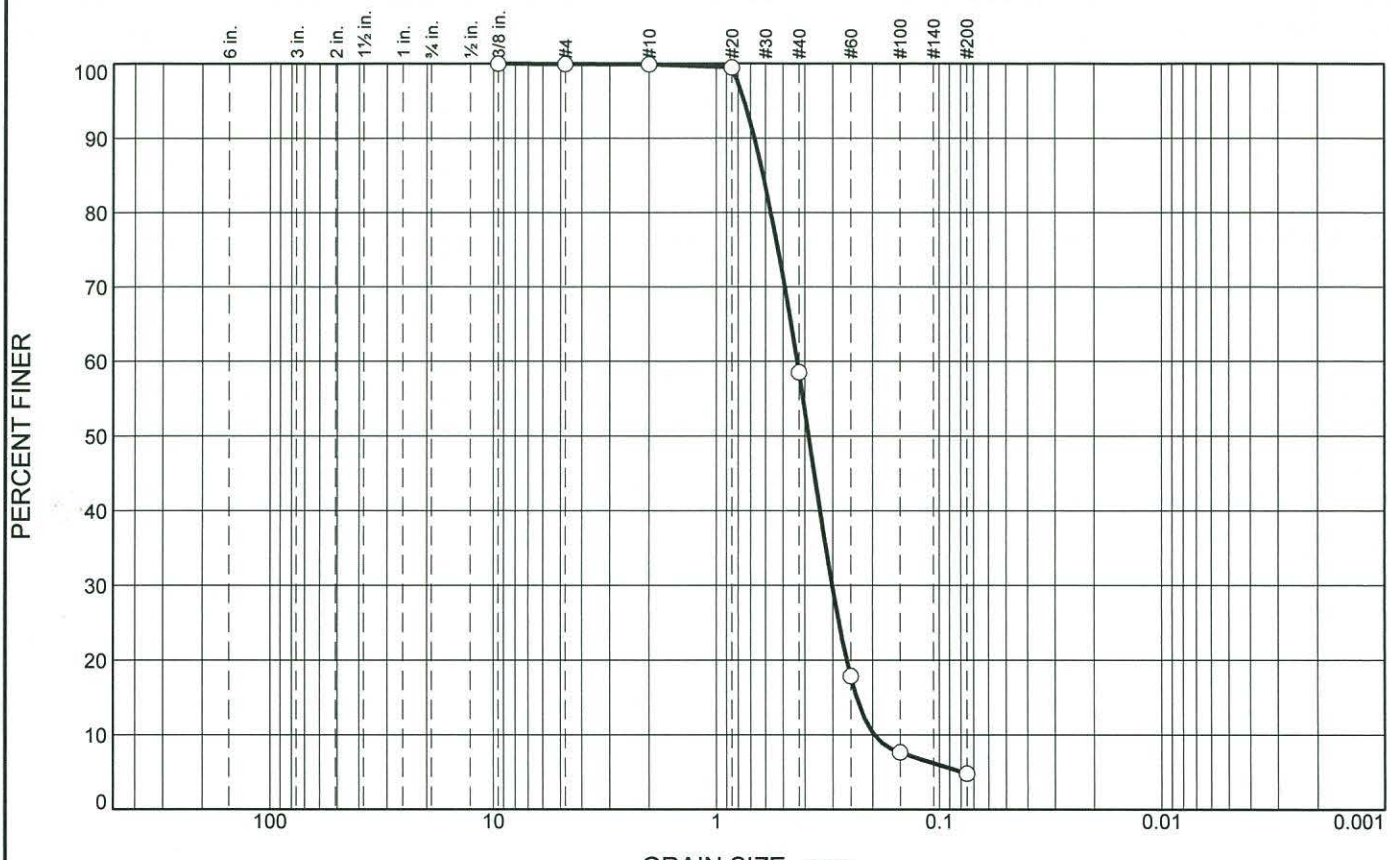
John Boschuk, Jr., P.E., C.F.E.
President

cc: GrafCon - INVOICE - PDF Only

Enclosures
JB/mlb
\wp10\letter\1546
Inv# 5894

938 South Central Avenue • Canonsburg, Pennsylvania 15317 Tel: (724) 746-4441 Fax: (724) 745-4261

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.0	41.3	53.8	4.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.9		
#10	99.9		
#20	99.5		
#40	58.6		
#60	17.9		
#100	7.7		
#200	4.8		

* (no specification provided)

Material Description

Bag Sample

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6707 D_{85}= 0.6128 D_{60}= 0.4325
D_{50}= 0.3844 D_{30}= 0.3021 D_{15}= 0.2344
D_{10}= 0.1951 C_u= 2.22 C_c= 1.08

Classification

USCS= SP AASHTO=

Remarks

As-Rec'd M/C = 26.35%

Location: 0283866
Sample Number: MR-2-BS **Depth:** 20-22 ft **Date:** 03/06/2015

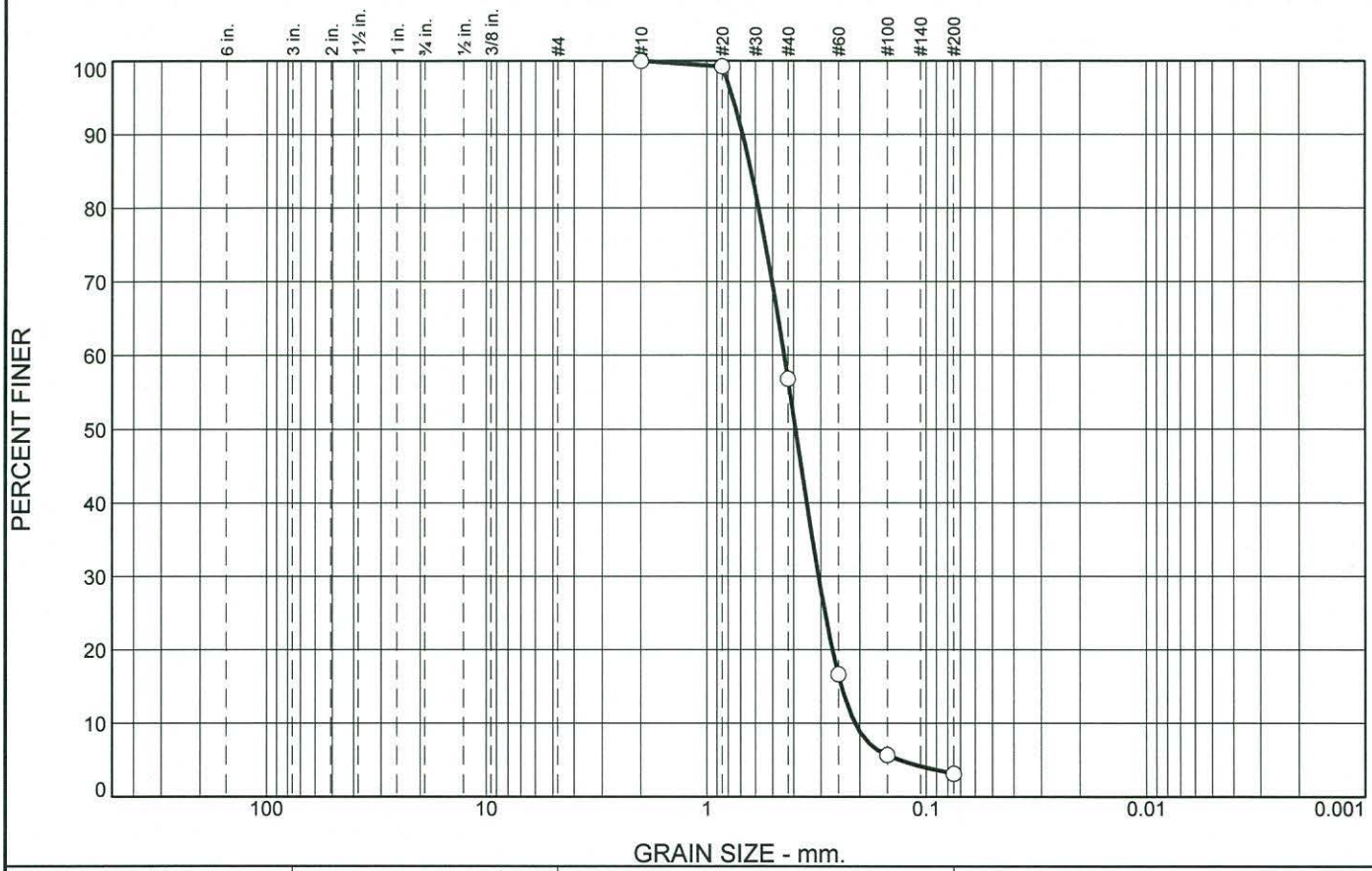
JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	43.2	53.6	3.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.2		
#40	56.8		
#60	16.7		
#100	5.7		
#200	3.2		

* (no specification provided)

Material Description

Bag Sample

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.6840 D_{85}= 0.6260 D_{60}= 0.4416
D_{50}= 0.3918 D_{30}= 0.3074 D_{15}= 0.2414
D_{10}= 0.2089 C_u= 2.11 C_c= 1.02

Classification

USCS= SP AASHTO=

Remarks

As-Rec'd M/C = 14.10%
Hydrometer is Not Applicable

Location: 0283866
Sample Number: MR-3-BS **Depth:** 8-10 ft **Date:** 03/06/2015

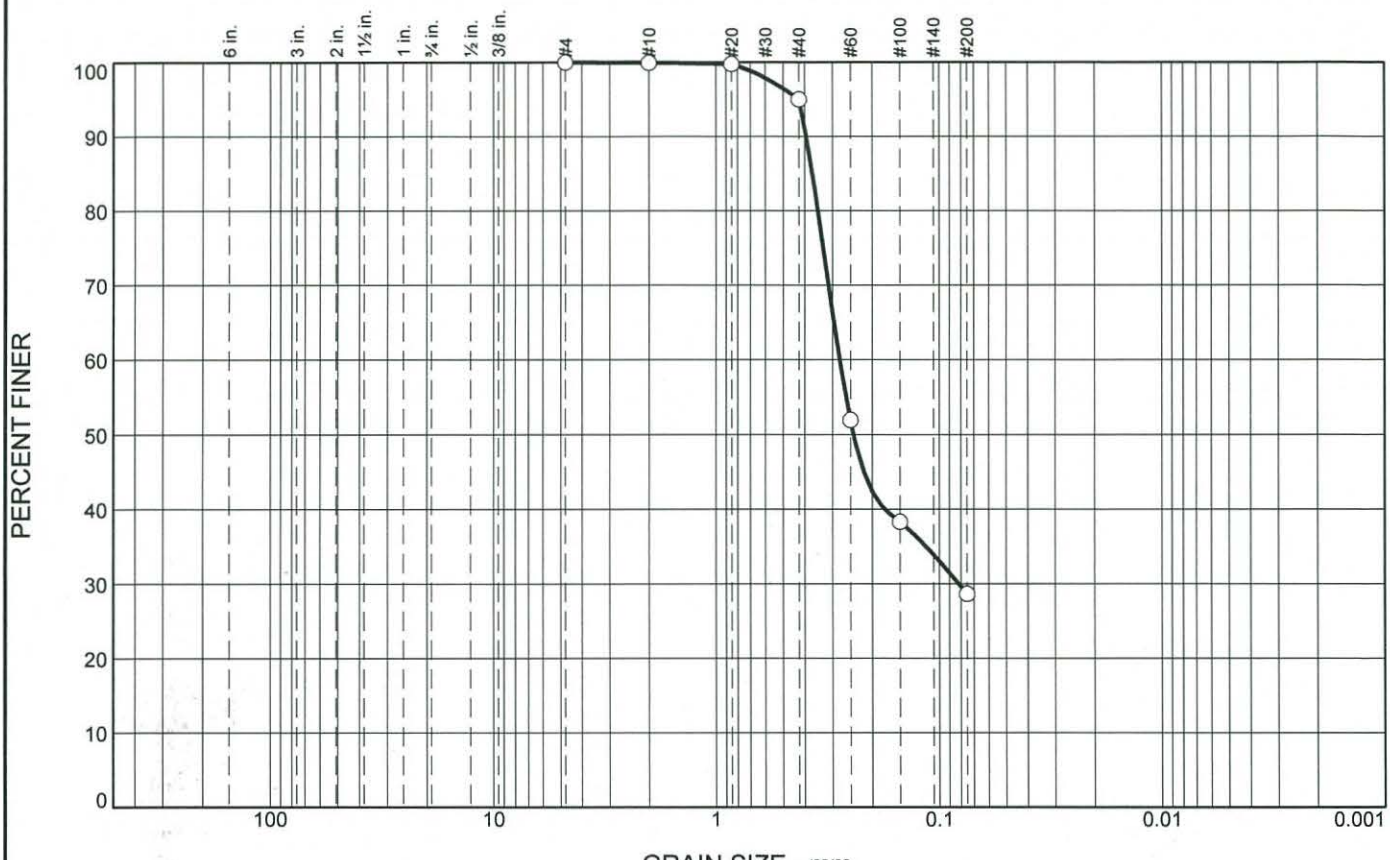
JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	4.9	66.3	28.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	99.8		
#40	95.0		
#60	52.0		
#100	38.3		
#200	28.7		

* (no specification provided)

Material Description

Bag Sample

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3942 D_{85}= 0.3699 D_{60}= 0.2788
D_{50}= 0.2419 D_{30}= 0.0817 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

As-Rec'd M/C = 33.20%

Location: 0283866
Sample Number: MR-5-BS **Depth:** 28-30 ft **Date:** 03/06/2015

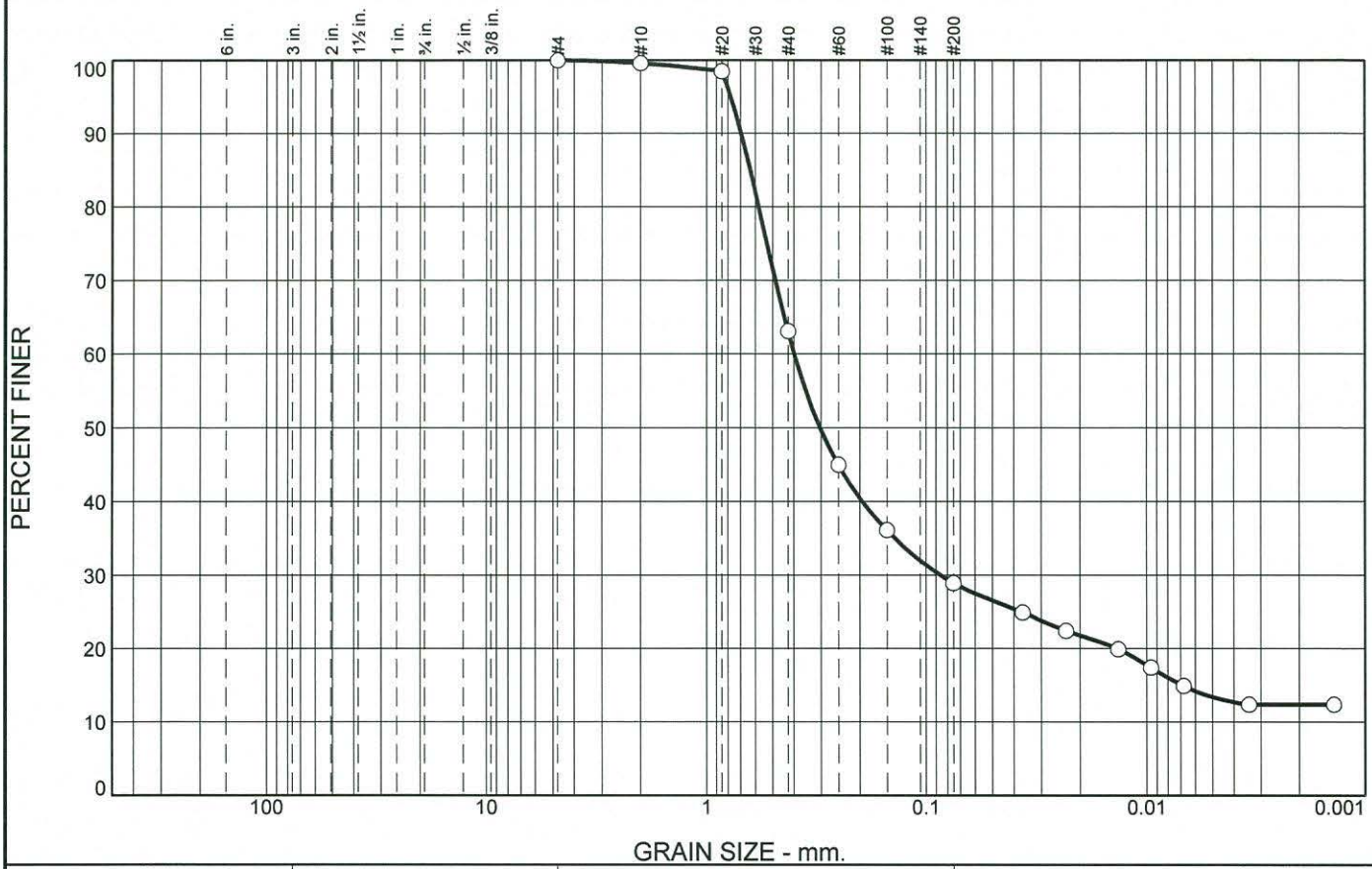
JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.4	36.5	34.2	15.5	13.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.6		
#20	98.5		
#40	63.1		
#60	45.0		
#100	36.1		
#200	28.9		

* (no specification provided)

Material Description

Bag Sample

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6934 D_{85}= 0.6307 D_{60}= 0.3976
D_{50}= 0.3027 D_{30}= 0.0859 D_{15}= 0.0069
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

As-Rec'd M/C = 37.66%

Location: 0283866
Sample Number: MR-3-BS **Depth:** 33-35 ft **Date:** 03/06/2015

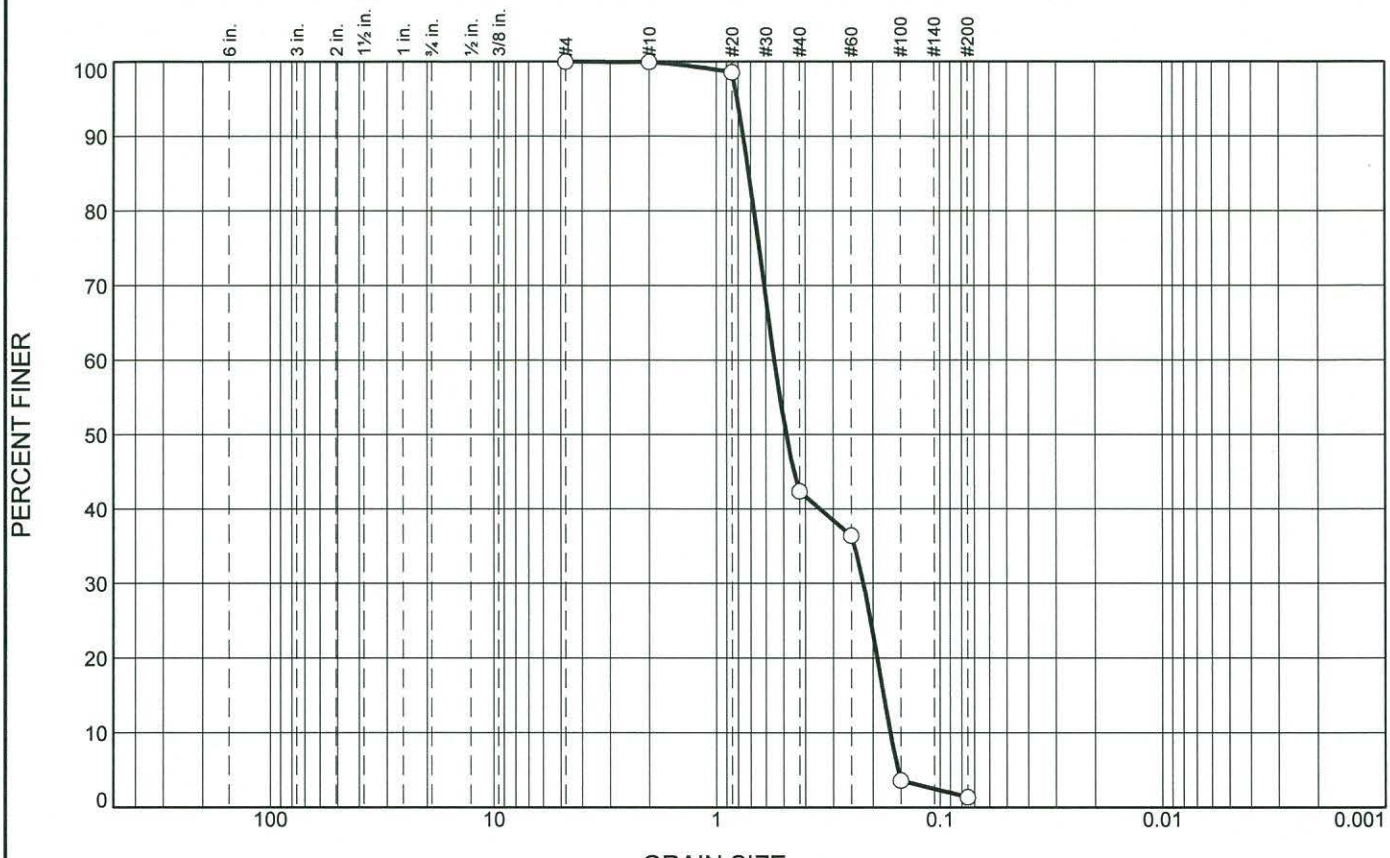
JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	57.6	41.0	1.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	98.6		
#40	42.4		
#60	36.4		
#100	3.6		
#200	1.4		

* (no specification provided)

Material Description

Bag Sample

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.7560 D_{85}= 0.7139 D_{60}= 0.5487
D_{50}= 0.4860 D_{30}= 0.2198 D_{15}= 0.1784
D_{10}= 0.1665 C_u= 3.30 C_c= 0.53

Classification

USCS= SP AASHTO=

Remarks

As-Rec'd M/C = 24.11%
Hydrometer is Not Applicable

Location: 0283866
Sample Number: MR-4-BS **Depth:** 36-38 ft **Date:** 03/06/2015

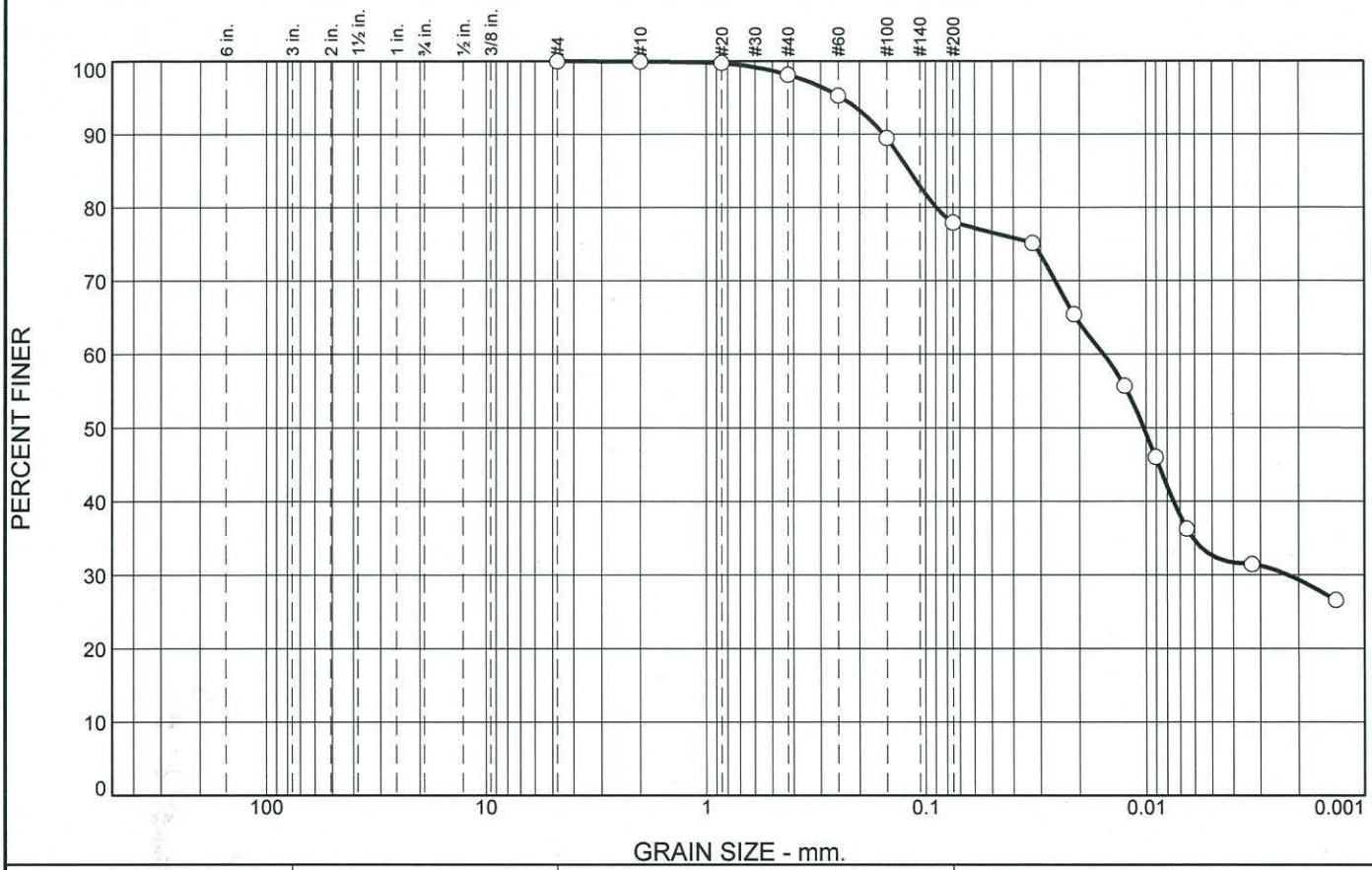
JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.8	20.1	45.4	32.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	99.8		
#40	98.1		
#60	95.3		
#100	89.5		
#200	78.0		

* (no specification provided)

Material Description

Bag Sample

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1548 D_{85}= 0.1178 D_{60}= 0.0155
D_{50}= 0.0102 D_{30}= 0.0022 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

As-Rec'd M/C = 46.62%

Location: 0283866
Sample Number: MR-5-BS **Depth:** 35-37 ft **Date:** 03/06/2015

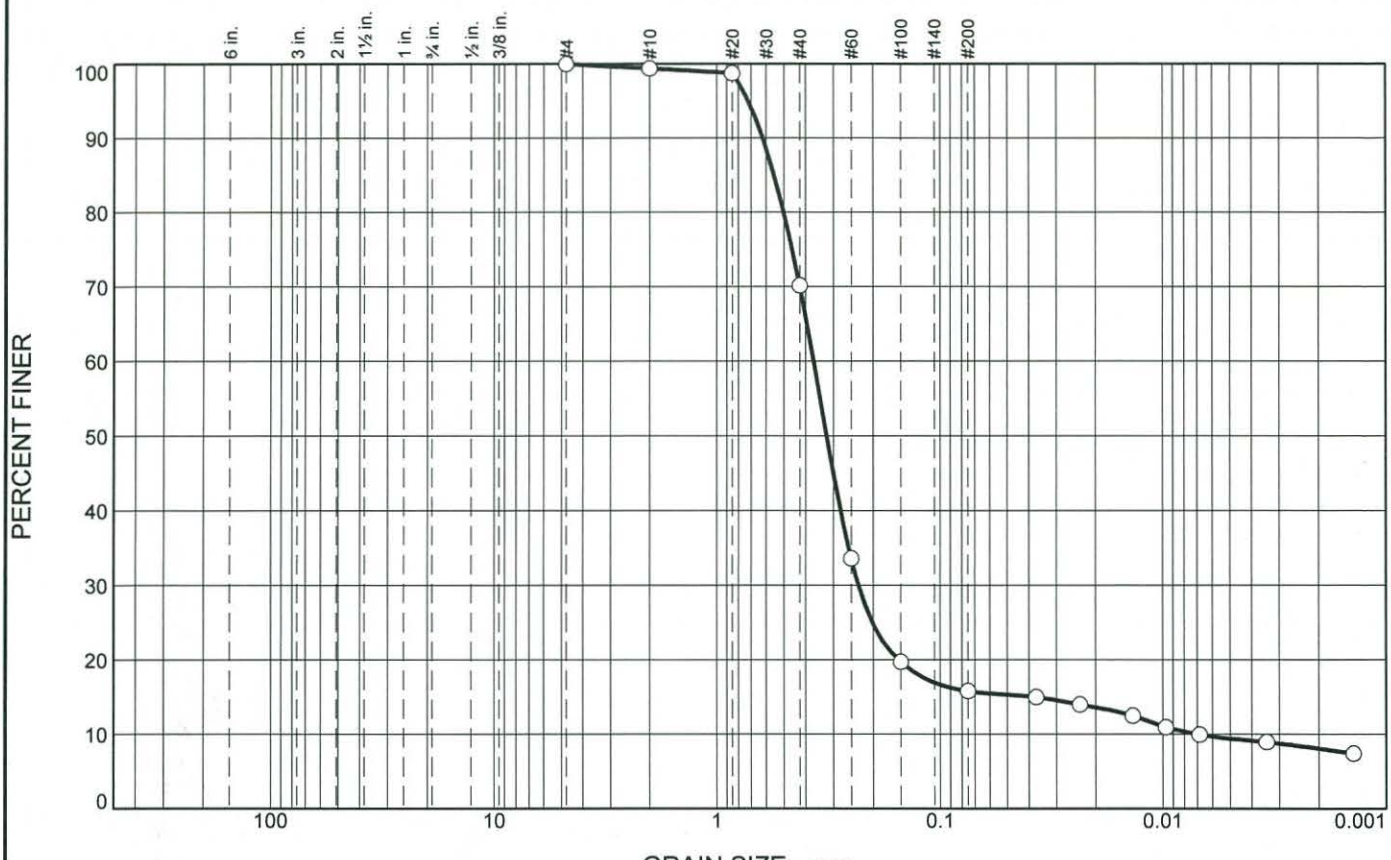
JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.6	29.2	54.4	6.4	9.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.4		
#20	98.8		
#40	70.2		
#60	33.6		
#100	19.8		
#200	15.8		

* (no specification provided)

Material Description

Bag Sample

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.6197 D_{85}= 0.5515 D_{60}= 0.3684
D_{50}= 0.3219 D_{30}= 0.2314 D_{15}= 0.0370
D_{10}= 0.0070 C_u= 52.85 C_c= 20.86

Classification

USCS= SM AASHTO=

Remarks

As-Rec'd M/C = 30.97%

Location: 0283866
Sample Number: MR-2-BS **Depth:** 40-42 ft **Date:** 03/06/2015

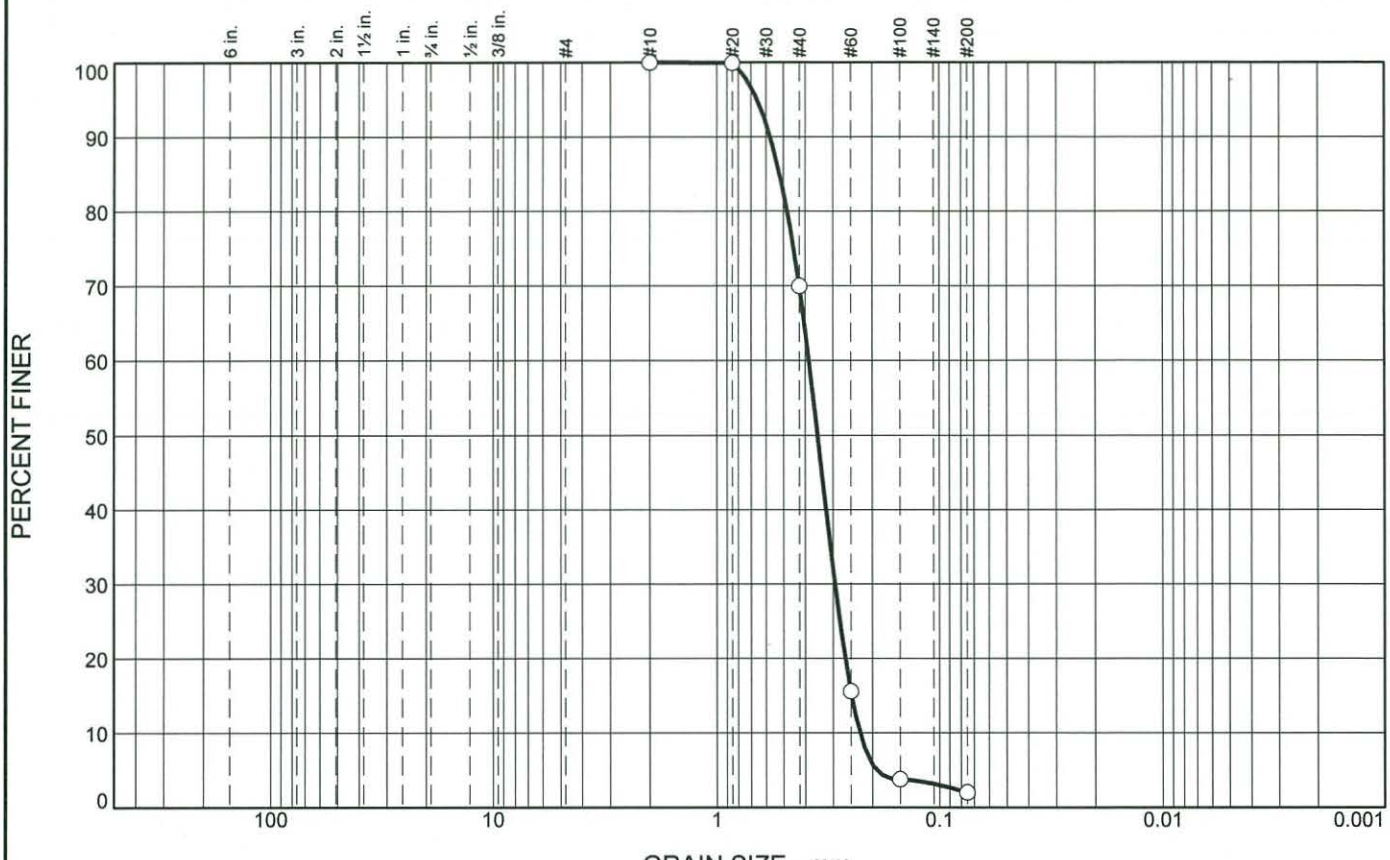
JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	30.0	68.0	2.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	100.0		
#40	70.0		
#60	15.6		
#100	3.8		
#200	2.0		

* (no specification provided)

Material Description

Bag Sample

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.5724 D_{85}= 0.5193 D_{60}= 0.3849
D_{50}= 0.3518 D_{30}= 0.2939 D_{15}= 0.2478
D_{10}= 0.2267 C_u= 1.70 C_c= 0.99

Classification

USCS= SP AASHTO=

Remarks

As-Rec'd M/C = 28.16%

Location: 0283866
Sample Number: MR-4-BS **Depth:** 48-50 ft **Date:** 03/06/2015

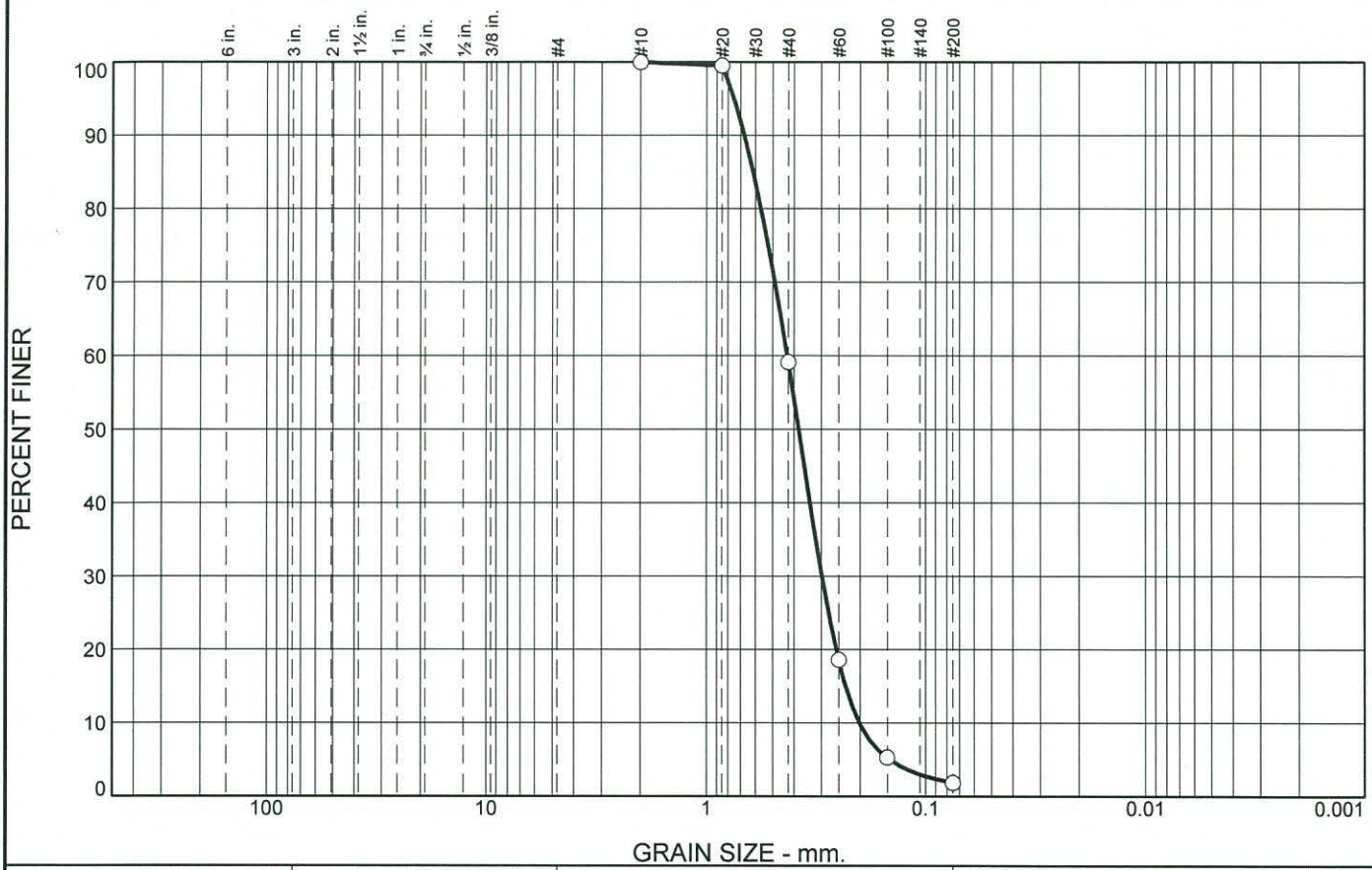
JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	40.9	57.2	1.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.5		
#40	59.1		
#60	18.6		
#100	5.3		
#200	1.9		

* (no specification provided)

Material Description

Shelby Tube

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6718 D_{85}= 0.6131 D_{60}= 0.4295
D_{50}= 0.3807 D_{30}= 0.2978 D_{15}= 0.2320
D_{10}= 0.2005 C_u= 2.14 C_c= 1.03

Classification

USCS= SP AASHTO=

Remarks

As-Rec'd M/C = 24.43%
Hydrometer is Not Applicable

Location: 0283866
Sample Number: MR-2-IS **Depth:** 10 ft **Date:** 03/09/2015

JLT Laboratories, Inc.

Canonsburg, PA

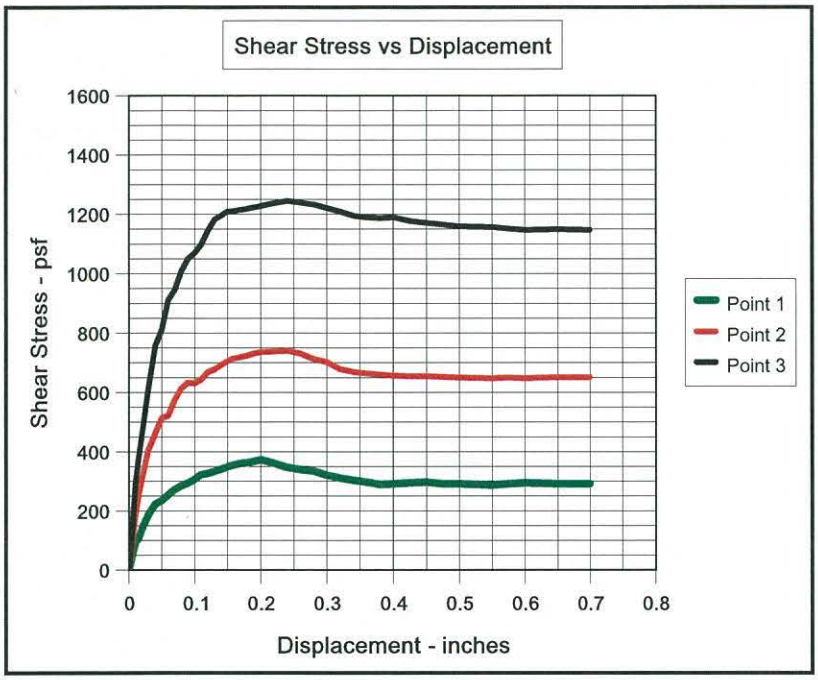
Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

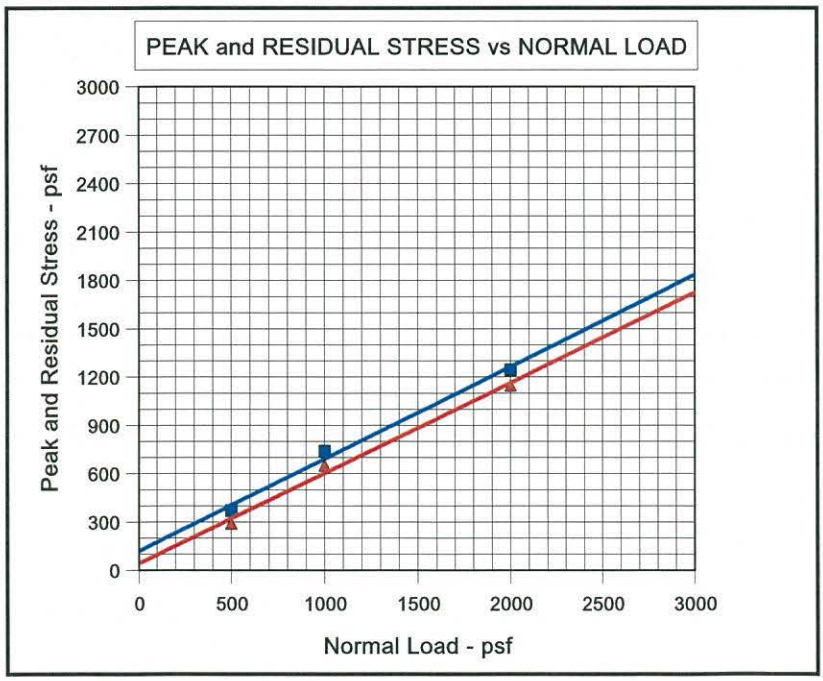
Tested By: RL **Checked By:** JB

DIRECT SHEAR TEST RESULTS

ASTM D-3080 2.8-inch GeoTest Shear Box

Client:	ERM	Print Date:	03/04/2015
Project:	"0283866 MMGL PEO Portland	Project No.:	15LS3165.01
Material:	Black fine grained material	Perf'd By:	MS
Sample ID:	MR-2-IS-10 ft	Chk'd By:	JBJr





PHYSICAL PROPERTIES

Initial	Point 1	Point 2	Point 3
Moisture Cnt, %	18.48	19.23	15.18
Dry Density, pcf	81.3	78.1	80.2
Saturation , %	47.40	45.65	37.86
Void Ratio	1.0330	1.1166	1.0624

At Test	Point 1	Point 2	Point 3
Moisture Cnt, %	35.20	37.60	37.70
Dry Density, pcf	83.0	80.4	82.7
Saturation , %	49.34	48.21	40.28
Void Ratio	0.9923	1.0573	0.9984

Other Information:

Specified Soil Properties	Density	Moisture
Tube Sample	pcf	%

CURVE DATA

Point	Normal Load psf	Peak Strength psf	Residual Strength psf
1	500	371	291
2	1000	740	650
3	2000	1244	1147
4			
5			
6			

Displacement Rate: 0.04 in/min

Saturation: No

STRENGTH PROPERTIES

		Peak	Residual
Cohesion	psf	119	43
Friction	Degrees	29.7	29.2

Comments:

Soil above the GWT.

Laboratories, Inc.

FIGURE- MR-2 IS- 10 ft

INPUT DATA FOR

ERM
"0283866
Black fine grained material

MR-2-IS-10 ft

Print Date: 03/04/2015
Project No.:15LS3165.01
Perf'd By: MS

Chk'd By: JBJr

UPPER GRAPH

Displacement inches	Point 1 Load lbs	Point 2 Load lbs	Point 3 Load lbs	Point 1 Stress psf	Point 2 Stress psf	Point 3 Stress psf
0.000	0.0	0.0	0.0	0.0	0.0	0.0
0.005	2.0	4.1	5.3	47.3	97.0	125.4
0.010	3.9	7.8	12.2	92.3	184.5	288.6
0.015	4.5	10.6	16.0	106.4	250.7	378.5
0.020	5.9	12.9	19.4	139.6	305.1	458.9
0.030	7.9	17.1	26.0	186.9	404.5	615.0
0.040	9.4	19.4	31.9	222.3	458.9	754.6
0.050	9.9	21.7	34.3	234.2	513.3	811.3
0.060	10.7	22.0	38.5	253.1	520.4	910.7
0.070	11.5	24.3	40.0	272.0	574.8	946.2
0.080	12.0	25.9	42.6	283.8	612.6	1007.7
0.090	12.4	26.8	44.4	293.3	633.9	1050.2
0.100	12.9	26.7	45.2	305.1	631.6	1069.2
0.110	13.6	27.2	46.4	321.7	643.4	1097.5
0.120	13.8	28.3	48.4	326.4	669.4	1144.9
0.130	14.1	28.7	50.0	333.5	678.9	1182.7
0.140	14.4	29.3	50.5	340.6	693.1	1194.5
0.150	14.7	29.8	51.1	347.7	704.9	1208.7
0.160	15.0	30.2	51.2	354.8	714.4	1211.1
0.170	15.2	30.4	51.4	359.5	719.1	1215.8
0.180	15.3	30.6	51.5	361.9	723.8	1218.2
0.190	15.5	30.9	51.7	366.6	730.9	1222.9
0.200	15.7	31.1	51.9	371.4	735.6	1227.6
0.220	15.2	31.2	52.3	359.5	738.0	1237.1
0.240	14.6	31.3	52.6	345.3	740.4	1244.2
0.260	14.3	30.9	52.4	338.3	730.9	1239.5
0.280	14.1	30.1	52.1	333.5	712.0	1232.4
0.300	13.5	29.7	51.6	319.3	702.5	1220.5
0.320	13.1	28.7	51.1	309.9	678.9	1208.7
0.340	12.8	28.3	50.5	302.8	669.4	1194.5
0.360	12.5	28.1	50.3	295.7	664.7	1189.8
0.380	12.2	27.9	50.2	288.6	659.9	1187.4
0.400	12.3	27.8	50.3	290.9	657.6	1189.8
0.425	12.4	27.7	49.8	293.3	655.2	1178.0
0.450	12.5	27.7	49.5	295.7	655.2	1170.9
0.475	12.3	27.6	49.3	290.9	652.9	1166.1
0.500	12.3	27.5	49.0	290.9	650.5	1159.0
0.550	12.1	27.4	48.9	286.2	648.1	1156.7
0.057	12.3	27.5	48.7	290.9	650.5	1152.0
0.600	12.4	27.4	48.5	293.3	648.1	1147.2
0.650	12.3	27.5	48.6	290.9	650.5	1149.6
0.700	12.3	27.5	48.5	290.9	650.5	1147.2
0.750	12.3	27.5	48.5	290.9	650.5	1147.2

LOWER GRAPH

Pn	Peak	Residual
500	371.4	290.9
1000	740.4	650.5
2000	1244.2	1147.2

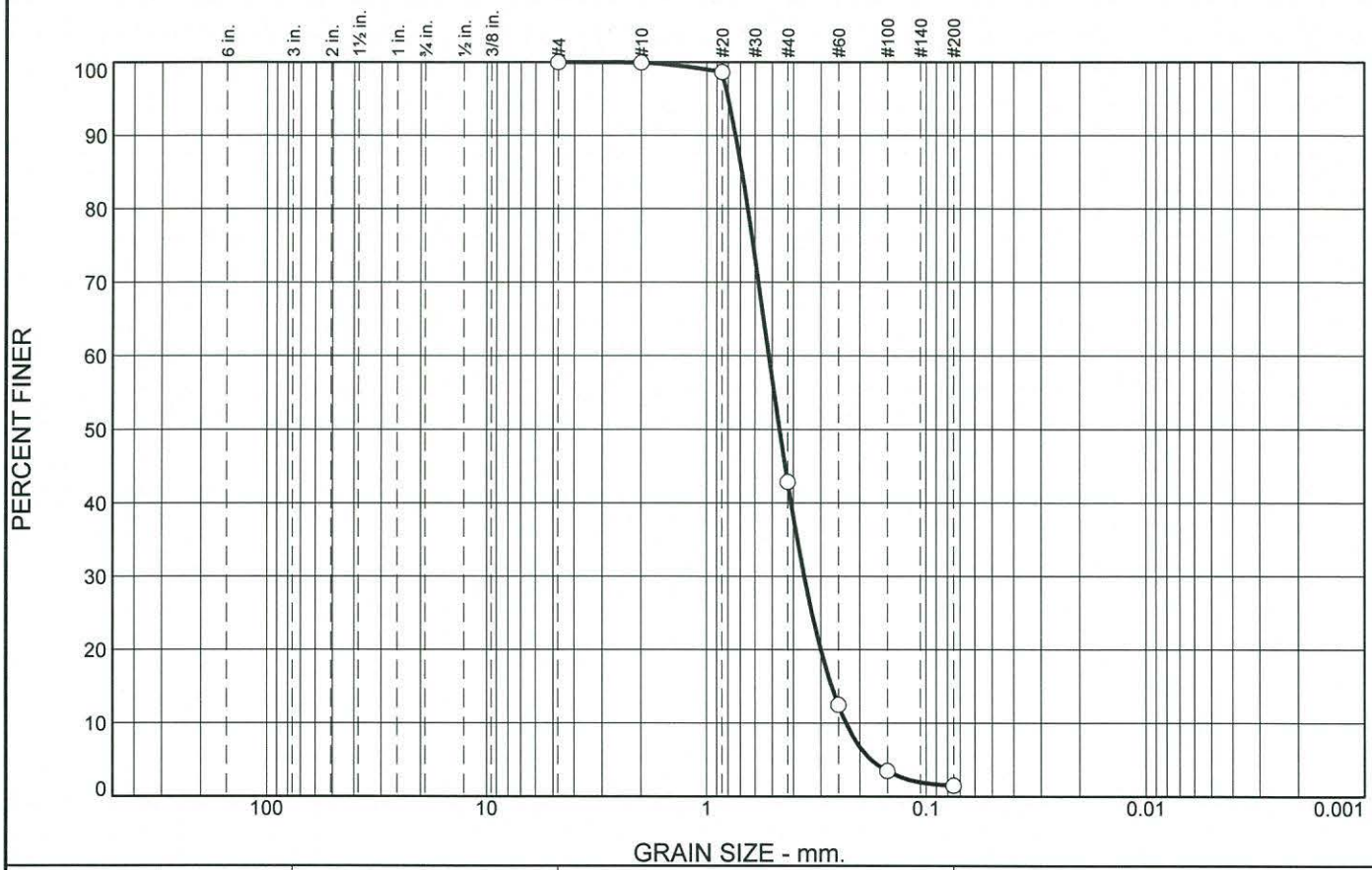
Engineering Properties

	Peak	Residual
Slope, m	0.571	0.56
Cohesion	119	42.6
Phi, degrees	29.73	29.25

FIGURE- MR-2 IS- 10 ft

JLT Laboratories, Inc.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	57.1	41.4	1.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	98.7		
#40	42.9		
#60	12.5		
#100	3.5		
#200	1.5		

* (no specification provided)

Material Description

Shelby Tube

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.7359 D_{85}= 0.6883 D_{60}= 0.5172
D_{50}= 0.4626 D_{30}= 0.3564 D_{15}= 0.2676
D_{10}= 0.2304 C_u= 2.24 C_c= 1.07

Classification

USCS= SP AASHTO=

Remarks

As-Rec'd M/C = 27.39%
Hydrometer is Not Applicable

Location: 0283866
Sample Number: MR-3-IS **Depth:** 18 ft **Date:** 03/09/2015

JLT Laboratories, Inc.

Canonsburg, PA

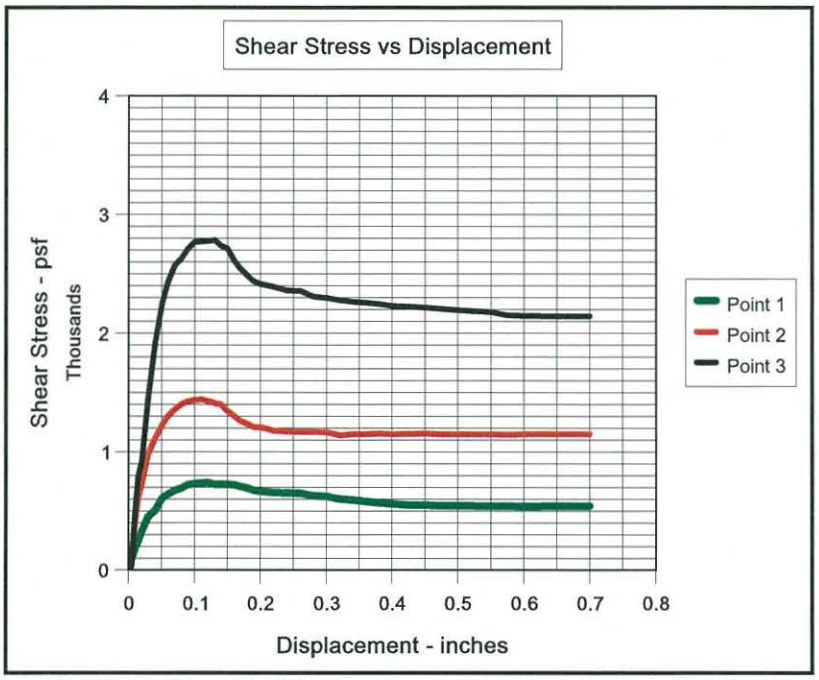
Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

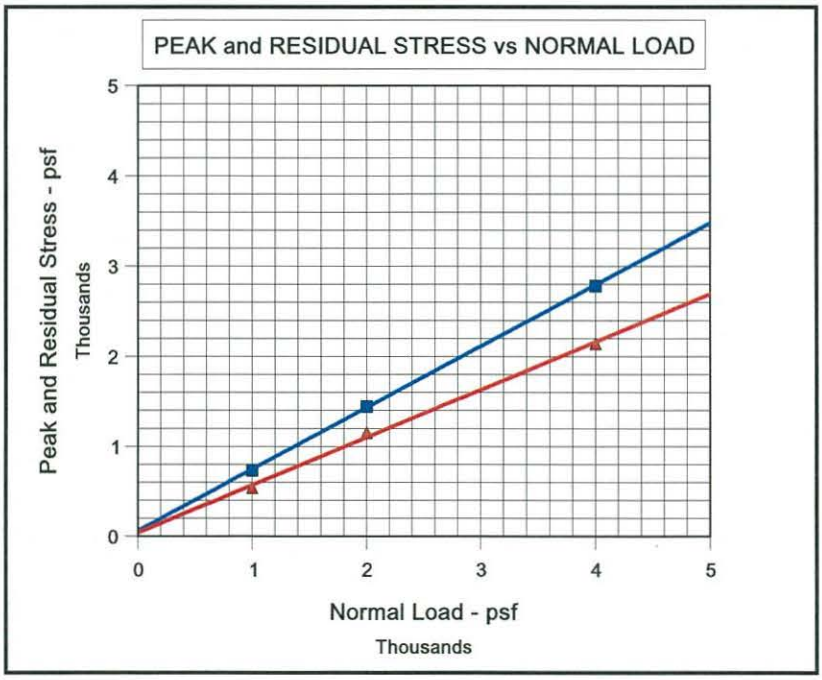
Tested By: RL **Checked By:** JB

DIRECT SHEAR TEST RESULTS

ASTM D-3080 2.8-inch GeoTest Shear Box

Client:	ERM	Print Date:	03/04/2015
Project:	"0283866 MMGL PEO Portland	Project No.:	15LS3165.01
Material:	Black fine grained material	Perf'd By:	MS
Sample ID:	MR-3-IS-18 ft	Chk'd By:	JBJr





PHYSICAL PROPERTIES

Initial	Point 1	Point 2	Point 3
Moisture Cnt, %	24.50	23.52	24.47
Dry Density, pcf	90.8	92.1	92.3
Saturation , %	79.1	78.3	82.0
Void Ratio	0.8209	0.7958	0.7911

At Test	Point 1	Point 2	Point 3
Moisture Cnt, %	35.20	37.60	37.70
Dry Density, pcf	93.1	95.5	96.5
Saturation , %	83.7	85.2	90.8
Void Ratio	0.7754	0.7311	0.7141

Other Information:

Specified Soil Properties	Density	Moisture
Tube Sample	pcf	%

CURVE DATA

Point	Normal Load psf	Peak Strength psf	Residual Strength psf
1	1000	736	539
2	2000	1443	1152
3	4000	2784	2143
4			
5			
6			

Displacement Rate: 0.04 in/min

Saturation: No

STRENGTH PROPERTIES

		Peak	Residual
Cohesion	psf	65	44
Friction	Degrees	34.3	27.9

Comments:

Laboratories, Inc.

FIGURE- MR-3 IS- 18 ft

INPUT DATA FOR

ERM
"0283866
Black fine grained material

MR-3-IS-18 ft

Print Date: 03/04/2015
Project No.:15LS3165.01
Perf'd By: MS

Chk'd By: JBJr

UPPER GRAPH

Displacement inches	Point 1 Load lbs	Point 2 Load lbs	Point 3 Load lbs	Point 1 Stress psf	Point 2 Stress psf	Point 3 Stress psf
0.000	0.0	0.0	0.0	0.0	0.0	0.0
0.005	4.1	5.5	1.4	97.0	130.1	33.1
0.010	7.6	17.0	19.9	179.8	402.1	470.7
0.015	10.3	25.7	33.2	243.6	607.9	785.3
0.020	13.8	30.7	38.5	326.4	726.2	910.7
0.030	19.0	41.4	61.5	449.4	979.3	1454.7
0.040	21.1	47.1	80.8	499.1	1114.1	1911.2
0.050	25.4	51.5	94.5	600.8	1218.2	2235.3
0.060	27.0	55.1	102.7	638.7	1303.3	2429.3
0.070	28.4	57.5	108.7	671.8	1360.1	2571.2
0.080	29.2	59.3	111.2	690.7	1402.7	2630.3
0.090	30.5	60.3	114.6	721.4	1426.3	2710.8
0.100	30.8	60.8	117.0	728.5	1438.2	2767.5
0.110	31.0	61.0	117.3	733.3	1442.9	2774.6
0.120	31.1	60.4	117.4	735.6	1428.7	2777.0
0.130	30.6	59.6	117.7	723.8	1409.8	2784.1
0.140	30.6	59.2	115.7	723.8	1400.3	2736.8
0.150	30.5	56.9	114.7	721.4	1345.9	2713.1
0.160	30.4	55.0	110.5	719.1	1301.0	2613.8
0.170	29.8	53.2	107.4	704.9	1258.4	2540.4
0.180	29.2	52.2	105.0	690.7	1234.7	2483.7
0.190	28.4	51.0	103.0	671.8	1206.4	2436.4
0.200	28.1	51.0	102.0	664.7	1206.4	2412.7
0.220	27.6	49.8	101.0	652.9	1178.0	2389.1
0.240	27.5	49.6	99.8	650.5	1173.2	2360.7
0.260	27.4	49.4	99.7	648.1	1168.5	2358.3
0.280	26.5	49.5	97.6	626.8	1170.9	2308.6
0.300	26.2	49.3	97.1	619.7	1166.1	2296.8
0.320	25.3	48.2	96.3	598.4	1140.1	2277.9
0.340	25.0	48.6	95.8	591.4	1149.6	2266.1
0.360	24.4	48.7	95.4	577.2	1152.0	2256.6
0.380	24.0	48.9	95.0	567.7	1156.7	2247.1
0.400	23.6	48.6	94.3	558.2	1149.6	2230.6
0.425	23.2	48.8	94.0	548.8	1154.3	2223.5
0.450	23.1	48.9	93.7	546.4	1156.7	2216.4
0.475	22.9	48.7	93.2	541.7	1152.0	2204.6
0.500	22.9	48.6	92.8	541.7	1149.6	2195.1
0.550	22.8	48.7	92.1	539.3	1152.0	2178.5
0.057	22.8	48.5	90.9	539.3	1147.2	2150.2
0.600	22.7	48.7	90.7	536.9	1152.0	2145.4
0.650	22.8	48.7	90.6	539.3	1152.0	2143.1
0.700	22.8	48.7	90.6	539.3	1152.0	2143.1
0.750	22.8	48.7	90.6	539.3	1152.0	2143.1

LOWER GRAPH

Pn	Peak	Residual
1000	735.6	539.3
2000	1442.9	1152.0
4000	2784.1	2143.1

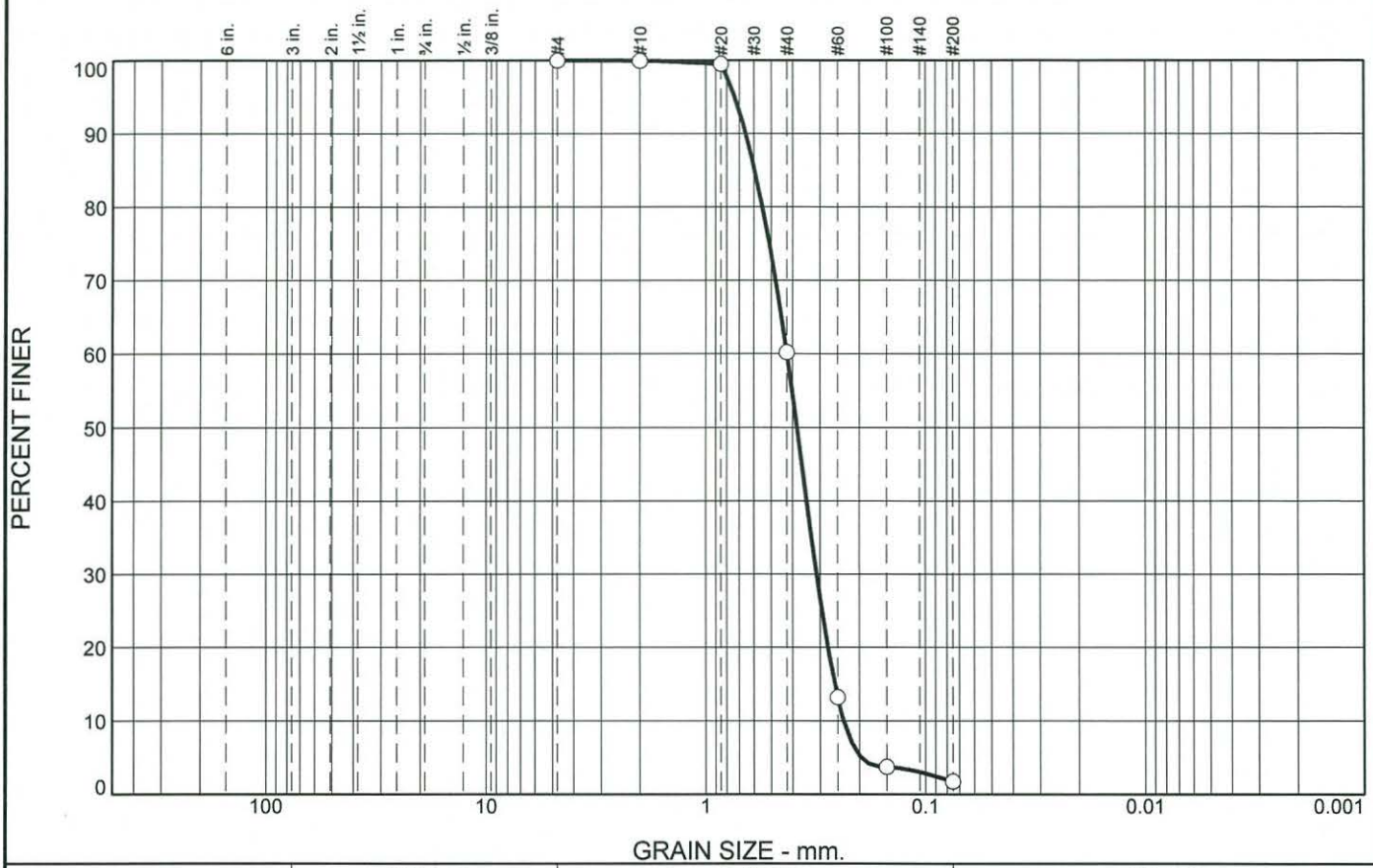
Engineering Properties

	Peak	Residual
Slope, m	0.681	0.529
Cohesion	65	43.8
Phi, degrees	34.25	27.88

FIGURE- MR-3 IS- 18 ft

Laboratories, Inc.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	39.8	58.4	1.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.5		
#40	60.2		
#60	13.2		
#100	3.7		
#200	1.8		

* (no specification provided)

Material Description

Shelby Tube

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6526 D_{85}= 0.5938 D_{60}= 0.4239
D_{50}= 0.3817 D_{30}= 0.3108 D_{15}= 0.2575
D_{10}= 0.2343 C_u= 1.81 C_c= 0.97

Classification

USCS= SP AASHTO=

Remarks

As-Rec'd M/C = 32.88%

Location: 0283866
Sample Number: MR-5-IS **Depth:** 31 ft **Date:** 03/09/2015

JLT Laboratories, Inc.

Canonsburg, PA

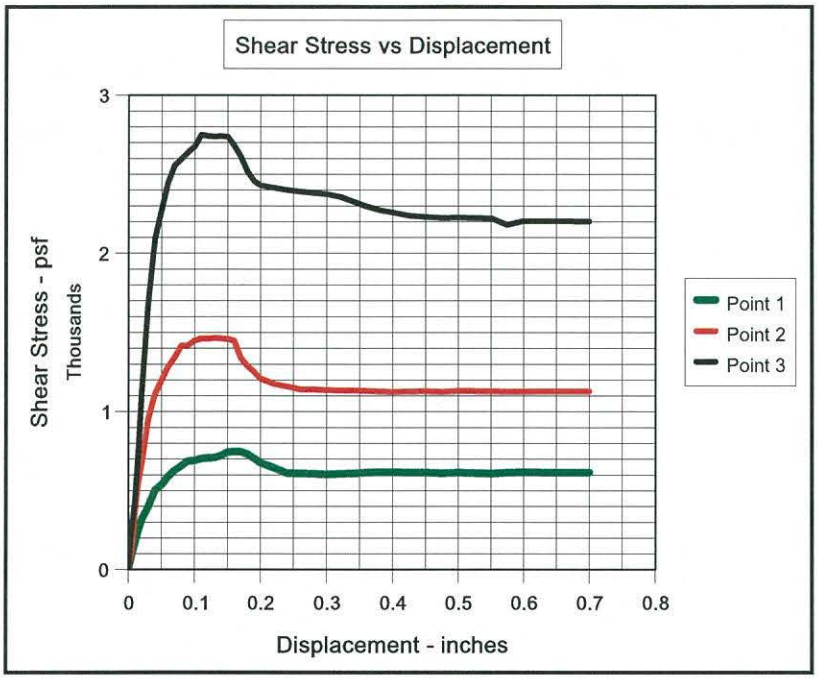
Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

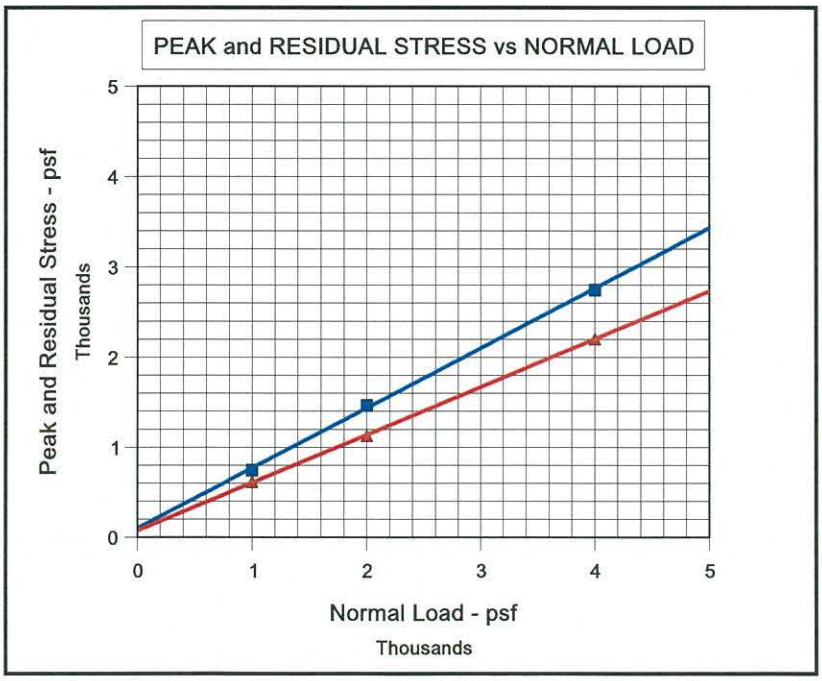
Tested By: RL **Checked By:** JB

DIRECT SHEAR TEST RESULTS

ASTM D-3080 2.8-inch GeoTest Shear Box

Client:	ERM	Print Date:	03/04/2015
Project:	"0283866 MMGL PEO Portland	Project No.:	15LS3165.01
Material:	Black fine grained material	Perf'd By:	MS
Sample ID:	MR-5-IS-31 ft	Chk'd By:	JBJr





PHYSICAL PROPERTIES

Initial	Point 1	Point 2	Point 3
Moisture Cnt, %	31.83	29.57	29.64
Dry Density, pcf	63.9	66.0	66.4
Saturation , %	53.1	52.1	52.7
Void Ratio	1.5893	1.5044	1.4915

At Test	Point 1	Point 2	Point 3
Moisture Cnt, %	35.20	37.60	37.70
Dry Density, pcf	65.8	68.6	69.4
Saturation , %	55.8	55.5	56.7
Void Ratio	1.5116	1.4117	1.3844

Other Information:

Specified Soil Properties	Density	Moisture
Tube Sample	pcf	%

CURVE DATA

Point	Normal Load psf	Peak Strength psf	Residual Strength psf
1	1000	745	613
2	2000	1466	1128
3	4000	2749	2202
4			
5			
6			

Displacement Rate: 0.04 in/min

Saturation: No

STRENGTH PROPERTIES

		Peak	Residual
Cohesion	psf	104	76
Friction	Degrees	33.6	28.0

Comments:

Laboratories, Inc.

FIGURE- MR-5 IS- 31 ft

INPUT DATA FOR

ERM
"0283866
Black fine grained material

MR-5-IS-31 ft

Print Date: 03/04/2015
Project No.:15LS3165.01
Perf'd By: MS

Chk'd By: JBJr

UPPER GRAPH

Displacement inches	Point 1 Load lbs	Point 2 Load lbs	Point 3 Load lbs	Point 1 Stress psf	Point 2 Stress psf	Point 3 Stress psf
0.000	0.0	0.0	0.0	0.0	0.0	0.0
0.005	3.9	4.0	10.8	92.3	94.6	255.5
0.010	7.0	15.0	18.0	165.6	354.8	425.8
0.015	10.3	23.0	30.0	243.6	544.0	709.6
0.020	13.3	28.4	47.0	314.6	671.8	1111.7
0.030	16.7	40.0	71.0	395.0	946.2	1679.4
0.040	21.1	46.8	88.1	499.1	1107.0	2083.9
0.050	22.6	50.7	96.0	534.6	1199.3	2270.8
0.060	24.8	54.2	103.4	586.6	1282.0	2445.8
0.070	26.5	56.8	108.1	626.8	1343.5	2557.0
0.080	27.7	60.0	109.7	655.2	1419.2	2594.8
0.090	29.0	60.0	111.5	686.0	1419.2	2637.4
0.100	29.2	61.3	113.1	690.7	1450.0	2675.3
0.110	29.7	61.9	116.2	702.5	1464.2	2748.6
0.120	29.9	61.9	115.9	707.3	1464.2	2741.5
0.130	30.0	62.0	115.8	709.6	1466.5	2739.1
0.140	30.5	61.9	115.9	721.4	1464.2	2741.5
0.150	31.4	61.7	115.7	742.7	1459.5	2736.8
0.160	31.5	61.2	113.3	745.1	1447.6	2680.0
0.170	31.5	56.6	110.4	745.1	1338.8	2611.4
0.180	30.8	54.4	106.4	728.5	1286.8	2516.8
0.190	29.7	52.9	103.8	702.5	1251.3	2455.3
0.200	28.5	51.1	102.7	674.1	1208.7	2429.3
0.220	27.2	49.7	102.1	643.4	1175.6	2415.1
0.240	25.8	49.0	101.5	610.3	1159.0	2400.9
0.260	25.7	48.2	101.1	607.9	1140.1	2391.4
0.280	25.6	48.2	100.7	605.5	1140.1	2382.0
0.300	25.4	48.1	100.4	600.8	1137.8	2374.9
0.320	25.6	48.0	99.7	605.5	1135.4	2358.3
0.340	25.7	48.0	98.4	607.9	1135.4	2327.6
0.360	25.9	47.9	97.1	612.6	1133.0	2296.8
0.380	26.0	47.7	96.1	615.0	1128.3	2273.2
0.400	26.0	47.6	95.5	615.0	1125.9	2259.0
0.425	25.9	47.7	94.6	612.6	1128.3	2237.7
0.450	25.9	47.8	94.3	612.6	1130.7	2230.6
0.475	25.8	47.6	94.0	610.3	1125.9	2223.5
0.500	25.9	47.9	94.1	612.6	1133.0	2225.8
0.550	25.7	47.8	93.9	607.9	1130.7	2221.1
0.057	25.9	47.7	92.1	612.6	1128.3	2178.5
0.600	26.0	47.7	93.2	615.0	1128.3	2204.6
0.650	25.9	47.7	93.2	612.6	1128.3	2204.6
0.700	25.9	47.7	93.1	612.6	1128.3	2202.2
0.750	25.9	47.7	93.1	612.6	1128.3	2202.2

LOWER GRAPH

Pn	Peak	Residual
1000	745.1	612.6
2000	1465.5	1128.3
4000	2748.6	2202.2

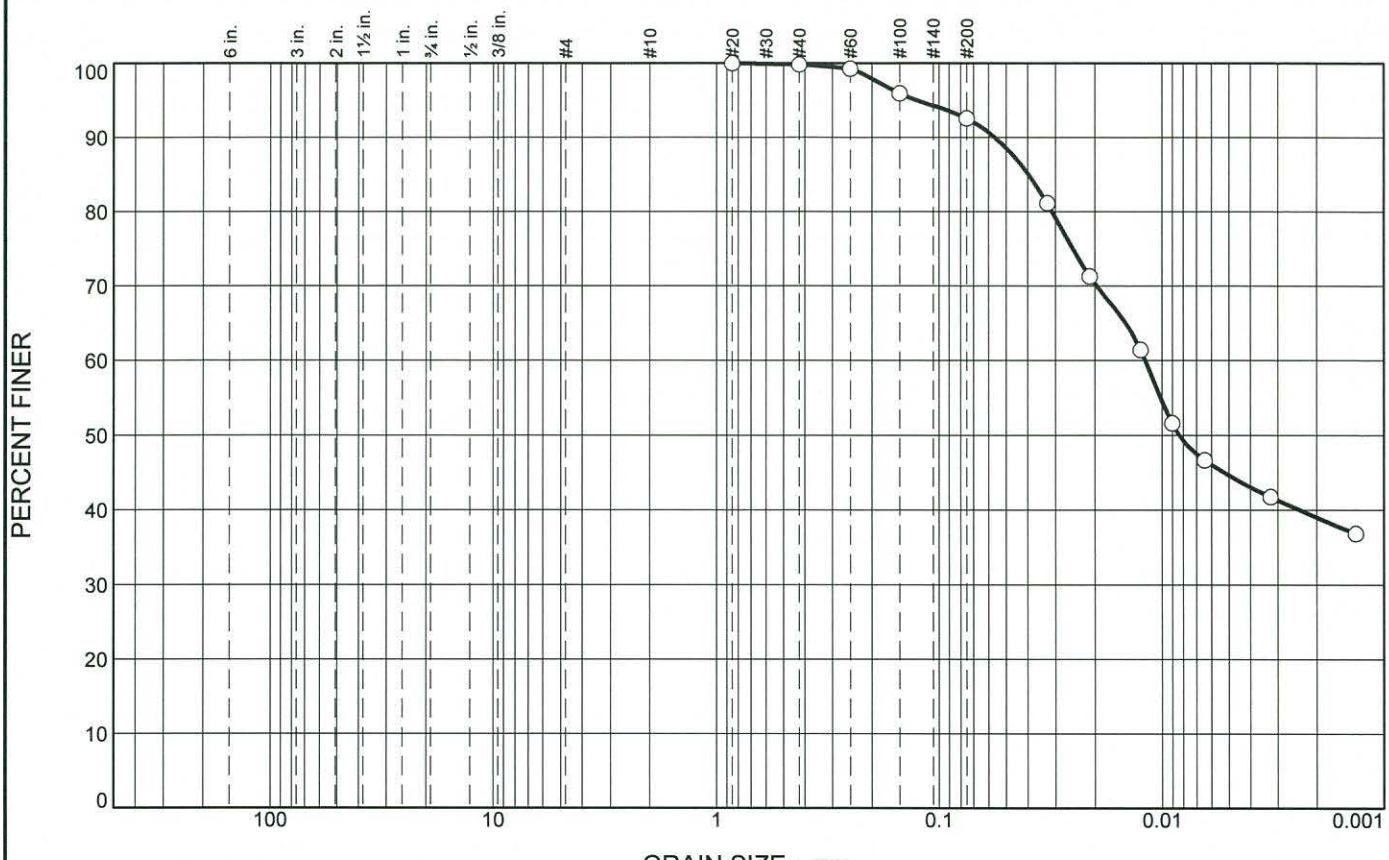
Engineering Properties

	Peak	Residual
Slope, m	0.664	0.531
Cohesion	104	75.7
Phi, degrees	33.58	27.97

FIGURE- MR-5 IS- 31 ft

Laboratories, Inc.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	7.2	48.0	44.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#20	100.0		
#40	99.8		
#60	99.3		
#100	95.9		
#200	92.6		

* (no specification provided)

Material Description

Shelby Tube

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.0561 D_{85}= 0.0396 D_{60}= 0.0118
D_{50}= 0.0083 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

As-Rec'd M/C = 36.44%

Location: 0283866
Sample Number: MR-2-IS **Depth:** 35 ft **Date:** 03/09/2015

JLT Laboratories, Inc.

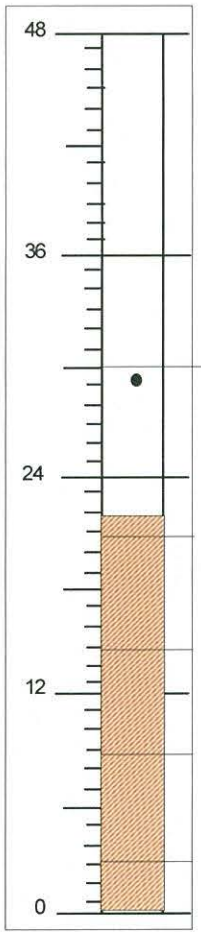
Canonsburg, PA

Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

Tested By: RL **Checked By:** JB

TUBE LOG and DENSITY AND MOISTURE OF TUBE SAMPLES

Client :	ERM	Job No. :	15LS3165.01
Project :	MMGL PEO Portland	Date :	03/06/2015
Material ID :	Shelby Tube No 0283866	Perf'd By :	MLB
Tube ID:	MR-2-IS 35 feet	Chk'd By :	JBJr



Moisture - Density Determination

Tare or Pan ID	Q-34				
Section Length	5.85				inches
Inside Diameter of Tube	2.83				inches
Wt. of Wet Soil + Tube + Tare	1662.5				grams
Wt. of Dry Soil + Tube + Tare	1373.3				grams
Weight of Tube Section only	466.4				grams
Wt. of Tare only	113.3				grams
Weight of Wet Soil only	1082.8				grams
Weight of Dry Soil Only	793.6				grams
Weight of Water in Sample	289.2				grams
Sample Volume	0.02129				cu ft
Moisture Content	36.44				%
Bulk Wet Density	112.0				pcf
Bulk Dry Density	82.1				pcf

Moisture Determinations Only

Tare /Pan ID				
Wet Soil plus Tare				grams
Dry Soil plus Tare				grams
Tare				grams
Water				grams
Dry Soil				grams
Moisture Content				%

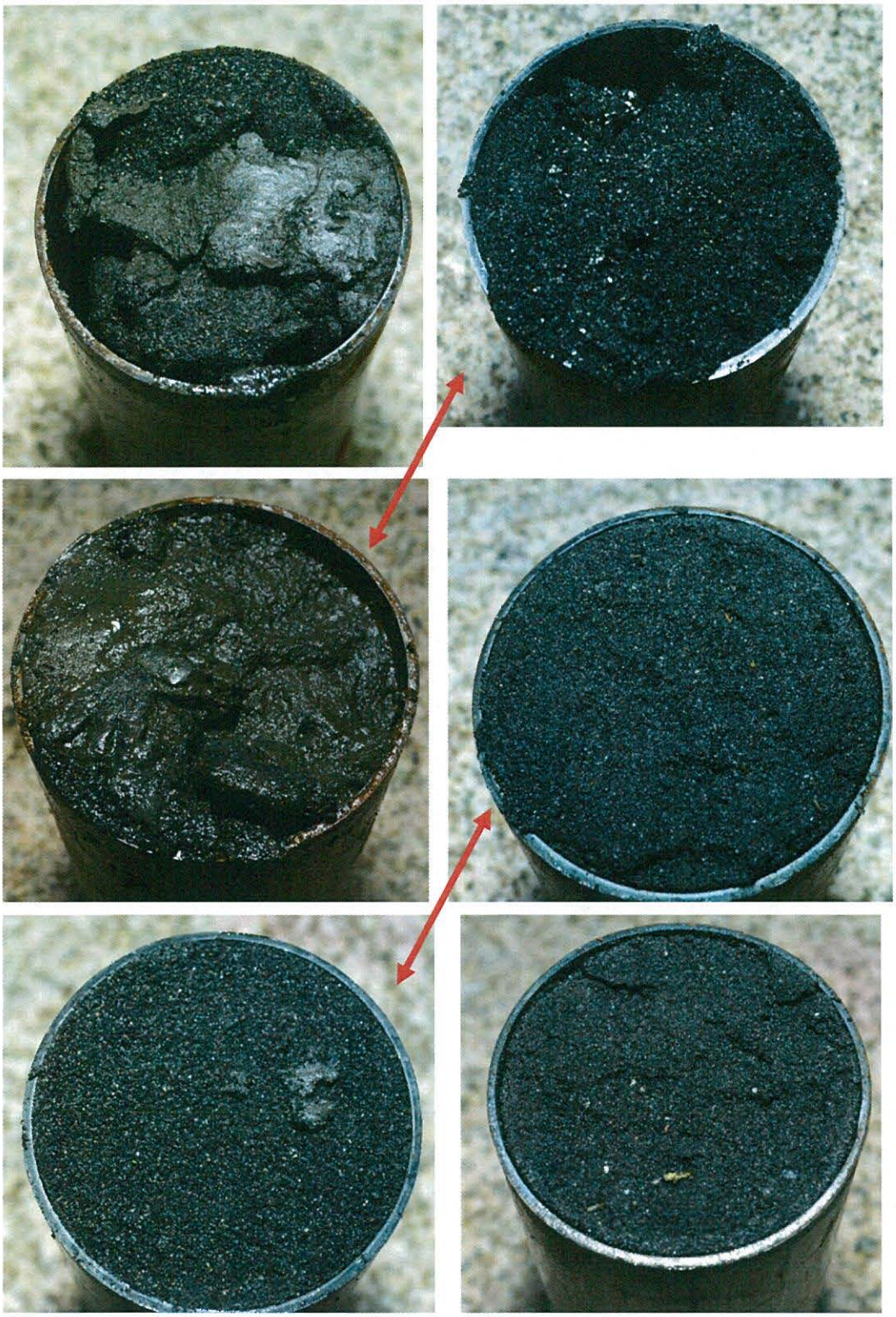
LEGEND

Black Fine Sand

JLT Laboratories, Inc.

Top of Sample

Bottom of Sample



CU SA 3

CU SA 2

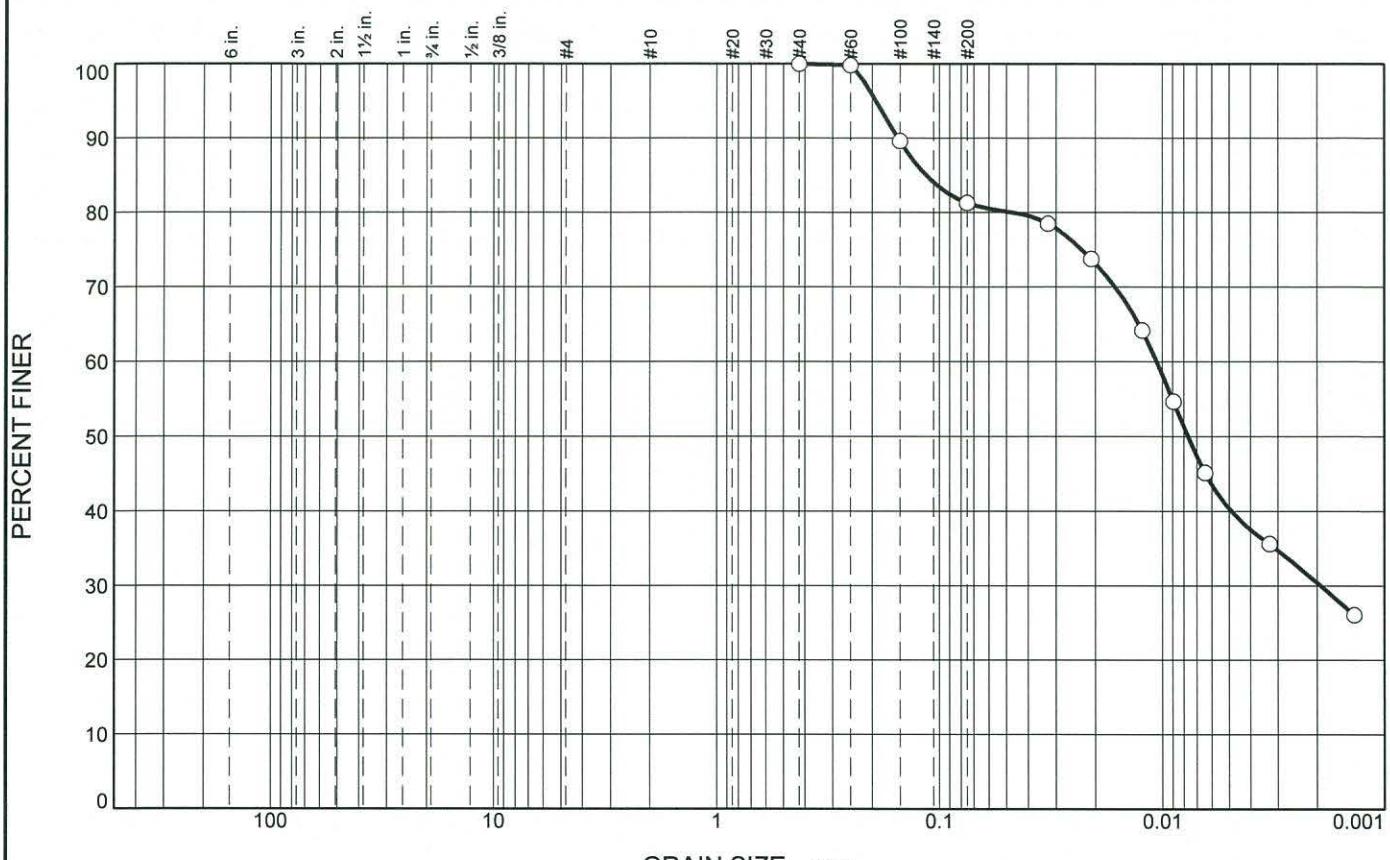
CU SA 1

Shelby Tube : MR - 2 – IS - 35 feet
March 5,2015

Within each sample are thin layers of Silt with water accumulations on top of the silt.

JLT Laboratories, Inc.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	18.7	40.9	40.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#40	100.0		
#60	99.8		
#100	89.6		
#200	81.3		

* (no specification provided)

Material Description

Shelby Tube

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.1529 D_{85}= 0.1141 D_{60}= 0.0106
D_{50}= 0.0076 D_{30}= 0.0019 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

As-Rec'd M/C = 39.65%

Location: 0283866
Sample Number: MR-4-IS **Depth:** 34 ft **Date:** 03/09/2015

JLT Laboratories, Inc.

Canonsburg, PA

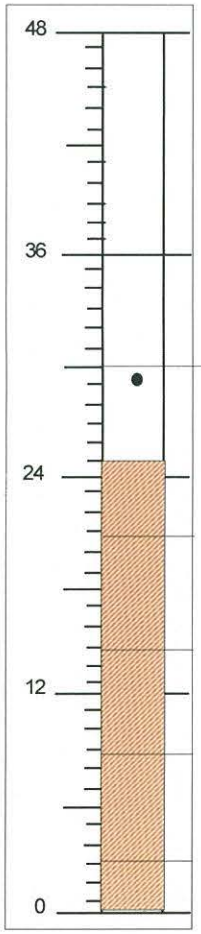
Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

Tested By: RL **Checked By:** JB

TUBE LOG and DENSITY AND MOISTURE OF TUBE SAMPLES

JLT

Client :	ERM	Job No. :	15LS3165.01
Project :	MMGL PEO Portland	Date :	03/06/2015
Material ID :	Shelby Tube No 0283866	Perf'd By :	MLB
Tube ID:	MR-4-IS 34 feet	Chk'd By :	JBJr



Top of Tube

Point 1: Black Sand with thin layers of black Silt

Point 2: Black Sand with 1 3" silt layer of black Silt

Point 3 used for Density and Moisture Content
Black fine Sand with two 2" layers of Silt

Spoil (loose material)

Moisture - Density Determination

Tare or Pan ID	P-23				
Section Length	5.57				inches
Inside Diameter of Tube	2.83				inches
Wt. of Wet Soil + Tube + Tare	1598.3				grams
Wt. of Dry Soil + Tube + Tare	1300.7				grams
Weight of Tube Section only	453.1				grams
Wt. of Tare only	97.0				grams
Weight of Wet Soil only	1048.2				grams
Weight of Dry Soil Only	750.6				grams
Weight of Water in Sample	297.6				grams
Sample Volume	0.02028				cu ft
Moisture Content	39.65				%
Bulk Wet Density	113.9				pcf
Bulk Dry Density	81.5				pcf

Moisture Determinations Only

Tare /Pan ID				
Wet Soil plus Tare				grams
Dry Soil plus Tare				grams
Tare				grams
Water				grams
Dry Soil				grams
Moisture Content				%

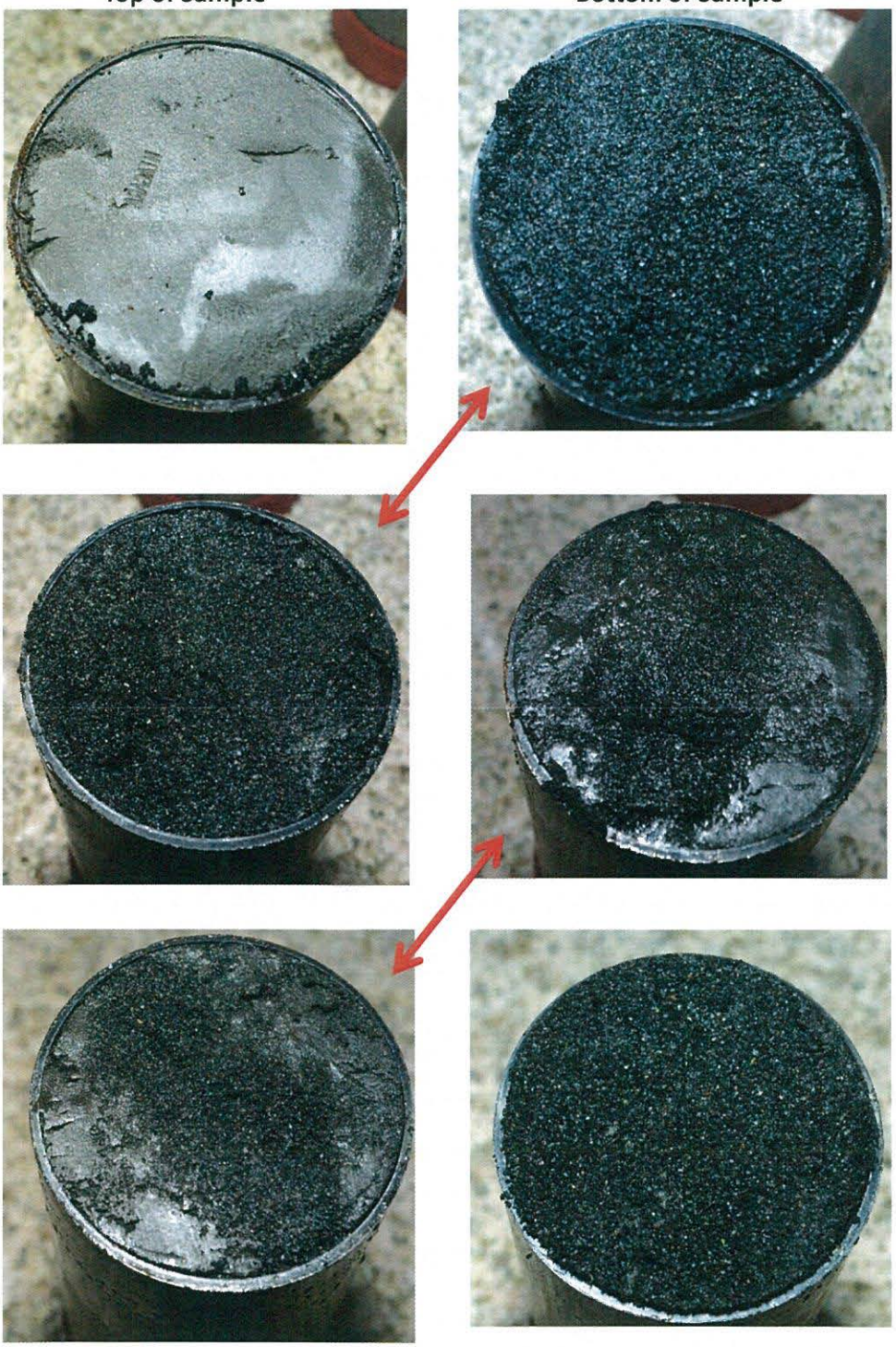
LEGEND

Black Fine Sand

JLT *Laboratories, Inc.*

Top of Sample

Bottom of Sample



CU SA 1

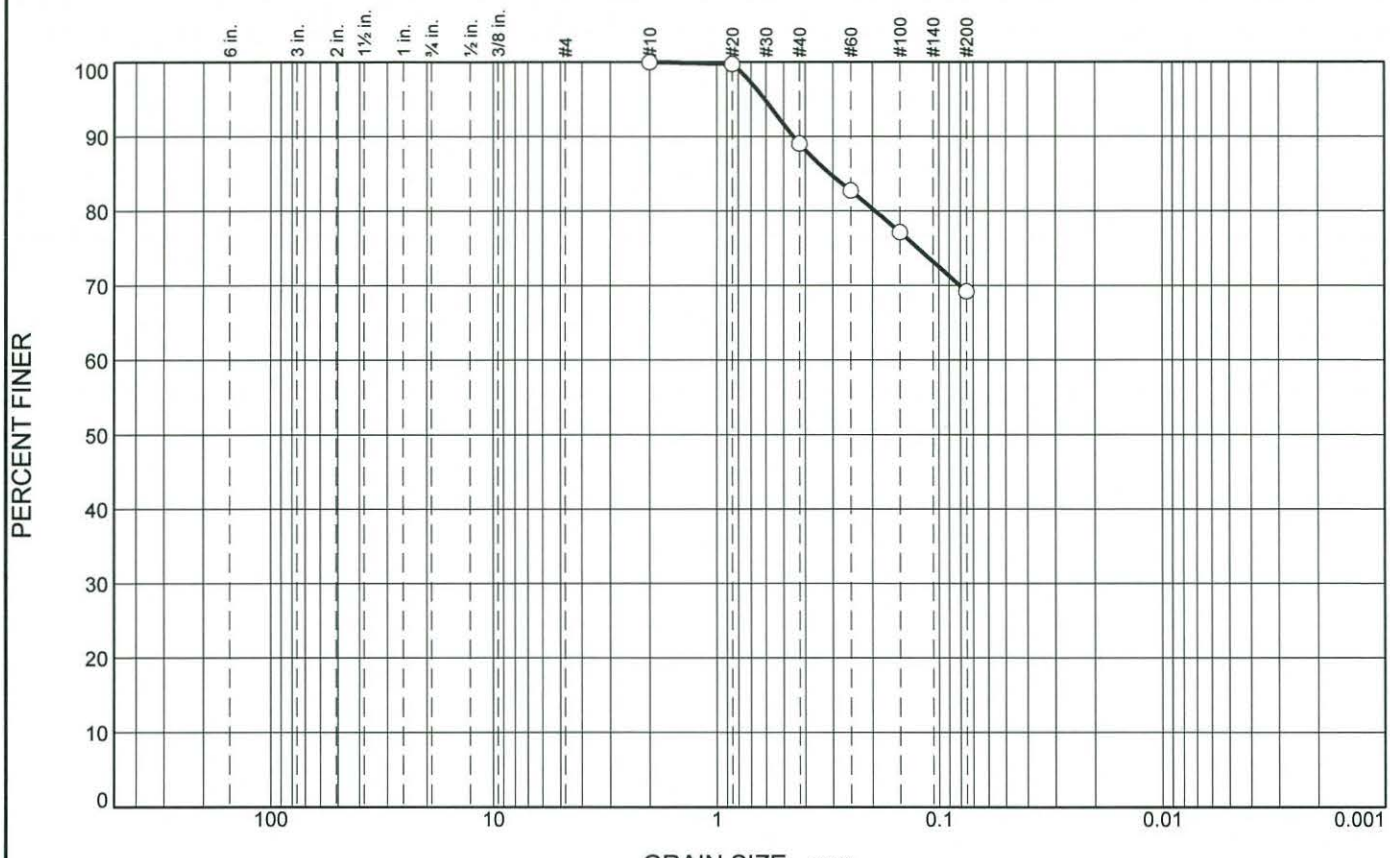
CU SA 2

CU SA 3

Shelby Tube : MR - 4 – IS - 34 feet

JLT Laboratories, Inc.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	10.9	19.9	69.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.7		
#40	89.1		
#60	82.8		
#100	77.2		
#200	69.2		

* (no specification provided)

Material Description

Shelby Tube

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.4518 D_{85}= 0.3085 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

As-Rec'd M/C = 40.82%
Hydrometer is Not Applicable

Location: 0283866
Sample Number: MR-5-IS **Depth:** 33 ft **Date:** 03/09/2015

JLT Laboratories, Inc.

Canonsburg, PA

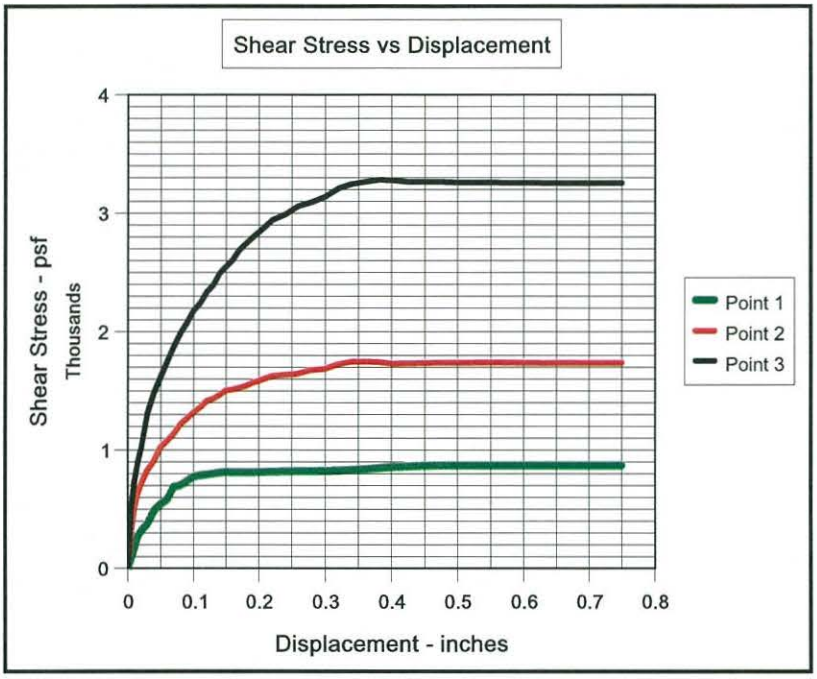
Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

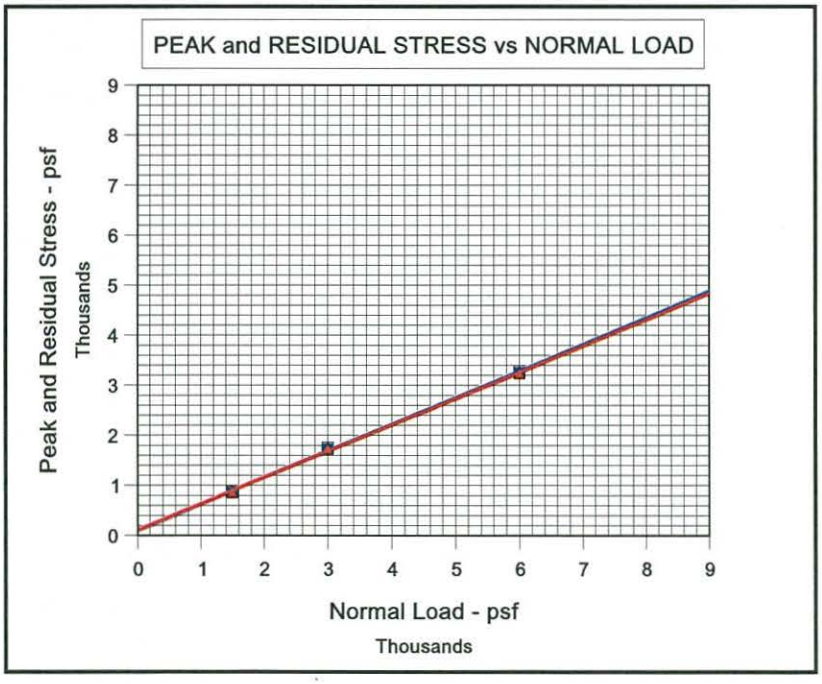
Tested By: RL **Checked By:** JB

DIRECT SHEAR TEST RESULTS

ASTM D-3080 2.8-inch GeoTest Shear Box

Client:	ERM	Print Date:	03/06/2015
Project:	"0283866	Project No.:	15LS3165.01
Material:	Gray-Black Silt Shelby Tube	Perf'd By:	MS
Sample ID:	MR-5-IS- 33 ft	Chk'd By:	JBJr





COMPACTION PROPERTIES

Initial	Point 1	Point 2	Point 3
Moisture Cnt, %	43.86	52.07	45.90
Dry Density, pcf	77.2	71.8	74.4
Saturation , %	101.4	105.5	99.2
Void Ratio	1.1508	1.3122	1.2311

At Test	Point 1	Point 2	Point 3
Moisture Cnt, %	42.51	47.42	44.30
Dry Density, pcf	77.9	73.4	76.2
Saturation , %	100.0	100.0	100.0
Void Ratio	1.1307	1.2614	1.1783

Other Information:

Specified Soil Properties	Density pcf	Moisture %

CURVE DATA

Point	Normal Load psf	Peak Strength psf	Residual Strength psf
1	1500	877	877
2	3000	1754	1742
3	6000	3281	3255
4			
5			
6			

Displacement Rate: 0.04 in/min

Saturation: Yes

STRENGTH PROPERTIES

		Peak	Residual
Cohesion	psf	113	120
Friction	Degrees	28.0	27.7

Comments:

Laboratories, Inc.

FIGURE - MR-5-IS-33

INPUT DATA FOR

ERM
"0283866
Gray-Black Silt

MR-5-IS- 33 ft

Print Date: 03/06/2015
Project No.:15LS3165.01
Perf'd By: MS

Chk'd By: JBJr

UPPER GRAPH

Displacement inches	Point 1 Load lbs	Point 2 Load lbs	Point 3 Load lbs	Point 1 Stress psf	Point 2 Stress psf	Point 3 Stress psf
0.000	0.0	0.0	0.0	0.0	0.0	0.0
0.005	4.0	13.5	21.0	93.5	315.7	491.1
0.010	7.3	22.2	31.2	170.7	519.2	729.6
0.015	11.6	27.0	37.8	271.3	631.4	884.0
0.020	13.7	30.6	42.9	320.4	715.6	1003.3
0.030	16.2	35.7	55.6	378.8	834.9	1300.3
0.040	21.0	39.0	63.3	491.1	912.0	1480.3
0.050	23.5	44.1	69.2	549.6	1031.3	1618.3
0.060	25.1	46.3	74.7	587.0	1082.8	1746.9
0.070	29.8	48.9	80.1	696.9	1143.6	1873.2
0.080	30.4	52.3	84.9	710.9	1223.1	1985.5
0.090	31.8	54.4	88.7	743.7	1272.2	2074.3
0.100	33.5	56.6	93.2	783.4	1323.6	2179.6
0.110	33.9	58.5	95.8	792.8	1368.1	2240.4
0.120	34.2	60.8	99.7	799.8	1421.9	2331.6
0.130	34.5	61.6	102.4	806.8	1440.6	2394.7
0.140	34.9	62.9	106.4	816.2	1471.0	2488.2
0.150	35.1	64.6	109.0	820.8	1510.7	2549.1
0.160	35.0	64.8	111.3	818.5	1515.4	2602.8
0.170	35.0	65.4	114.9	818.5	1529.4	2687.0
0.180	35.0	66.1	117.2	818.5	1545.8	2740.8
0.190	35.0	67.3	119.4	818.5	1573.9	2792.3
0.200	35.1	67.9	121.4	820.8	1587.9	2839.0
0.220	35.2	69.8	125.8	823.2	1632.3	2941.9
0.240	35.3	70.2	127.8	825.5	1641.7	2988.7
0.260	35.4	70.6	130.8	827.9	1651.0	3058.9
0.280	35.5	72.0	132.2	830.2	1683.8	3091.6
0.300	35.6	72.3	134.2	832.5	1690.8	3138.4
0.320	35.7	74.1	137.2	834.9	1732.9	3208.5
0.340	35.9	75.0	138.8	839.6	1753.9	3245.9
0.360	36.1	75.0	139.6	844.2	1753.9	3264.7
0.380	36.5	74.9	140.3	853.6	1751.6	3281.0
0.400	36.9	74.3	140.2	862.9	1737.6	3278.7
0.425	37.2	74.4	139.7	870.0	1739.9	3267.0
0.450	37.4	74.5	139.6	874.6	1742.2	3264.7
0.475	37.5	74.6	139.6	877.0	1744.6	3264.7
0.500	37.5	74.7	139.4	877.0	1746.9	3260.0
0.550	37.5	74.8	139.4	877.0	1749.3	3260.0
0.057	37.5	74.8	139.3	877.0	1749.3	3257.6
0.600	37.5	74.6	139.3	877.0	1744.6	3257.6
0.650	37.5	74.5	139.2	877.0	1742.2	3255.3
0.700	37.5	74.5	139.2	877.0	1742.2	3255.3
0.750	37.5	74.5	139.2	877.0	1742.2	3255.3

LOWER GRAPH

Pn	Peak	Residual
1500	877	877.0
3000	1753.9	1742.2
6000	3281	3255.3

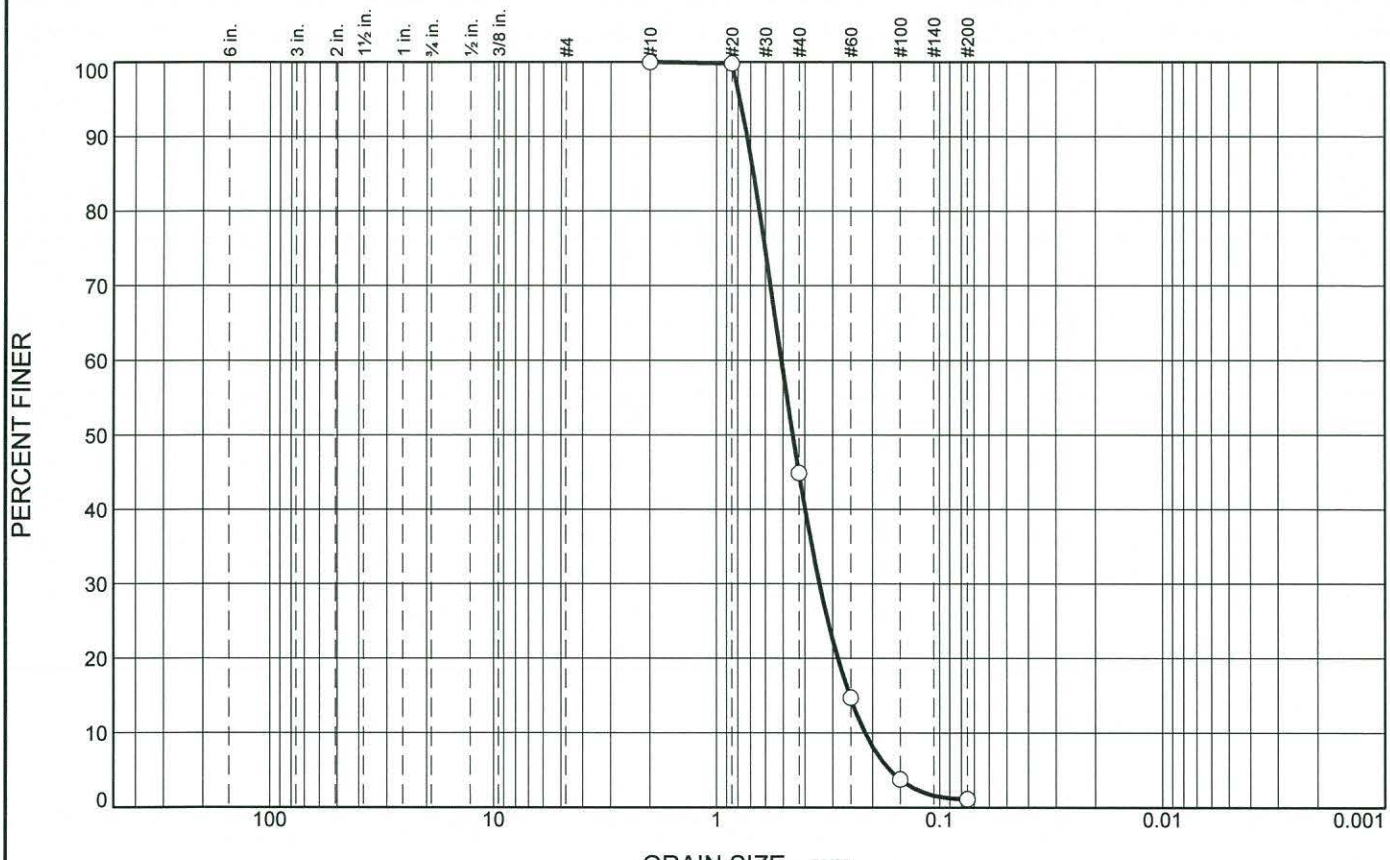
Engineering Properties

	Peak	Residual
Slope, m	0.531	0.525
Cohesion	113	120
Phi, degrees	27.97	27.70

FIGURE - MR-5-IS-33

JLT Laboratories, Inc.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	55.1	43.7	1.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.8		
#40	44.9		
#60	14.7		
#100	3.8		
#200	1.2		

* (no specification provided)

Material Description

Shelby Tube

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.7250 D_{85}= 0.6786 D_{60}= 0.5080
D_{50}= 0.4526 D_{30}= 0.3433 D_{15}= 0.2519
D_{10}= 0.2146 C_u= 2.37 C_c= 1.08

Classification

USCS= SP AASHTO=

Remarks

As-Rec'd M/C = 26.09%

Location: 0283866
Sample Number: MR-3-IS **Depth:** 42 ft **Date:** 03/09/2015

JLT Laboratories, Inc.

Canonsburg, PA

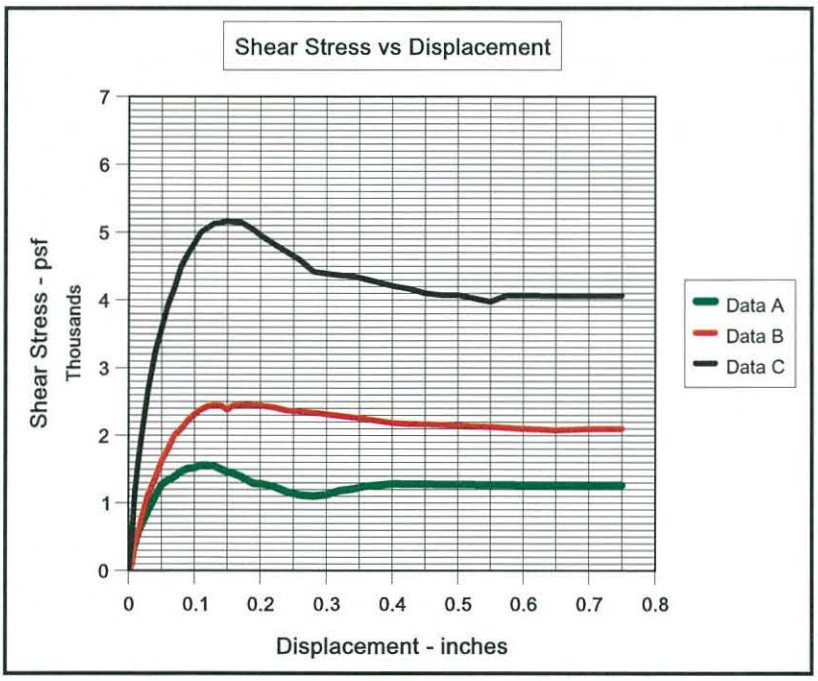
Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

Tested By: RL **Checked By:** JB

DIRECT SHEAR TEST RESULTS

ASTM D-3080 2.8-inch GeoTest Shear Box

Client:	ERM		Print Date:	03/05/2015
Project:	"0283866		Project No.:	15LS3165.01
Material:	Lower Sand	Shelby Tube	Perf'd By:	MS
Sample ID:	MR-3 IS- 42 ft		Chk'd By:	JBJr



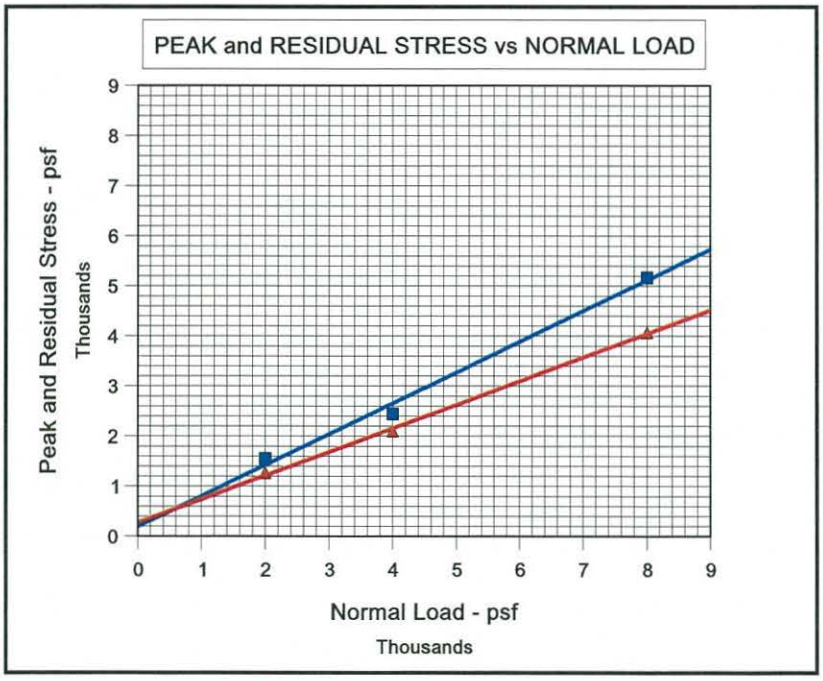
TION PROPERTIES

Initial	Point 1	Point 2	Point 3
Moisture Cnt, %	27.38	28.33	29.07
Dry Density, pcf	92.1	90.3	89.6
Saturation , %	90.9	89.8	90.8
Void Ratio	0.8013	0.8388	0.8515

At Test	Point 1	Point 2	Point 3
Moisture Cnt, %	29.50	29.43	29.22
Dry Density, pcf	93.0	93.1	93.4
Saturation , %	100.0	100.0	100.0
Void Ratio	0.7848	0.7829	0.7771

Other Information:

Specified Soil Properties	Density pcf	Moisture %



CURVE DATA

Point	Normal Load psf	Peak Strength psf	Residual Strength psf
1	2000	1555	1263
2	4000	2449	2098
3	8000	5168	4064
4			
5			
6			

Displacement Rate: 0.04 in/min

Saturation: Yes

STRENGTH PROPERTIES

		Peak	Residual
Cohesion	psf	195	279
Friction	Degrees	31.5	25.2

Comments:

Laboratories, Inc.

FIGURE - MR-3-IS-42

INPUT DATA FOR

ERM
"0283866
Lower Sand

MR-3 IS- 42 ft

Print Date: 03/05/2015
Project No.:15LS3165.01
Perf'd By: MS

Chk'd By: JBJr

UPPER GRAPH

Displacement inches	Point 1 Load lbs	Point 2 Load lbs	Point 3 Load lbs	Point 1 Stress psf	Point 2 Stress psf	Point 3 Stress psf
0.000	0.0	0.0	0.0	0.0	0.0	0.0
0.005	8.6	4.0	18.0	201.1	93.5	420.9
0.010	16.9	16.5	49.0	395.2	385.9	1145.9
0.015	24.3	23.3	68.1	568.3	544.9	1592.6
0.020	29.1	33.0	85.5	680.5	771.7	1999.5
0.030	38.0	48.0	114.2	888.7	1122.5	2670.7
0.040	46.4	57.8	137.2	1085.1	1351.7	3208.5
0.050	54.1	69.5	152.9	1265.2	1625.3	3575.7
0.060	57.0	77.1	167.9	1333.0	1803.0	3926.5
0.070	59.2	86.0	178.9	1384.4	2011.2	4183.7
0.080	62.5	89.5	191.9	1461.6	2093.0	4487.7
0.090	64.4	95.0	200.0	1506.0	2221.7	4677.2
0.100	64.8	98.8	206.9	1515.4	2310.5	4838.5
0.110	66.5	101.8	213.7	1555.2	2380.7	4997.5
0.120	66.4	104.0	216.4	1552.8	2432.1	5060.7
0.130	66.0	104.7	219.2	1543.5	2448.5	5126.2
0.140	64.1	104.5	219.6	1499.0	2443.8	5135.5
0.150	62.2	101.6	221.0	1454.6	2376.0	5168.3
0.160	61.2	104.6	220.3	1431.2	2446.2	5151.9
0.170	59.3	104.8	220.0	1386.8	2450.8	5144.9
0.180	57.2	105.0	217.7	1337.7	2455.5	5091.1
0.190	55.0	104.8	215.3	1286.2	2450.8	5035.0
0.200	54.7	104.5	211.7	1279.2	2443.8	4950.8
0.220	53.2	103.3	206.3	1244.1	2415.8	4824.5
0.240	49.7	101.3	201.3	1162.3	2369.0	4707.6
0.260	47.7	100.7	196.3	1115.5	2354.9	4590.6
0.280	47.1	100.0	188.9	1101.5	2338.6	4417.6
0.300	47.9	99.0	187.7	1120.2	2315.2	4389.5
0.320	50.5	98.0	186.6	1181.0	2291.8	4363.8
0.340	51.5	97.0	186.1	1204.4	2268.4	4352.1
0.360	53.3	96.0	184.0	1246.5	2245.0	4303.0
0.380	54.0	94.8	182.0	1262.8	2217.0	4256.2
0.400	54.8	93.7	180.1	1281.5	2191.2	4211.8
0.425	54.5	93.0	178.2	1274.5	2174.9	4167.3
0.450	54.5	92.7	175.4	1274.5	2167.9	4101.9
0.475	54.4	92.3	174.1	1272.2	2158.5	4071.5
0.500	54.3	92.0	174.1	1269.8	2151.5	4071.5
0.550	54.2	91.1	170.0	1267.5	2130.4	3975.6
0.057	54.2	90.5	174.0	1267.5	2116.4	4069.1
0.600	54.0	90.0	173.9	1262.8	2104.7	4066.8
0.650	54.0	89.0	173.8	1262.8	2081.3	4064.5
0.700	54.0	89.7	173.8	1262.8	2097.7	4064.5
0.750	54.0	89.7	173.8	1262.8	2097.7	4064.5

LOWER GRAPH

Pn	Peak	Residual
2000	1555.2	1262.8
4000	2448.5	2097.7
8000	5168.3	4064.5

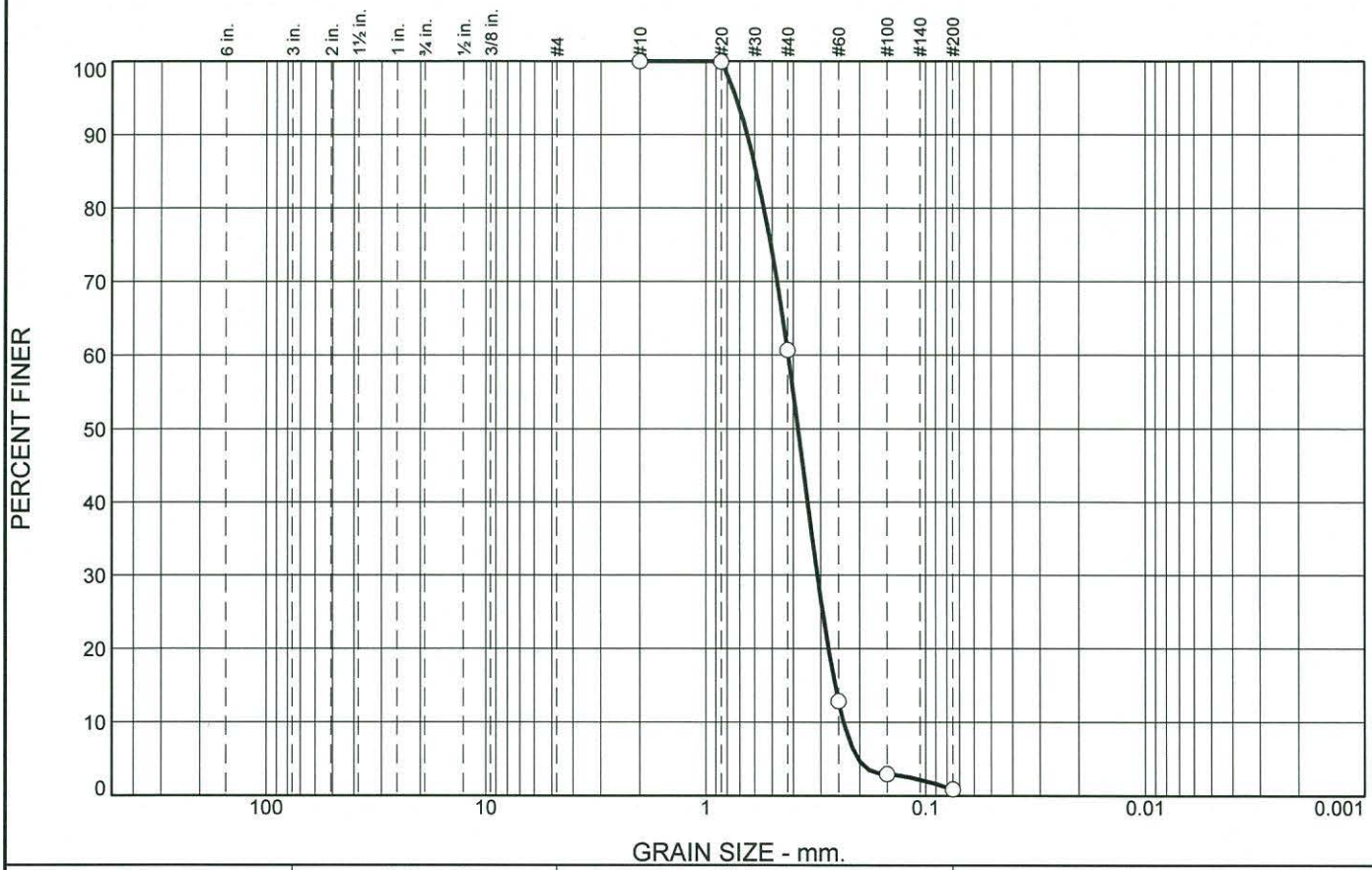
Engineering Properties

	Peak	Residual
Slope, m	0.613	0.47
Cohesion	195	279
Phi, degrees	31.51	25.17

FIGURE - MR-3-IS-42

JLT Laboratories, Inc.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	39.3	59.8	0.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	100.0		
#40	60.7		
#60	12.9		
#100	3.0		
#200	0.9		

* (no specification provided)

Material Description

Shelby Tube

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6467 D_{85}= 0.5890 D_{60}= 0.4217
D_{50}= 0.3802 D_{30}= 0.3107 D_{15}= 0.2585
D_{10}= 0.2364 C_u= 1.78 C_c= 0.97

Classification

USCS= SP AASHTO=

Remarks

As-Rec'd M/C = 27.58%

Location: 0283866
Sample Number: MR-4-IS **Depth:** 50 ft **Date:** 03/09/2015

JLT Laboratories, Inc.

Canonsburg, PA

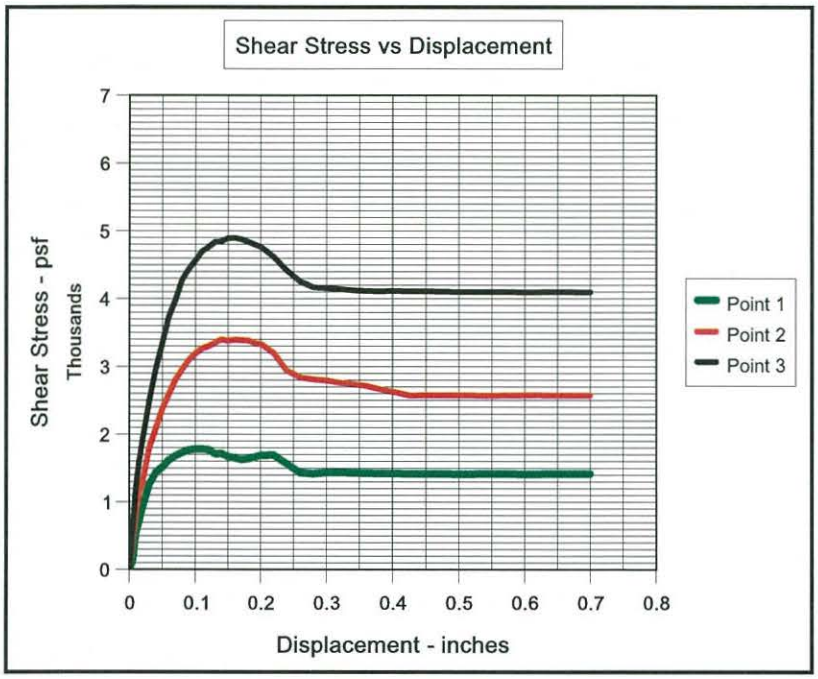
Client: ERM
Project: MMGL PEO Portland
ERM Project No: 0283866
Project No: 15LS3165.01 **Figure**

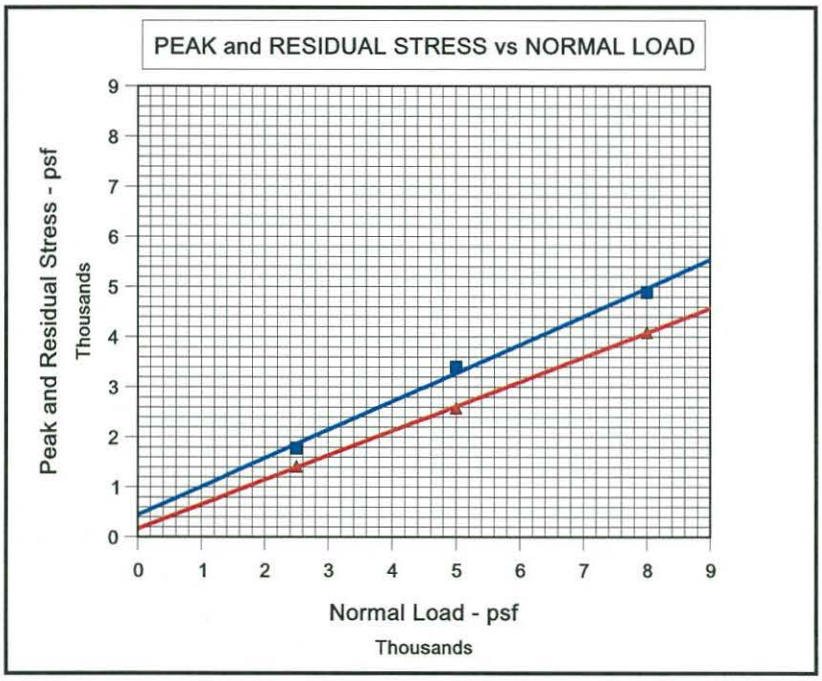
Tested By: RL **Checked By:** JB

DIRECT SHEAR TEST RESULTS

ASTM D-3080 2.8-inch GeoTest Shear Box

Client:	ERM		Print Date:	03/04/2015
Project:	"0283866		Project No.:	15LS3165.01
Material:	Lower Sand	Shelby Tube	Perf'd By:	MS
Sample ID:	MR-4 IS- 50 ft		Chk'd By:	JBJr





TION PROPERTIES

Initial	Point 1	Point 2	Point 3
Moisture Cnt, %	29.53	34.20	32.75
Dry Density, pcf	92.2	86.2	92.1
Saturation , %	98.2	98.4	108.5
Void Ratio	0.8003	0.9250	0.8030

At Test	Point 1	Point 2	Point 3
Moisture Cnt, %	29.65	29.00	28.30
Dry Density, pcf	92.8	93.7	94.7
Saturation , %	100.0	100.0	100.0
Void Ratio	0.7886	0.7714	0.7527

Other Information:

Specified Soil Properties	Density pcf	Moisture %

CURVE DATA

Point	Normal Load psf	Peak Strength psf	Residual Strength psf
1	2500	1777	1413
2	5000	3400	2577
3	8000	4895	4095
4			
5			
6			

Displacement Rate: 0.04 in/min

Saturation: Yes

STRENGTH PROPERTIES

		Peak	Residual
Cohesion	psf	441	172
Friction	Degrees	29.5	26.0

Comments:

Laboratories, Inc.

FIGURE - MR-4-IS-50

INPUT DATA FOR

ERM
"0283866
Lower Sand

MR-4 IS- 50 ft

Print Date: 03/04/2015
Project No.:15LS3165.01
Perf'd By: MS

Chk'd By: JBJr

UPPER GRAPH

Displacement inches	Point 1 Load lbs	Point 2 Load lbs	Point 3 Load lbs	Point 1 Stress psf	Point 2 Stress psf	Point 3 Stress psf
0.000	0.0	0.0	0.0	0.0	0.0	0.0
0.005	4.5	18.0	23.3	105.2	420.9	544.9
0.010	22.5	35.0	50.4	526.2	818.5	1178.6
0.015	30.3	48.0	67.2	708.6	1122.5	1571.5
0.020	39.3	55.2	81.6	919.1	1290.9	1908.3
0.030	53.3	76.1	105.3	1246.5	1779.7	2462.5
0.040	61.0	88.6	126.1	1426.5	2072.0	2948.9
0.050	64.5	101.5	142.7	1508.4	2373.7	3337.2
0.060	68.9	110.6	159.4	1611.3	2586.5	3727.7
0.070	71.7	120.2	170.4	1676.8	2811.0	3984.9
0.080	73.7	126.3	182.8	1723.5	2953.6	4274.9
0.090	75.3	132.5	189.6	1761.0	3098.6	4433.9
0.100	76.0	136.6	194.9	1777.3	3194.5	4557.9
0.110	76.0	139.8	200.6	1777.3	3269.3	4691.2
0.120	75.5	141.2	203.4	1765.6	3302.1	4756.7
0.130	73.0	143.5	206.9	1707.2	3355.9	4838.5
0.140	73.1	145.4	207.2	1709.5	3400.3	4845.5
0.150	71.1	144.6	209.1	1662.7	3381.6	4890.0
0.160	70.3	145.3	209.3	1644.0	3398.0	4894.6
0.170	69.4	145.0	208.6	1623.0	3390.9	4878.3
0.180	69.8	144.8	206.9	1632.3	3386.3	4838.5
0.190	70.8	143.1	205.4	1655.7	3346.5	4803.4
0.200	72.0	142.6	203.8	1683.8	3334.8	4766.0
0.220	72.1	137.0	197.5	1686.1	3203.9	4618.7
0.240	66.7	125.8	188.8	1559.8	2941.9	4415.2
0.260	61.1	121.5	181.8	1428.9	2841.4	4251.5
0.280	60.4	120.4	178.2	1412.5	2815.6	4167.3
0.300	61.3	119.8	177.7	1433.5	2801.6	4155.7
0.320	61.2	118.2	177.1	1431.2	2764.2	4141.6
0.340	61.1	117.4	176.3	1428.9	2745.5	4122.9
0.360	60.8	116.2	176.0	1421.9	2717.4	4115.9
0.380	60.7	114.3	175.8	1419.5	2673.0	4111.2
0.400	60.6	112.6	175.9	1417.2	2633.2	4113.6
0.425	60.5	110.2	175.8	1414.8	2577.1	4111.2
0.450	60.5	110.3	175.7	1414.8	2579.5	4108.9
0.475	60.5	110.4	175.6	1414.8	2581.8	4106.5
0.500	60.3	110.3	175.4	1410.2	2579.5	4101.9
0.550	60.5	110.2	175.3	1414.8	2577.1	4099.5
0.057	60.4	110.3	175.3	1412.5	2579.5	4099.5
0.600	60.2	110.4	175.2	1407.8	2581.8	4097.2
0.650	60.5	110.2	175.3	1414.8	2577.1	4099.5
0.700	60.4	110.2	175.1	1412.5	2577.1	4094.9
0.750	60.4	110.2	175.1	1412.5	2577.1	4094.9

LOWER GRAPH

Pn	Peak	Residual
2500	1777.3	1412.5
5000	3400.3	2577.1
8000	4894.6	4094.9

Engineering Properties

	Peak	Residual
Slope, m	0.565	0.488
Cohesion	441	172
Phi, degrees	29.47	26.01

FIGURE - MR-4-IS-50

Laboratories, Inc.

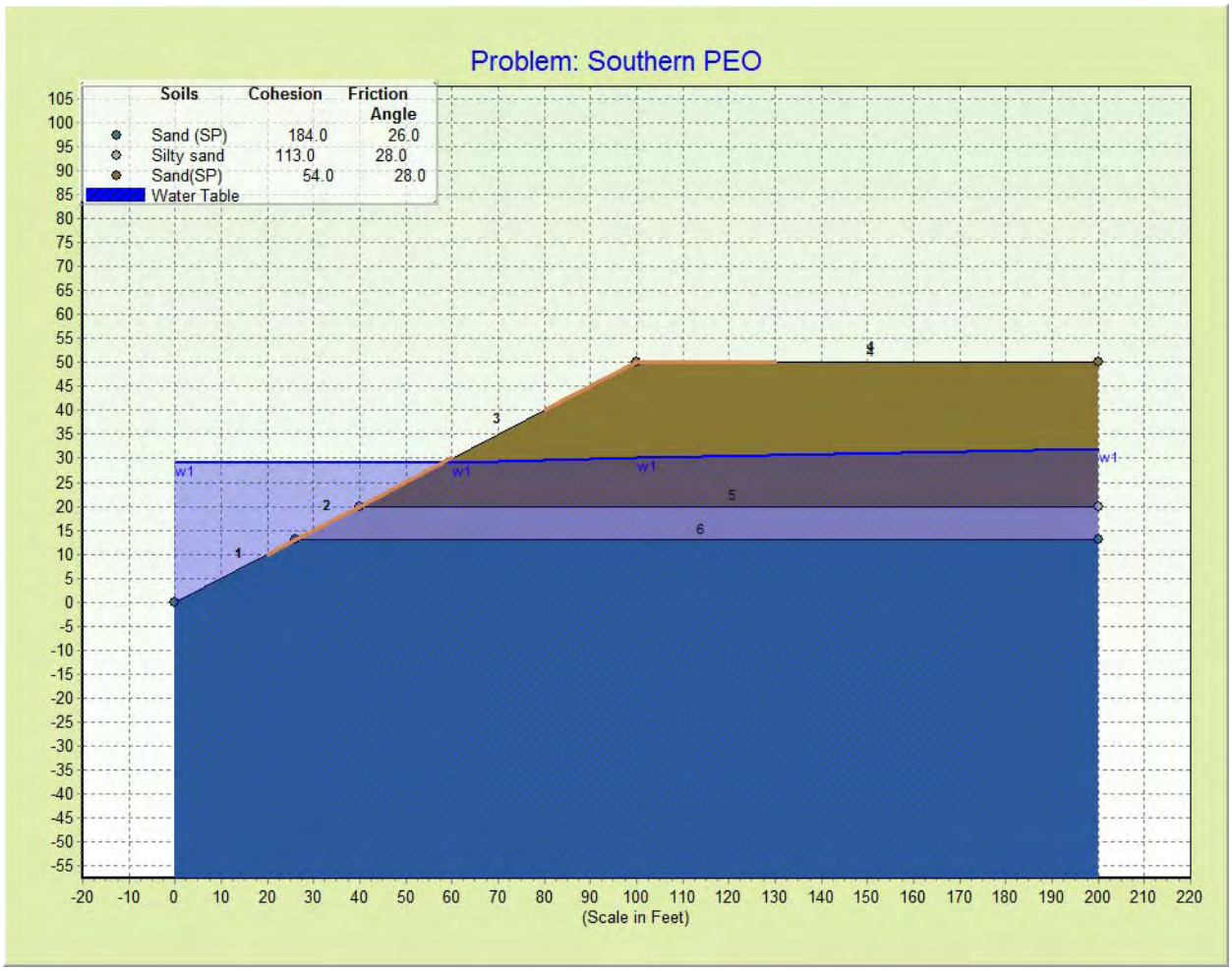
Appendix C
Stability Analyses

The purpose of the calculations presented herein is to evaluate the stability of the riverbank slope and the minimum setback of the proposed slurry wall from the riverbank crest, as discussed in the Memorandum. Stability analyses for both rotational and sliding block failures were performed for the following scenarios, and are presented herein.

- Existing Riverbank, Normal Groundwater Condition.
- Existing Riverbank, Rapid Drawdown Condition.
- During Construction, Normal Groundwater Condition.
- During Construction, Rapid Drawdown Condition.
- Post-Construction, Normal Groundwater Condition.
- Post-Construction, Rapid Drawdown Condition.

Appendix C.1
Existing Riverbank, Normal Groundwater Condition

========== DATA SUMMARY ==========



Profile Data

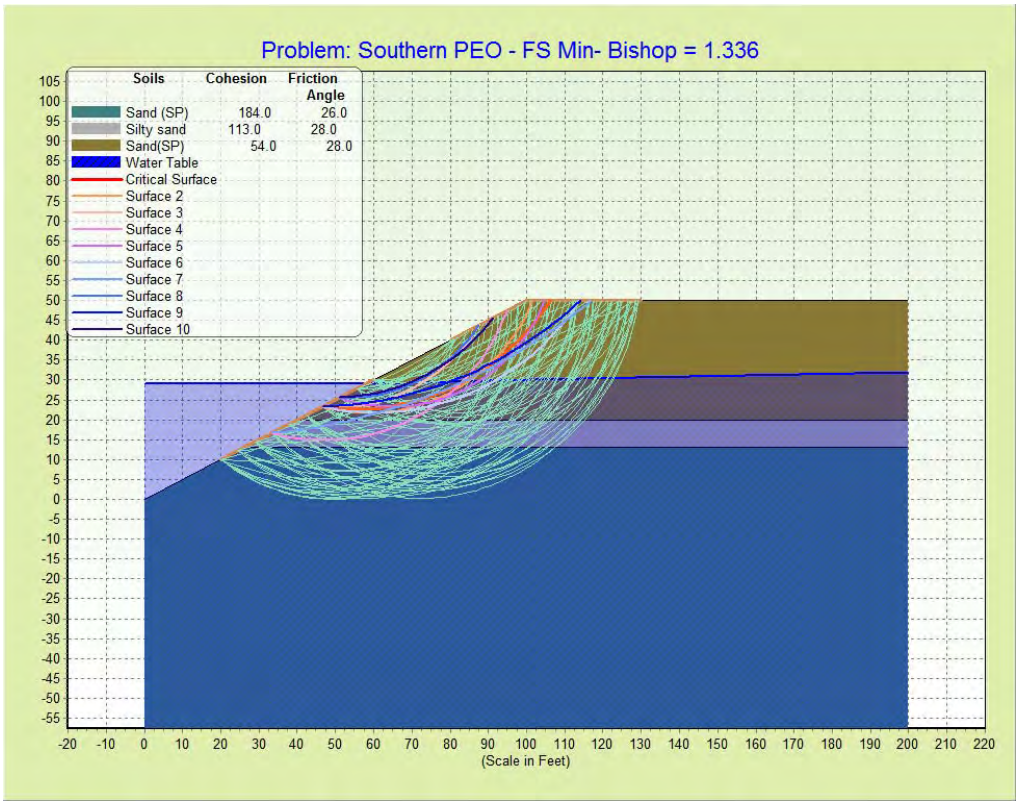
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	200	50	1
5	40	20	200	20	2
6	26	13	200	13	3

Soil Properties

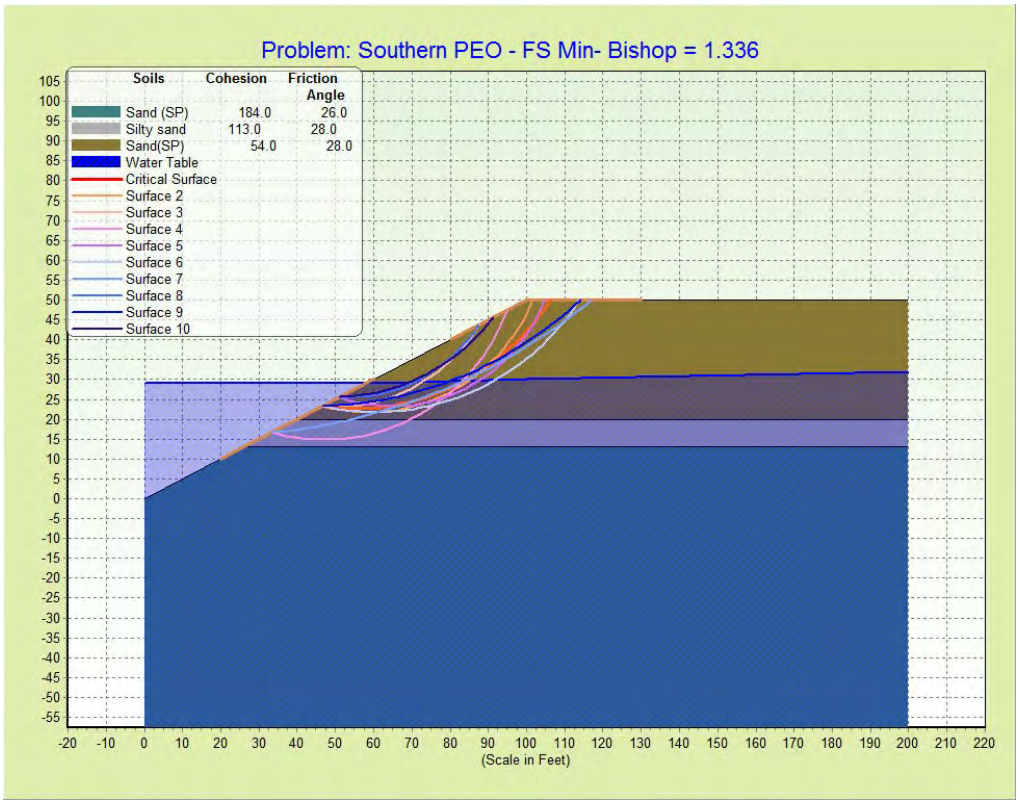
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

4 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	200.00	50.00	1
5	40.00	20.00	200.00	20.00	2
6	26.00	13.00	200.00	13.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1
3	117.0	125.0	184.0	26.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	100.00	30.00
4	200.00	32.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 20.00 ft.
and X = 60.00 ft.

Each Surface Terminates Between X = 80.00 ft.
and X = 130.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.65	23.07
3	50.64	22.88
4	52.64	22.75
5	54.64	22.69

6	56.64	22.69
7	58.63	22.76
8	60.63	22.89
9	62.62	23.09
10	64.60	23.36
11	66.57	23.69
12	68.53	24.09
13	70.48	24.55
14	72.41	25.08
15	74.32	25.67
16	76.21	26.32
17	78.08	27.03
18	79.92	27.81
19	81.74	28.64
20	83.53	29.54
21	85.29	30.49
22	87.01	31.51
23	88.70	32.57
24	90.36	33.70
25	91.97	34.88
26	93.55	36.11
27	95.08	37.39
28	96.58	38.72
29	98.02	40.10
30	99.42	41.53
31	100.78	43.00
32	102.08	44.52
33	103.33	46.08
34	104.53	47.68
35	105.68	49.32
36	106.12	50.00

Circle Center At X = 55.5 ; Y = 83.1 and Radius, 60.5

*** 1.336 ***

Individual data on the 38 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.0	146.5	715.3	723.4	0.0	0.0	0.0	0.0	0.0
2	2.0	433.9	580.1	751.9	0.0	0.0	0.0	0.0	0.0
3	2.0	708.0	442.9	772.1	0.0	0.0	0.0	0.0	0.0
4	2.0	967.4	304.3	784.1	0.0	0.0	0.0	0.0	0.0
5	2.0	1210.9	165.0	787.9	0.0	0.0	0.0	0.0	0.0
6	2.0	1437.5	25.5	783.4	0.0	0.0	0.0	0.0	0.0
7	1.4	1098.5	0.0	529.3	0.0	0.0	0.0	0.0	0.0
8	0.6	536.2	0.0	241.6	0.0	0.0	0.0	0.0	0.0
9	2.0	1811.3	0.0	754.5	0.0	0.0	0.0	0.0	0.0
10	2.0	1968.7	0.0	731.5	0.0	0.0	0.0	0.0	0.0
11	2.0	2106.4	0.0	700.4	0.0	0.0	0.0	0.0	0.0
12	2.0	2223.7	0.0	661.0	0.0	0.0	0.0	0.0	0.0
13	1.9	2320.7	0.0	613.5	0.0	0.0	0.0	0.0	0.0
14	1.9	2397.0	0.0	558.0	0.0	0.0	0.0	0.0	0.0
15	1.9	2452.7	0.0	494.4	0.0	0.0	0.0	0.0	0.0
16	1.9	2488.0	0.0	422.9	0.0	0.0	0.0	0.0	0.0

17	1.9	2503.2	0.0	343.6	0.0	0.0	0.0	0.0	0.0
18	1.8	2498.6	0.0	256.4	0.0	0.0	0.0	0.0	0.0
19	1.8	2474.9	0.0	161.6	0.0	0.0	0.0	0.0	0.0
20	1.8	2432.7	0.0	59.2	0.0	0.0	0.0	0.0	0.0
21	0.1	128.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0
22	1.7	2249.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1.7	2312.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	1.7	2231.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	1.7	2135.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1.6	2026.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1.6	1905.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	1.5	1774.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	1.5	1633.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	1.4	1484.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	1.4	1328.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.6	512.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.8	640.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	1.3	902.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	1.3	653.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	1.2	416.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	1.1	191.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.4	16.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.61	22.85
3	50.57	22.46
4	52.55	22.15
5	54.53	21.92
6	56.53	21.78
7	58.53	21.73
8	60.53	21.76
9	62.52	21.88
10	64.51	22.08
11	66.49	22.37
12	68.46	22.74
13	70.40	23.20
14	72.33	23.74
15	74.23	24.36
16	76.10	25.06
17	77.94	25.85
18	79.75	26.71
19	81.52	27.64
20	83.24	28.66
21	84.92	29.74
22	86.55	30.90
23	88.13	32.12
24	89.66	33.42
25	91.13	34.77
26	92.54	36.19
27	93.89	37.67
28	95.17	39.20
29	96.39	40.79
30	97.54	42.43
31	98.61	44.11
32	99.61	45.84
33	100.54	47.62
34	101.39	49.43

35	101.63	50.00

Circle Center At X = 58.8 ; Y = 68.3 and Radius, 46.6

*** 1.340 ***

1

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.66	23.21
3	50.66	23.18
4	52.66	23.25
5	54.66	23.40
6	56.64	23.64
7	58.61	23.97
8	60.57	24.39
9	62.50	24.90
10	64.41	25.50
11	66.29	26.18
12	68.14	26.94
13	69.95	27.79
14	71.72	28.72
15	73.45	29.73
16	75.13	30.82
17	76.76	31.98
18	78.33	33.21
19	79.85	34.52
20	81.30	35.89
21	82.69	37.33
22	84.02	38.82
23	85.28	40.38
24	86.46	41.99
25	87.57	43.65
26	87.69	43.84

Circle Center At X = 50.3 ; Y = 67.3 and Radius, 44.1

*** 1.385 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	16.67
2	35.27	16.17
3	37.23	15.75
4	39.20	15.41
5	41.18	15.15

6	43.17	14.96
7	45.17	14.85
8	47.17	14.81
9	49.17	14.86
10	51.16	14.98
11	53.15	15.18
12	55.13	15.45
13	57.10	15.80
14	59.06	16.23
15	60.99	16.74
16	62.91	17.32
17	64.80	17.97
18	66.66	18.70
19	68.49	19.49
20	70.30	20.36
21	72.06	21.30
22	73.79	22.30
23	75.48	23.38
24	77.13	24.51
25	78.73	25.71
26	80.28	26.97
27	81.78	28.29
28	83.23	29.67
29	84.63	31.10
30	85.97	32.59
31	87.25	34.13
32	88.47	35.71
33	89.62	37.34
34	90.72	39.02
35	91.74	40.73
36	92.70	42.49
37	93.59	44.28
38	94.41	46.10
39	94.97	47.49

Circle Center At X = 47.0 ; Y = 66.3 and Radius, 51.5

*** 1.419 ***

1

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.02	24.95
3	54.95	24.44
4	56.91	24.02
5	58.88	23.69
6	60.86	23.45
7	62.86	23.30
8	64.86	23.25
9	66.86	23.29
10	68.85	23.42
11	70.84	23.65
12	72.82	23.97
13	74.77	24.38

14	76.71	24.88
15	78.62	25.47
16	80.50	26.15
17	82.35	26.92
18	84.16	27.77
19	85.93	28.70
20	87.65	29.72
21	89.32	30.82
22	90.94	31.99
23	92.51	33.23
24	94.01	34.55
25	95.45	35.94
26	96.83	37.39
27	98.13	38.91
28	99.37	40.48
29	100.53	42.11
30	101.61	43.79
31	102.61	45.52
32	103.53	47.30
33	104.37	49.11
34	104.73	50.00

Circle Center At X = 65.0 ; Y = 66.1 and Radius, 42.9

*** 1.426 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.63	22.93
3	50.60	22.59
4	52.58	22.31
5	54.57	22.09
6	56.56	21.93
7	58.56	21.84
8	60.56	21.81
9	62.56	21.84
10	64.55	21.93
11	66.55	22.08
12	68.54	22.30
13	70.52	22.57
14	72.49	22.91
15	74.45	23.31
16	76.39	23.77
17	78.33	24.29
18	80.24	24.87
19	82.13	25.51
20	84.01	26.21
21	85.86	26.96
22	87.69	27.78
23	89.49	28.65
24	91.26	29.57
25	93.01	30.55
26	94.72	31.58
27	96.40	32.67

28	98.04	33.81
29	99.65	34.99
30	101.22	36.23
31	102.76	37.52
32	104.25	38.85
33	105.70	40.23
34	107.10	41.65
35	108.47	43.11
36	109.78	44.62
37	111.05	46.17
38	112.27	47.75
39	113.44	49.38
40	113.86	50.00

Circle Center At X = 60.6 ; Y = 86.2 and Radius, 64.4

*** 1.437 ***

1

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	16.67
2	35.32	16.86
3	37.31	17.07
4	39.30	17.31
5	41.28	17.57
6	43.26	17.86
7	45.24	18.18
8	47.21	18.52
9	49.17	18.88
10	51.13	19.27
11	53.09	19.69
12	55.04	20.13
13	56.99	20.59
14	58.93	21.08
15	60.86	21.60
16	62.78	22.14
17	64.70	22.70
18	66.62	23.29
19	68.52	23.90
20	70.42	24.54
21	72.30	25.20
22	74.18	25.88
23	76.05	26.59
24	77.91	27.32
25	79.77	28.08
26	81.61	28.86
27	83.44	29.66
28	85.26	30.49
29	87.07	31.33
30	88.87	32.21
31	90.66	33.10
32	92.44	34.02
33	94.20	34.96
34	95.96	35.92

35	97.70	36.91
36	99.42	37.91
37	101.14	38.94
38	102.84	39.99
39	104.53	41.07
40	106.20	42.16
41	107.86	43.28
42	109.51	44.41
43	111.14	45.57
44	112.76	46.75
45	114.36	47.95
46	115.94	49.16
47	117.00	50.00

Circle Center At X = 19.5 ; Y = 173.0 and Radius, 156.9

*** 1.446 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.11	25.50
3	55.11	25.55
4	57.11	25.69
5	59.09	25.93
6	61.06	26.26
7	63.02	26.69
8	64.95	27.22
9	66.85	27.83
10	68.72	28.54
11	70.55	29.34
12	72.35	30.22
13	74.10	31.19
14	75.79	32.25
15	77.44	33.39
16	79.03	34.60
17	80.56	35.89
18	82.02	37.25
19	83.42	38.68
20	84.74	40.18
21	86.00	41.74
22	87.17	43.36
23	87.39	43.69

Circle Center At X = 53.2 ; Y = 66.8 and Radius, 41.3

*** 1.451 ***

1

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.67	23.40
3	50.66	23.51
4	52.66	23.65
5	54.65	23.83
6	56.64	24.05
7	58.62	24.30
8	60.60	24.60
9	62.57	24.93
10	64.54	25.30
11	66.50	25.70
12	68.45	26.15
13	70.39	26.63
14	72.32	27.14
15	74.24	27.70
16	76.15	28.29
17	78.05	28.91
18	79.94	29.58
19	81.81	30.28
20	83.67	31.01
21	85.52	31.78
22	87.35	32.58
23	89.17	33.42
24	90.97	34.29
25	92.75	35.20
26	94.51	36.14
27	96.26	37.12
28	97.99	38.12
29	99.70	39.16
30	101.39	40.23
31	103.05	41.34
32	104.70	42.47
33	106.32	43.64
34	107.93	44.84
35	109.50	46.07
36	111.06	47.32
37	112.59	48.61
38	114.10	49.93
39	114.18	50.00

Circle Center At X = 44.2 ; Y = 128.5 and Radius, 105.2

*** 1.454 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.11	25.65
3	55.10	25.82
4	57.09	26.06
5	59.06	26.38

6	61.02	26.77
7	62.97	27.23
8	64.90	27.77
9	66.80	28.38
10	68.68	29.06
11	70.53	29.81
12	72.36	30.63
13	74.15	31.52
14	75.91	32.47
15	77.63	33.49
16	79.31	34.58
17	80.95	35.72
18	82.54	36.93
19	84.09	38.20
20	85.59	39.52
21	87.04	40.90
22	88.44	42.33
23	89.78	43.81
24	91.07	45.34
25	91.30	45.65

Circle Center At X = 49.6 ; Y = 78.8 and Radius, 53.2

*** 1.455 ***

1

```
                Y            A     X     I     S            F     T

                0.00     25.00     50.00     75.00    100.00    125.00

X        0.00 *---------+-W-------+---------+---------+---------+
              -
              -
              -
              -
              -   .
        25.00 + ...*
              - .....
              -.....44
              -.....47.
              ......47*
              ......47.1
A       50.00 ......4.715
              ......4.715.
              ......4.7130W
              .......4.138.
              .......441130.
              ........42138..
X       75.00 .........41133..
              ..........21933..
              -.........611.333.
              -..........5214.033
              -...........6114444.
              - ...........6512244.
I      100.00 +  .........W.671112*
              -   ...........667111
              -    ............66..
              -     ............666
```

```
             -       ............7
             -         ...........
S    125.00 +           .........
             -                ....
             -
             -
             -
             -
     150.00 +
             -
             -
             -
             -
             -
F    175.00 +
             -
             -
             -
             -
             -
T    200.00 +    *  *    W      *
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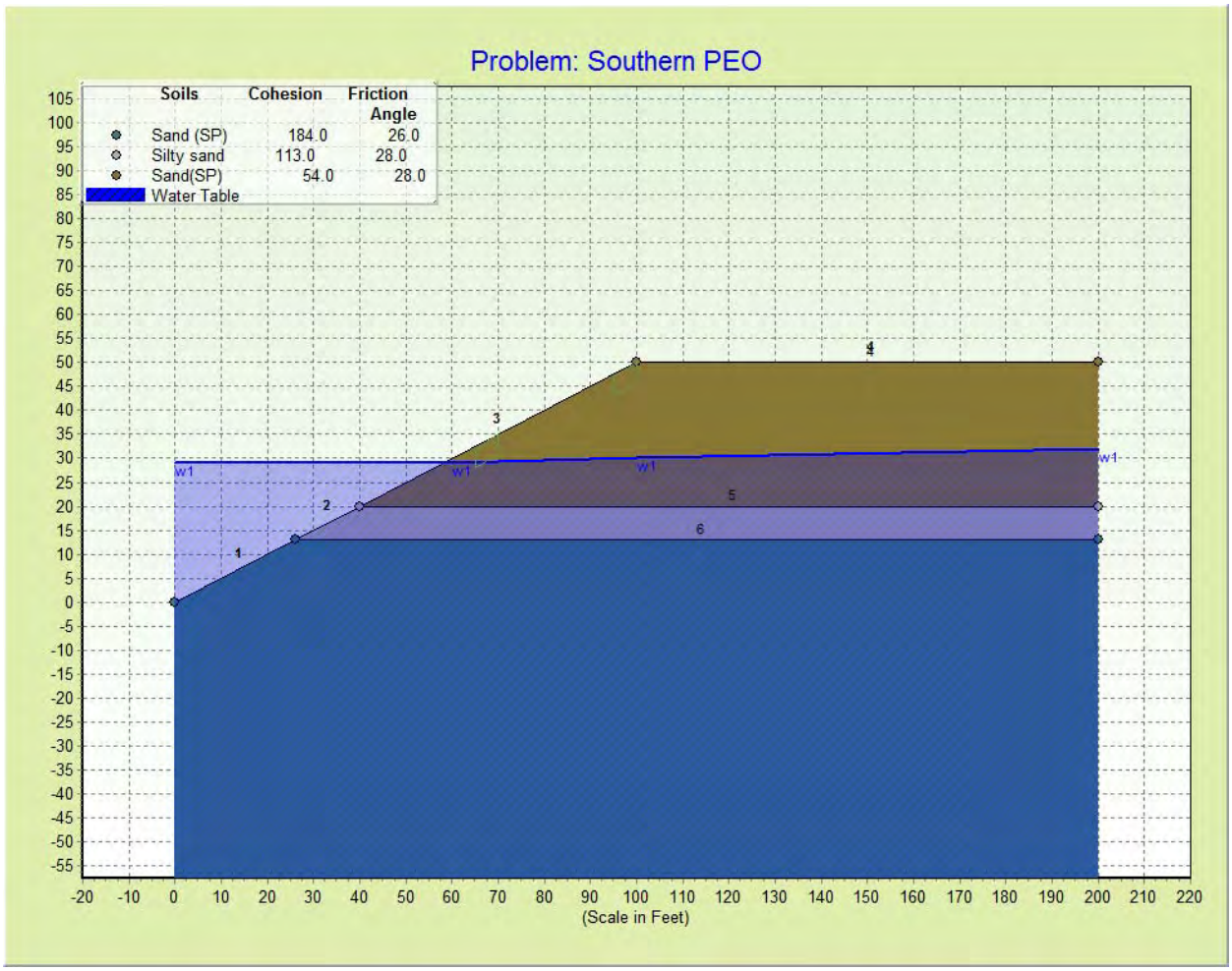
========== DATA SUMMARY ==========



Profile Data

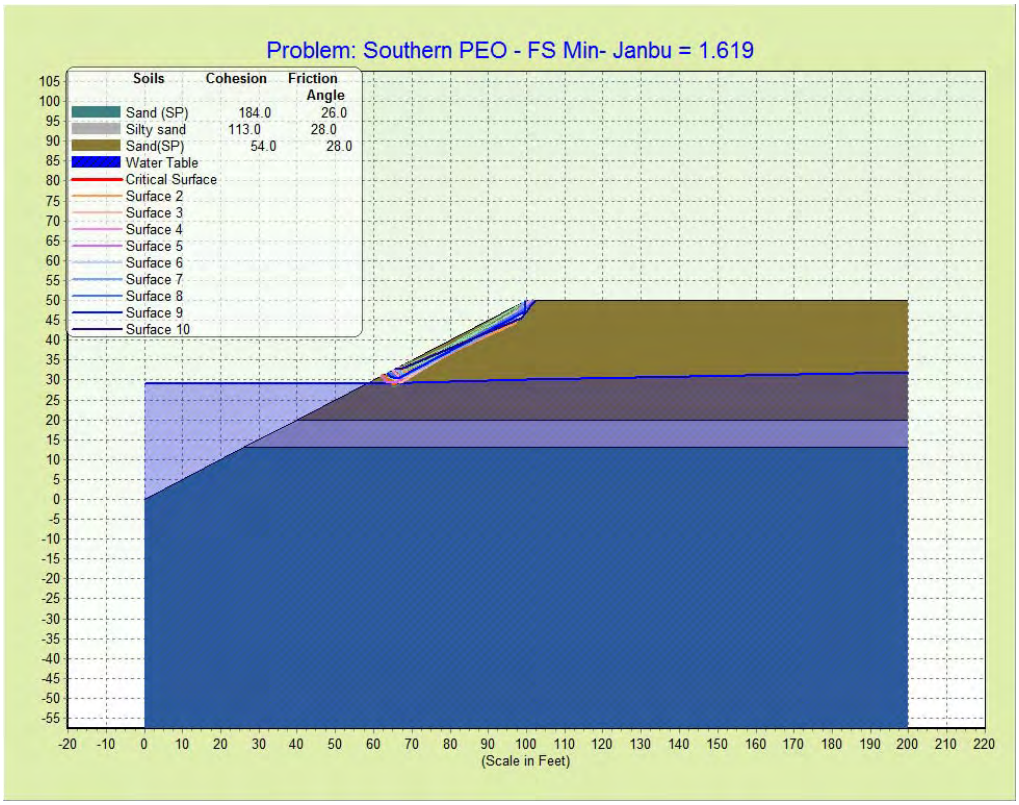
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	200	50	1
5	40	20	200	20	2
6	26	13	200	13	3

Soil Properties

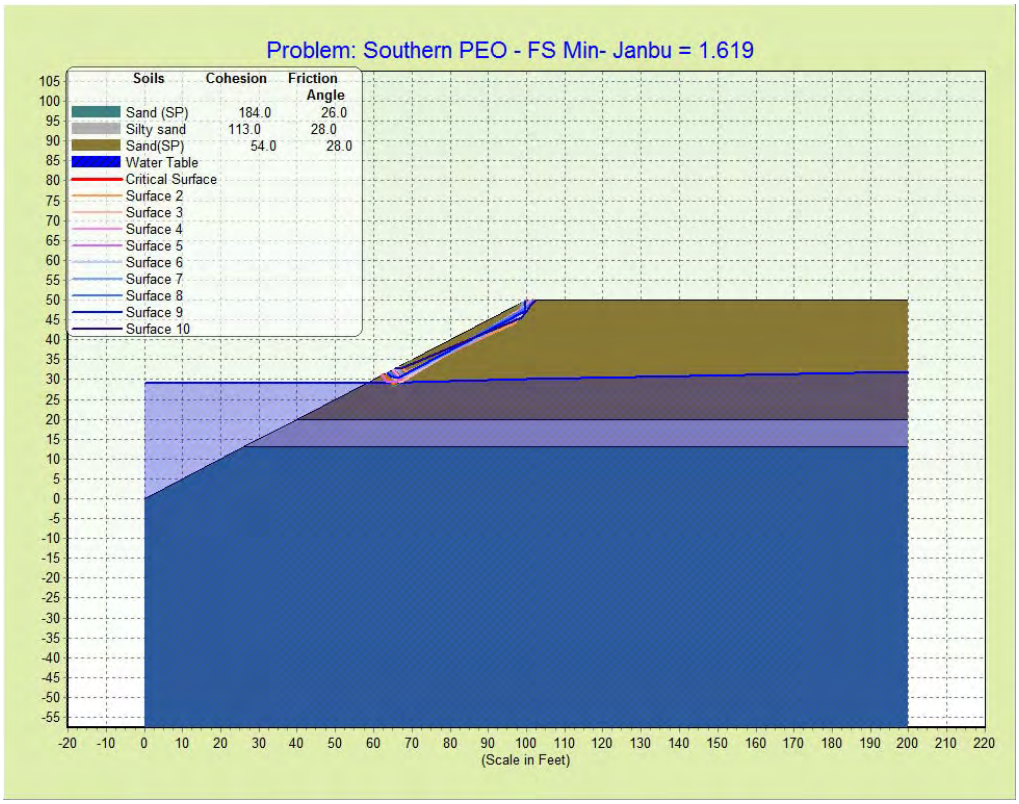
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

4 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	200.00	50.00	1
5	40.00	20.00	200.00	20.00	2
6	26.00	13.00	200.00	13.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1
3	117.0	125.0	184.0	26.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	100.00	30.00
4	200.00	32.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

20 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 2.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	65.00	30.00	70.00	33.00	4.00
2	95.00	45.00	100.00	48.00	4.00

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.27	31.14
2	63.54	30.01
3	65.26	28.99
4	98.43	46.02
5	99.56	47.67
6	100.97	49.09
7	101.64	50.00

*** 1.619 ***

Individual data on the 9 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.3	124.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.5	427.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.2	90.1	0.0	1.2	0.0	0.0	0.0	0.0	0.0
4	0.3	117.3	0.0	1.4	0.0	0.0	0.0	0.0	0.0
5	32.9	12461.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.1	332.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.4	97.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1.0	151.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.7	33.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.44	33.22
2	67.07	32.95
3	68.75	31.87
4	97.06	44.28
5	98.02	46.04
6	99.09	47.73
7	100.35	49.28
8	100.92	50.00

*** 1.624 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.34	31.67
2	63.82	31.42
3	65.33	30.10
4	67.18	29.35
5	99.79	48.34
6	101.20	49.75
7	101.33	50.00

*** 1.702 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.77	32.39
2	65.71	31.80
3	67.18	30.44
4	98.78	46.32
5	99.48	48.19
6	100.88	49.61
7	100.92	50.00

*** 1.704 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	61.95	30.97
2	62.12	30.82
3	63.54	29.41
4	65.54	29.36
5	97.59	46.85
6	98.65	48.54
7	99.00	49.50

*** 1.708 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.54	32.77
2	66.45	32.08
3	67.87	30.67
4	99.37	46.73
5	100.78	48.15
6	101.57	49.99
7	101.59	50.00

*** 1.710 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.63	32.82
2	66.53	32.38
3	67.95	30.96
4	96.20	44.70
5	97.61	46.12
6	98.74	47.77
7	98.88	49.44

*** 1.712 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.82	31.91
2	64.77	31.40
3	66.42	30.27
4	99.78	47.79
5	101.07	49.32
6	101.71	50.00

*** 1.729 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.44	31.72
2	64.43	30.94
3	66.34	30.35
4	99.34	47.08
5	99.69	49.05
6	99.74	49.87

*** 1.734 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.36	32.68
2	67.01	32.61
3	98.73	45.67
4	99.99	47.23
5	101.21	48.81
6	102.37	50.00

*** 1.742 ***

1

```
                Y            A     X     I     S            F     T

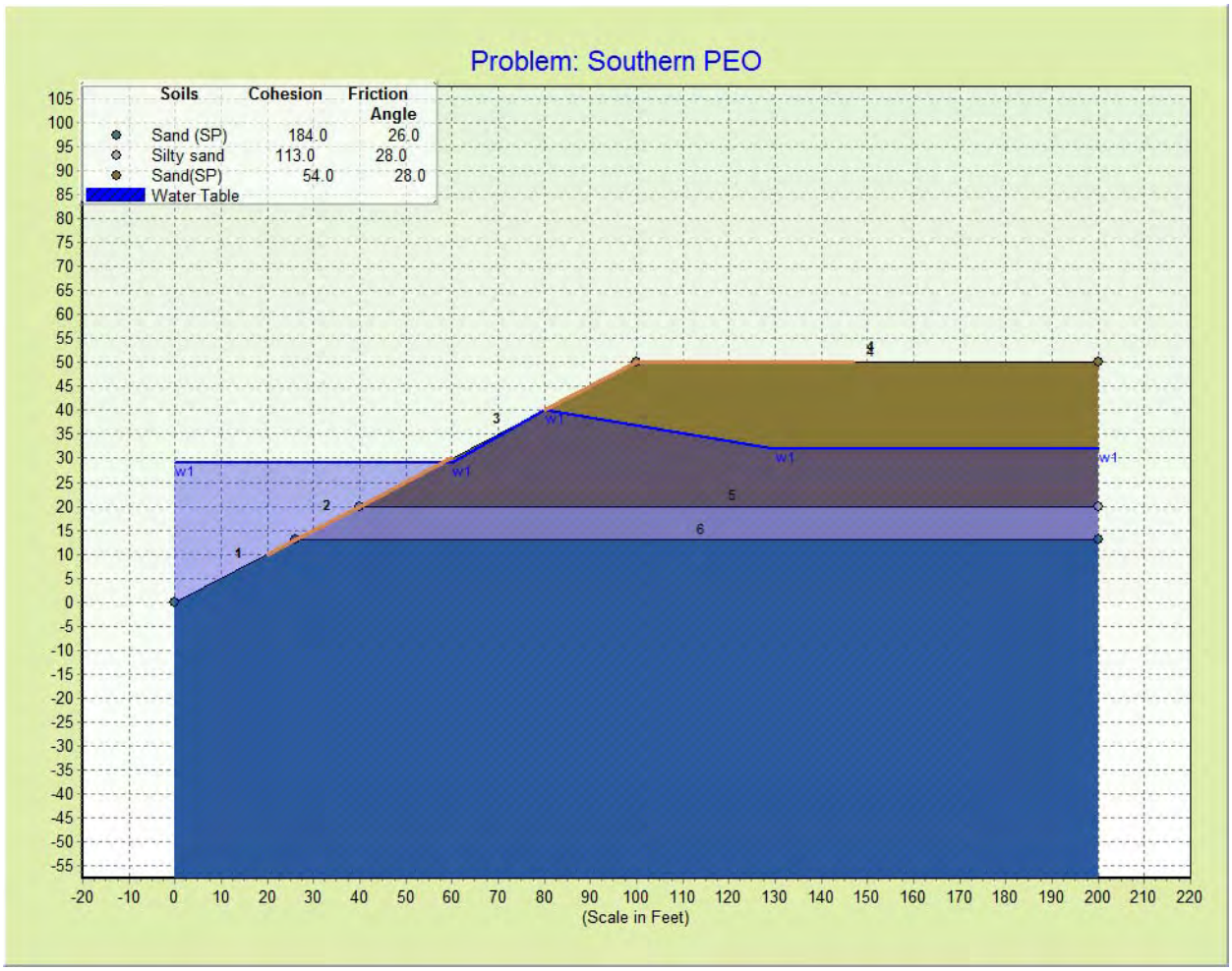
                0.00     25.00     50.00     75.00    100.00    125.00

X        0.00 *---------+-W-------+---------+---------+---------+
              -
              -
              -
              -
              -
        25.00 +    *
              -
              -
              -
              -       *
              -
A       50.00 +
              -
              -           W
              -           13
              -           12.
              -           .2
X       75.00 +
              -
              -
              -
              -
              -                 25
I      100.00 +           W     11*
              -                  0
              -
              -
              -
              -
S      125.00 +
              -
              -
              -
              -
              -
       150.00 +
              -
              -
              -
              -
```

```
                -
F     175.00 +
                -
                -
                -
                -
                -
T     200.00 +     *   *     W       *
```

Appendix C.2
Existing Riverbank, Rapid Drawdown Condition

========== DATA SUMMARY ==========



Profile Data

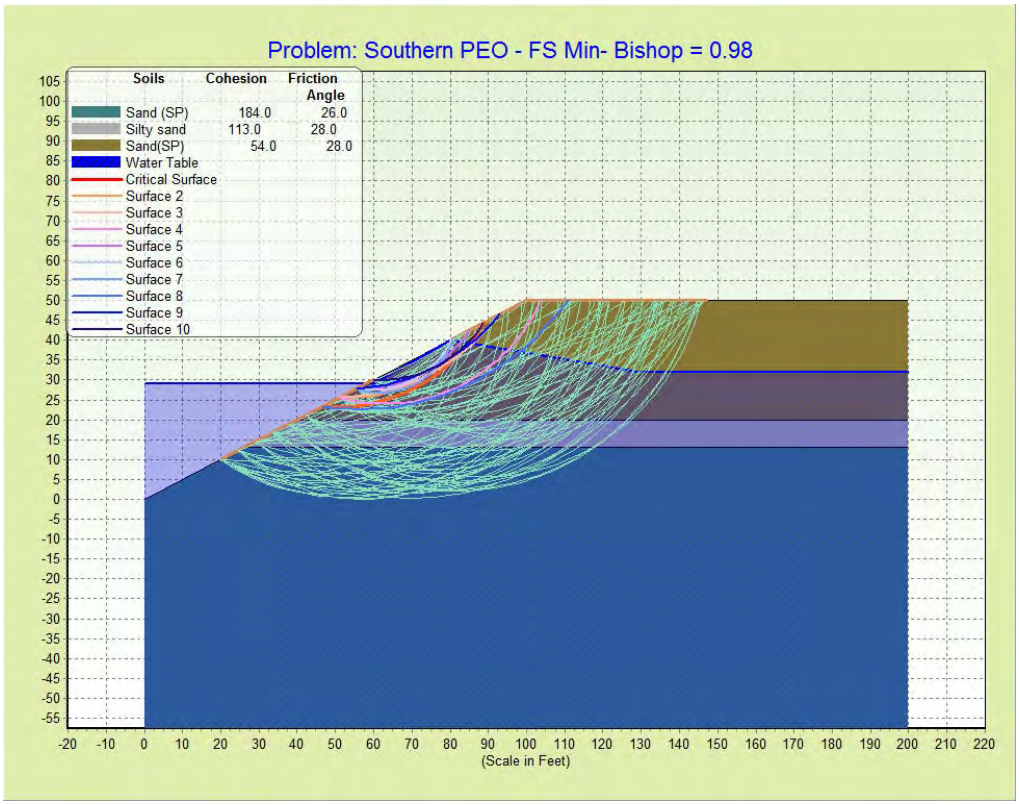
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	200	50	1
5	40	20	200	20	2
6	26	13	200	13	3

Soil Properties

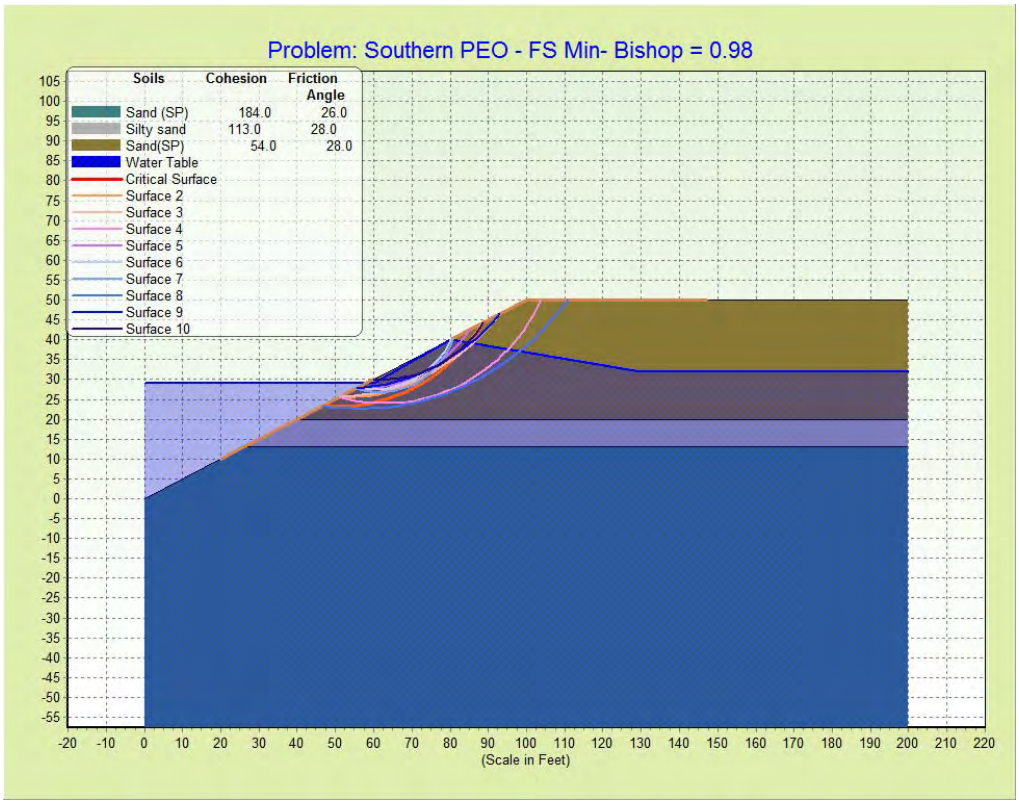
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

4 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	200.00	50.00	1
5	40.00	20.00	200.00	20.00	2
6	26.00	13.00	200.00	13.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1
3	117.0	125.0	184.0	26.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	80.00	40.00
4	130.00	32.00
5	200.00	32.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 20.00 ft.
and X = 60.00 ft.

Each Surface Terminates Between X = 80.00 ft.
and X = 147.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.66	23.21
3	50.66	23.18
4	52.66	23.24

5	54.66	23.38
6	56.64	23.61
7	58.62	23.93
8	60.58	24.34
9	62.52	24.83
10	64.43	25.41
11	66.32	26.07
12	68.18	26.81
13	70.00	27.63
14	71.78	28.54
15	73.53	29.52
16	75.22	30.57
17	76.87	31.71
18	78.47	32.91
19	80.02	34.18
20	81.50	35.52
21	82.93	36.92
22	84.29	38.38
23	85.59	39.90
24	86.82	41.48
25	87.98	43.11
26	88.82	44.41

Circle Center At X = 50.4 ; Y = 68.6 and Radius, 45.4

*** 0.980 ***

Individual data on the 28 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.0	131.7	719.7	714.6	0.0	0.0	0.0	0.0	0.0
2	2.0	385.5	581.5	724.1	0.0	0.0	0.0	0.0	0.0
3	2.0	618.4	441.9	722.6	0.0	0.0	0.0	0.0	0.0
4	2.0	828.4	302.0	710.1	0.0	0.0	0.0	0.0	0.0
5	2.0	1014.2	162.8	686.6	0.0	0.0	0.0	0.0	0.0
6	2.0	1174.5	25.4	652.2	0.0	0.0	0.0	0.0	0.0
7	1.4	903.1	0.0	433.5	0.0	0.0	0.0	0.0	0.0
8	0.6	392.7	0.0	158.5	0.0	0.0	0.0	0.0	0.0
9	1.9	1394.7	0.0	580.8	0.0	0.0	0.0	0.0	0.0
10	1.9	1475.3	0.0	638.8	0.0	0.0	0.0	0.0	0.0
11	1.9	1528.9	0.0	685.9	0.0	0.0	0.0	0.0	0.0
12	1.9	1556.1	0.0	722.1	0.0	0.0	0.0	0.0	0.0
13	1.8	1557.4	0.0	747.4	0.0	0.0	0.0	0.0	0.0
14	1.8	1533.9	0.0	761.5	0.0	0.0	0.0	0.0	0.0
15	1.7	1486.9	0.0	764.6	0.0	0.0	0.0	0.0	0.0
16	1.7	1418.0	0.0	756.7	0.0	0.0	0.0	0.0	0.0
17	1.6	1329.1	0.0	737.6	0.0	0.0	0.0	0.0	0.0
18	1.6	1222.2	0.0	707.5	0.0	0.0	0.0	0.0	0.0
19	1.5	1088.8	0.0	659.8	0.0	0.0	0.0	0.0	0.0
20	0.0	11.0	0.0	7.4	0.0	0.0	0.0	0.0	0.0
21	1.5	964.7	0.0	620.1	0.0	0.0	0.0	0.0	0.0
22	1.4	808.2	0.0	422.6	0.0	0.0	0.0	0.0	0.0
23	1.4	645.6	0.0	218.5	0.0	0.0	0.0	0.0	0.0
24	0.7	276.2	0.0	30.9	0.0	0.0	0.0	0.0	0.0
25	0.6	205.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

26	1.2	328.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1.2	180.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.8	40.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.11	25.50
3	55.11	25.55
4	57.11	25.68
5	59.09	25.91
6	61.07	26.24
7	63.02	26.65
8	64.96	27.16
9	66.87	27.76
10	68.74	28.45
11	70.59	29.22
12	72.39	30.08
13	74.15	31.03
14	75.87	32.06
15	77.54	33.16
16	79.15	34.35
17	80.70	35.61
18	82.19	36.94
19	83.62	38.34
20	84.98	39.80
21	86.28	41.33
22	87.49	42.92
23	88.38	44.19

Circle Center At X = 53.2 ; Y = 68.0 and Radius, 42.4

*** 0.987 ***

1

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.11	25.65
3	55.10	25.81
4	57.09	26.05
5	59.06	26.36
6	61.03	26.74
7	62.98	27.19
8	64.91	27.71
9	66.82	28.29
10	68.71	28.95
11	70.57	29.68
12	72.41	30.47
13	74.22	31.32
14	75.99	32.24

15	77.73	33.23
16	79.44	34.27
17	81.11	35.38
18	82.73	36.55
19	84.31	37.77
20	85.85	39.05
21	87.34	40.38
22	88.78	41.77
23	90.17	43.21
24	91.51	44.69
25	92.79	46.23
26	93.01	46.50

Circle Center At X = 49.5 ; Y = 81.1 and Radius, 55.6

*** 1.010 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.05	25.08
3	55.01	24.68
4	56.99	24.38
5	58.98	24.16
6	60.98	24.03
7	62.97	23.99
8	64.97	24.04
9	66.97	24.18
10	68.96	24.40
11	70.93	24.72
12	72.89	25.12
13	74.83	25.61
14	76.75	26.18
15	78.64	26.83
16	80.50	27.57
17	82.32	28.40
18	84.10	29.30
19	85.85	30.28
20	87.55	31.33
21	89.20	32.46
22	90.79	33.66
23	92.34	34.94
24	93.82	36.27
25	95.25	37.68
26	96.61	39.14
27	97.91	40.67
28	99.13	42.25
29	100.29	43.88
30	101.37	45.56
31	102.37	47.29
32	103.30	49.06
33	103.74	50.00

Circle Center At X = 62.9 ; Y = 69.1 and Radius, 45.1

*** 1.040 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.56	27.76
3	59.55	27.86
4	61.54	28.08
5	63.51	28.41
6	65.46	28.86
7	67.38	29.42
8	69.27	30.09
9	71.11	30.87
10	72.90	31.76
11	74.64	32.75
12	76.32	33.83
13	77.93	35.02
14	79.47	36.29
15	80.94	37.66
16	82.32	39.10
17	83.61	40.63
18	84.82	42.22
19	85.00	42.50

Circle Center At X = 56.8 ; Y = 62.1 and Radius, 34.3

*** 1.044 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.54	27.52
3	59.54	27.42
4	61.54	27.50
5	63.52	27.76
6	65.47	28.18
7	67.39	28.76
8	69.24	29.51
9	71.03	30.41
10	72.73	31.47
11	74.33	32.66
12	75.83	33.99
13	77.20	35.44
14	78.45	37.00
15	79.56	38.67
16	80.40	40.20

Circle Center At X = 59.6 ; Y = 50.7 and Radius, 23.3

*** 1.070 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.49	27.27
3	59.46	26.95
4	61.46	26.83
5	63.46	26.91
6	65.44	27.18
7	67.38	27.65
8	69.27	28.31
9	71.09	29.15
10	72.81	30.17
11	74.42	31.35
12	75.91	32.69
13	77.26	34.17
14	78.45	35.77
15	79.48	37.49
16	80.34	39.29
17	80.72	40.36

Circle Center At X = 61.7 ; Y = 47.0 and Radius, 20.2

*** 1.070 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.65	23.07
3	50.64	22.87
4	52.63	22.73
5	54.63	22.64
6	56.63	22.62
7	58.63	22.65
8	60.63	22.75
9	62.62	22.90
10	64.61	23.11
11	66.59	23.38
12	68.57	23.71
13	70.53	24.10
14	72.48	24.55
15	74.42	25.05

16	76.34	25.61
17	78.24	26.23
18	80.12	26.90
19	81.98	27.63
20	83.82	28.41
21	85.64	29.25
22	87.43	30.14
23	89.19	31.08
24	90.93	32.08
25	92.63	33.12
26	94.31	34.22
27	95.95	35.36
28	97.55	36.56
29	99.12	37.80
30	100.65	39.08
31	102.15	40.41
32	103.60	41.79
33	105.01	43.20
34	106.38	44.66
35	107.70	46.16
36	108.99	47.70
37	110.22	49.27
38	110.76	50.00

Circle Center At X = 56.5 ; Y = 90.1 and Radius, 67.5

*** 1.076 ***

1

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.55	27.94
3	59.54	28.18
4	61.51	28.49
5	63.47	28.87
6	65.42	29.33
7	67.35	29.86
8	69.26	30.46
9	71.14	31.13
10	73.00	31.87
11	74.83	32.68
12	76.62	33.56
13	78.39	34.51
14	80.11	35.51
15	81.80	36.59
16	83.45	37.72
17	85.05	38.92
18	86.61	40.17
19	88.12	41.49
20	89.58	42.85
21	90.98	44.28
22	92.34	45.75
23	92.96	46.48

Circle Center At X = 52.2 ; Y = 81.3 and Radius, 53.6

*** 1.077 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.00	30.00
2	62.00	29.94
3	64.00	30.00
4	65.99	30.19
5	67.97	30.50
6	69.92	30.93
7	71.84	31.49
8	73.72	32.17
9	75.56	32.96
10	77.34	33.87
11	79.06	34.88
12	80.72	36.00
13	82.30	37.23
14	83.80	38.55
15	85.22	39.96
16	86.54	41.46
17	87.77	43.04
18	88.65	44.33

Circle Center At X = 62.0 ; Y = 61.8 and Radius, 31.9

*** 1.092 ***

1

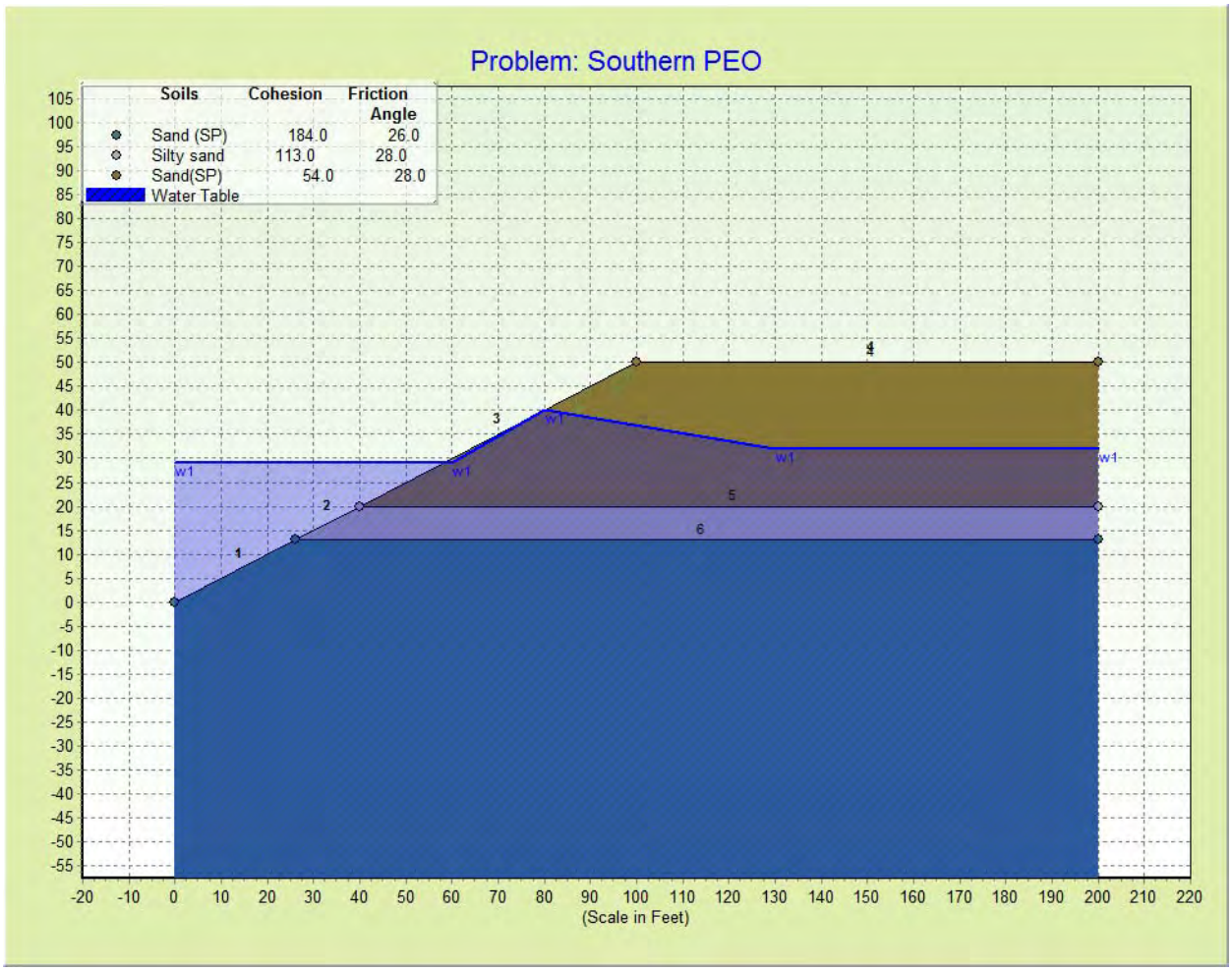
```
           Y            A     X     I     S            F     T

           0.00     25.00     50.00     75.00    100.00    125.00

X      0.00 *---------+-W-------+---------+---------+---------+
            -
            -
            -
            -
            -   .
      25.00 + ...*
            - .....
            -.......
            -........
            -.......*
            .........1
A     50.00 .........12
            .........125
            .........113W
            .........8129.
```

```
             .........8113.
             ..........4125.
X     75.00 ..........4.115.
             ..........84.115W
             -..........44.1125
             -...........44..111
             -............44..333
             -............844...
I    100.00 + ............8844.*
             - ............88.44
             -  ...............888
             -   ................8
             -    ................
             -     ...............
S    125.00 +      ...............
             -       .....W.......
             -         ...........
             -           .........
             -              ......
             -                 ...
     150.00 +
             -
             -
             -
             -
             -
F    175.00 +
             -
             -
             -
             -
             -
T    200.00 +    *  *    W      *
```

========== DATA SUMMARY ==========



Profile Data

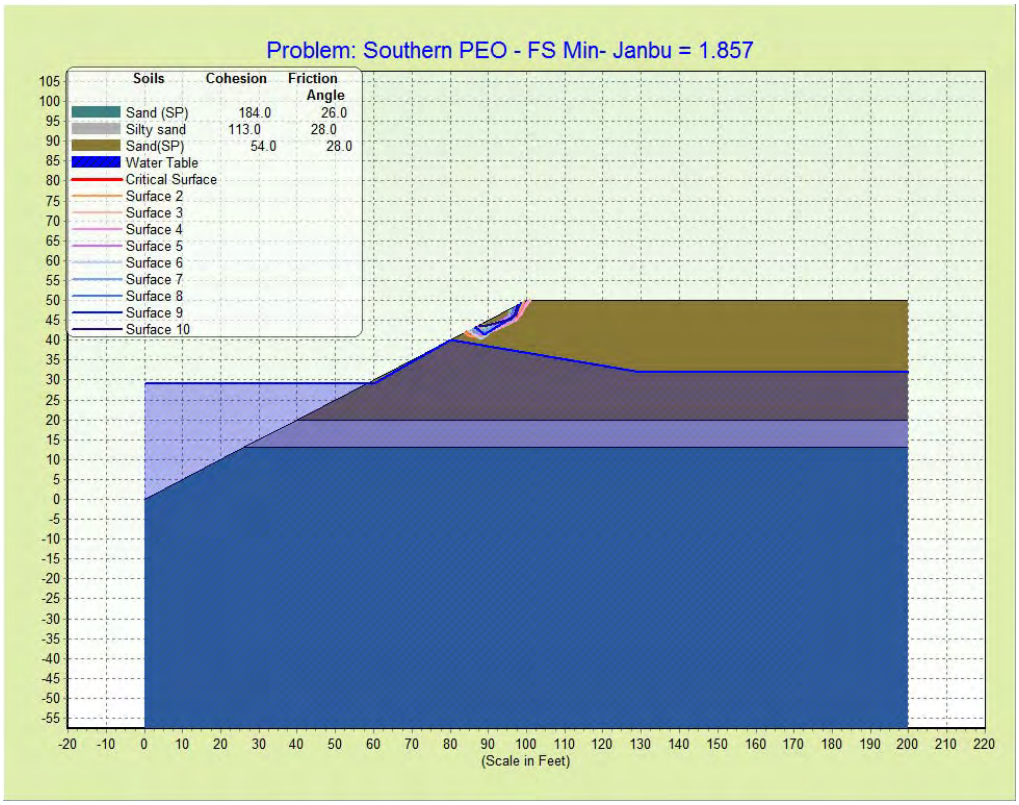
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	200	50	1
5	40	20	200	20	2
6	26	13	200	13	3

Soil Properties

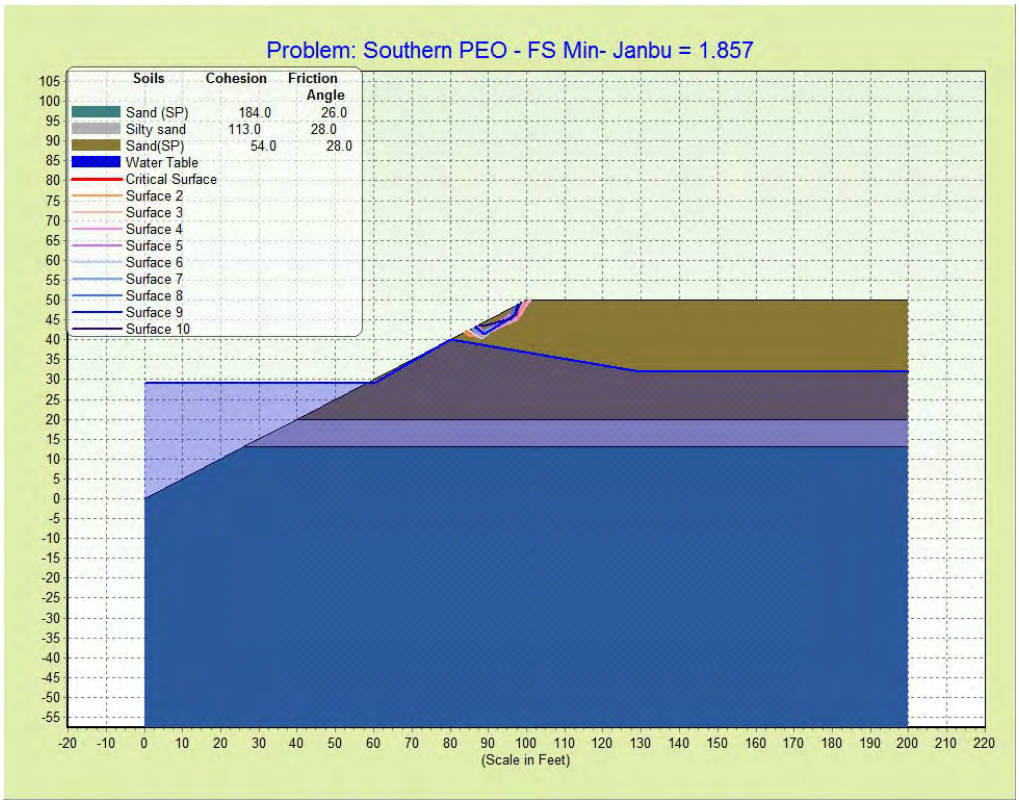
Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

4 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	200.00	50.00	1
5	40.00	20.00	200.00	20.00	2
6	26.00	13.00	200.00	13.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1
3	117.0	125.0	184.0	26.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	80.00	40.00
4	130.00	32.00
5	200.00	32.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

20 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 2.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	87.00	41.00	90.00	43.00	3.00
2	95.00	45.00	98.00	47.00	3.00

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	84.17	42.09
2	85.18	41.19
3	87.15	40.83
4	96.72	45.36
5	98.13	46.78
6	99.34	48.37
7	100.75	49.79

8	100.84	50.00

*** 1.857 ***

Individual data on the 8 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.0	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.0	452.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	9.6	3054.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.4	414.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1.2	241.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.7	83.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.7	49.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.62	41.81
2	85.10	41.02
3	87.10	40.89
4	96.31	44.40
5	97.06	46.26
6	98.37	47.76
7	99.32	49.53
8	99.58	49.79

*** 1.934 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.78	42.89
2	86.00	42.79
3	87.47	41.42
4	97.24	45.15
5	98.59	46.63
6	99.61	48.35
7	100.94	49.85
8	101.05	50.00

*** 1.974 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.21	43.60
2	88.10	42.79
3	89.77	41.68
4	97.74	45.47
5	98.72	47.22
6	99.86	48.86
7	100.53	50.00

*** 2.069 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	84.89	42.45
2	86.12	41.58
3	88.11	41.47
4	96.66	47.23
5	97.80	48.88
6	97.84	48.92

*** 2.136 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	84.78	42.39
2	84.79	42.39
3	86.48	41.32
4	88.24	40.36
5	96.56	46.64
6	97.80	48.21
7	98.34	49.17

*** 2.149 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.78	42.89
2	87.08	41.64
3	96.44	45.28
4	97.04	47.19
5	98.44	48.62
6	98.73	49.37

*** 2.264 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	86.53	43.27
2	87.53	42.40
3	89.38	41.64
4	95.92	45.81
5	96.59	47.70
6	97.77	48.88

*** 2.299 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	86.49	43.24
2	87.36	42.64
3	88.82	41.27
4	97.21	46.41
5	97.89	48.29
6	98.70	49.35

*** 2.334 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.42	43.71
2	88.69	43.46
3	95.80	45.19
4	97.06	46.75
5	97.65	48.66
6	97.87	48.93

*** 2.340 ***

1

```
                Y            A     X     I     S            F     T

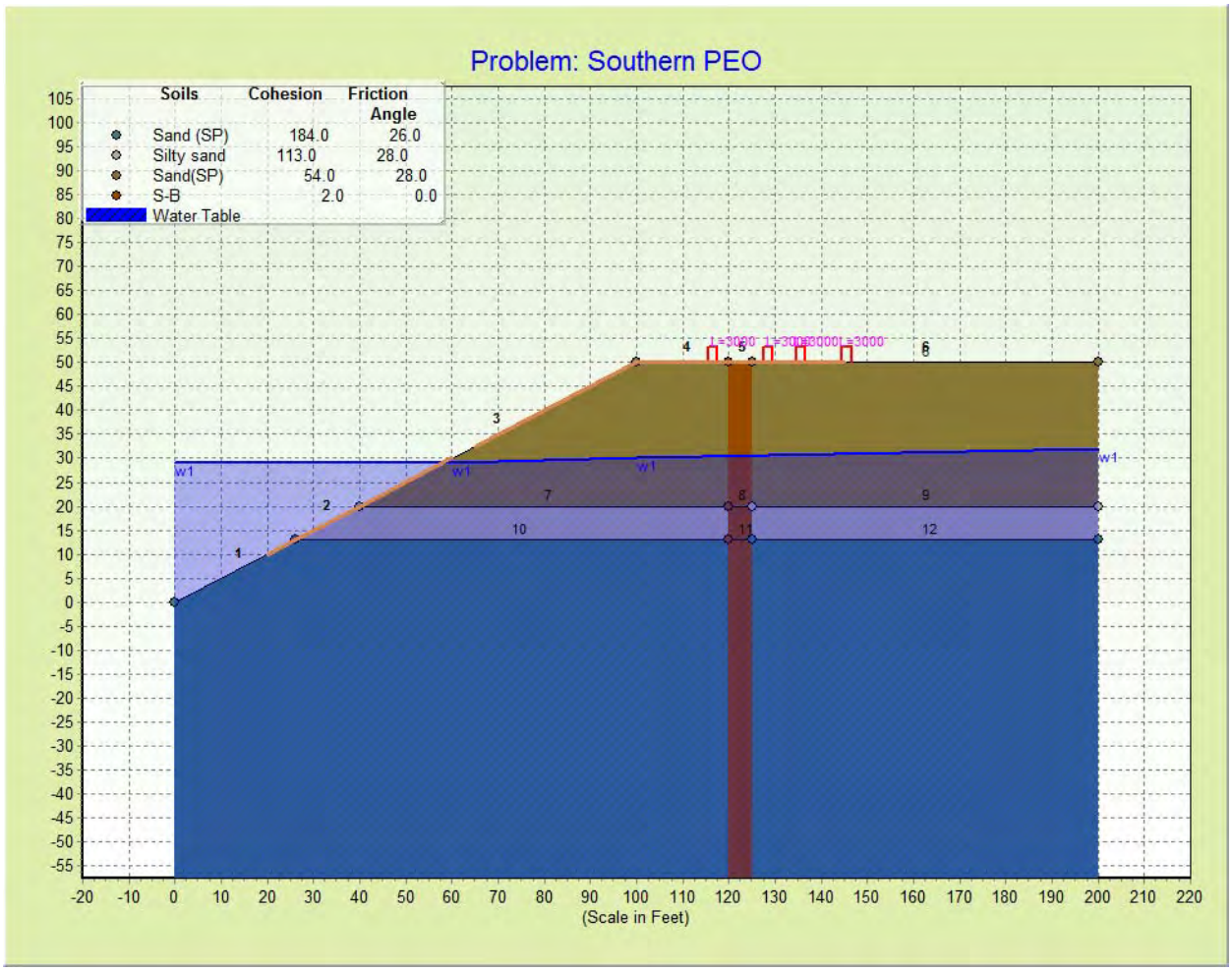
                0.00     25.00     50.00     75.00    100.00    125.00

X        0.00 *---------+-W-------+---------+---------+---------+
              -
              -
              -
              -
              -
        25.00 +    *
              -
              -
              -
              -       *
              -
A       50.00 +
              -
              -           W
              -
              -
              -
X       75.00 +
              -               W
              -               11
              -               13.
              -                4
              -                 125
I      100.00 +                  1*
              -
              -
              -
              -
              -
S      125.00 +
              -            W
              -
              -
              -
              -
       150.00 +
              -
              -
              -
              -
```

```
                -
F     175.00 +
                -
                -
                -
                -
                -
T     200.00 +     *   *     W       *
```

Appendix C.3
During Construction, Normal Groundwater Condition

========== DATA SUMMARY ==========



Profile Data

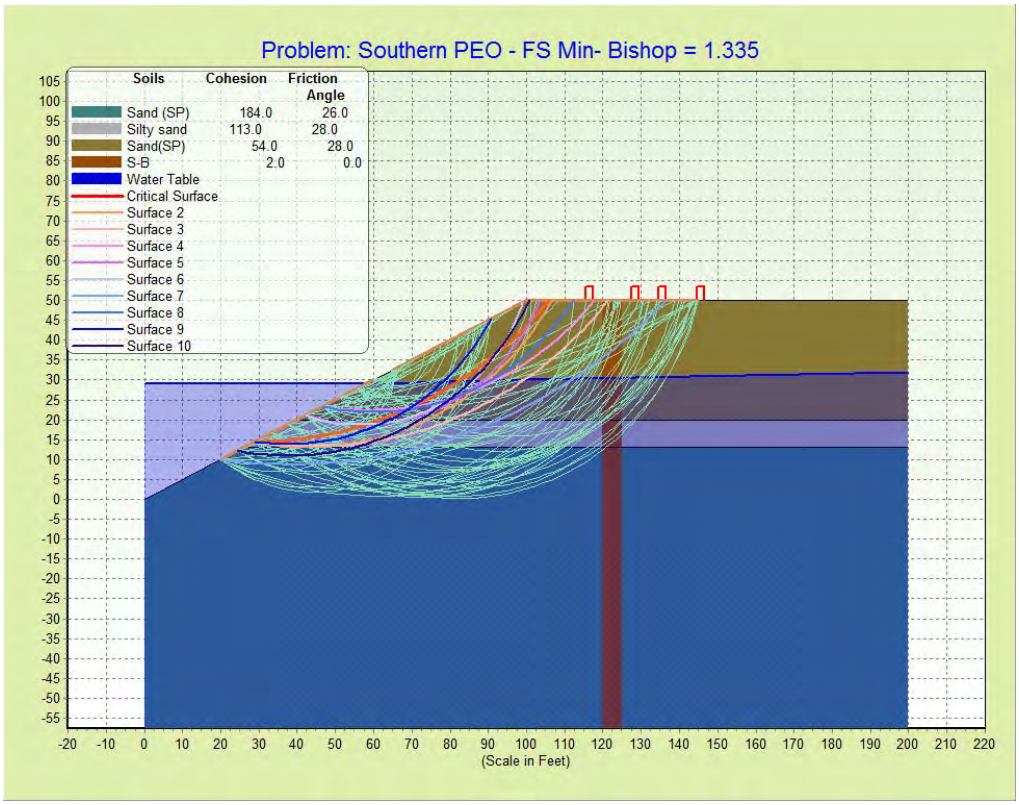
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	120	50	1
5	120	50	125	50	4
6	125	50	200	50	1
7	40	20	120	20	2
8	120	20	125	20	4
9	125	20	200	20	2
10	26	13	120	13	3

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
11	120	13	125	13	4
12	125	13	200	13	3

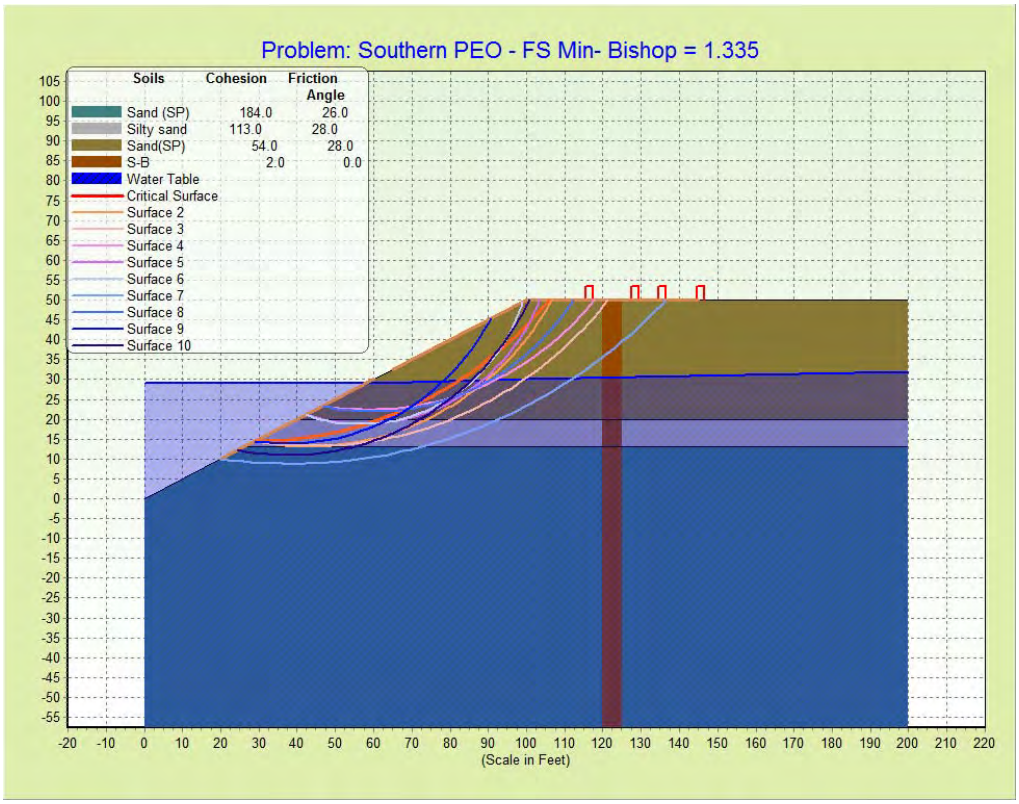
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)
4	110	120	2	0	0	0	1	S-B

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	120.00	50.00	1
5	120.00	50.00	125.00	50.00	4
6	125.00	50.00	200.00	50.00	1
7	40.00	20.00	120.00	20.00	2
8	120.00	20.00	125.00	20.00	4
9	125.00	20.00	200.00	20.00	2
10	26.00	13.00	120.00	13.00	3
11	120.00	13.00	125.00	13.00	4
12	125.00	13.00	200.00	13.00	3

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1

3	117.0	125.0	184.0	26.0	0.00	0.0	1
4	110.0	120.0	2.0	0.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	100.00	30.00
4	200.00	32.00

1

BOUNDARY LOAD(S)

4 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	115.50	117.50	3000.0	0.0
2	127.50	129.50	3000.0	0.0
3	134.50	136.50	3000.0	0.0
4	144.50	146.50	3000.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 20.00 ft.
and X = 60.00 ft.

Each Surface Terminates Between X = 65.00 ft.
and X = 145.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.89	14.44
2	30.89	14.47
3	32.89	14.53
4	34.89	14.64
5	36.88	14.78
6	38.87	14.96
7	40.86	15.18
8	42.84	15.44
9	44.82	15.74
10	46.79	16.08
11	48.76	16.45
12	50.71	16.87
13	52.66	17.32
14	54.60	17.81
15	56.53	18.34
16	58.45	18.91
17	60.35	19.51
18	62.25	20.15
19	64.13	20.83
20	66.00	21.54
21	67.85	22.29
22	69.69	23.08
23	71.51	23.90
24	73.32	24.76
25	75.11	25.65
26	76.88	26.58
27	78.63	27.55
28	80.37	28.54
29	82.08	29.57
30	83.77	30.64
31	85.45	31.74
32	87.10	32.87
33	88.72	34.03
34	90.33	35.22
35	91.91	36.45
36	93.47	37.70
37	95.00	38.99
38	96.51	40.30
39	97.99	41.65
40	99.44	43.02
41	100.87	44.42

42	102.27	45.85
43	103.64	47.31
44	104.98	48.79
45	106.03	50.00

Circle Center At X = 28.6 ; Y = 116.5 and Radius, 102.1

*** 1.335 ***

Individual data on the 49 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.0	112.1	1961.0	1814.9	0.0	0.0	0.0	0.0	0.0
2	2.0	331.5	1820.7	1809.3	0.0	0.0	0.0	0.0	0.0
3	2.0	541.4	1680.0	1798.8	0.0	0.0	0.0	0.0	0.0
4	2.0	741.5	1539.1	1783.5	0.0	0.0	0.0	0.0	0.0
5	2.0	931.4	1398.1	1763.2	0.0	0.0	0.0	0.0	0.0
6	1.1	608.7	730.4	989.6	0.0	0.0	0.0	0.0	0.0
7	0.9	502.8	527.0	748.5	0.0	0.0	0.0	0.0	0.0
8	2.0	1285.5	1117.1	1708.1	0.0	0.0	0.0	0.0	0.0
9	2.0	1449.5	977.4	1673.3	0.0	0.0	0.0	0.0	0.0
10	2.0	1602.6	838.5	1633.6	0.0	0.0	0.0	0.0	0.0
11	2.0	1744.5	700.7	1589.1	0.0	0.0	0.0	0.0	0.0
12	2.0	1875.1	564.1	1539.9	0.0	0.0	0.0	0.0	0.0
13	1.9	1994.3	429.0	1485.8	0.0	0.0	0.0	0.0	0.0
14	1.9	2102.1	295.5	1427.0	0.0	0.0	0.0	0.0	0.0
15	1.9	2198.4	163.9	1363.4	0.0	0.0	0.0	0.0	0.0
16	1.9	2283.2	34.2	1295.1	0.0	0.0	0.0	0.0	0.0
17	1.6	1905.9	0.0	1000.8	0.0	0.0	0.0	0.0	0.0
18	0.4	441.2	0.0	221.3	0.0	0.0	0.0	0.0	0.0
19	1.5	1832.4	0.0	887.0	0.0	0.0	0.0	0.0	0.0
20	0.4	564.3	0.0	261.2	0.0	0.0	0.0	0.0	0.0
21	1.9	2432.9	0.0	1071.9	0.0	0.0	0.0	0.0	0.0
22	1.9	2456.9	0.0	990.9	0.0	0.0	0.0	0.0	0.0
23	1.9	2469.8	0.0	905.3	0.0	0.0	0.0	0.0	0.0
24	1.8	2471.9	0.0	815.1	0.0	0.0	0.0	0.0	0.0
25	1.8	2463.4	0.0	720.4	0.0	0.0	0.0	0.0	0.0
26	1.8	2444.4	0.0	621.2	0.0	0.0	0.0	0.0	0.0
27	1.8	2415.4	0.0	517.5	0.0	0.0	0.0	0.0	0.0
28	1.8	2376.4	0.0	409.4	0.0	0.0	0.0	0.0	0.0
29	1.8	2327.9	0.0	296.9	0.0	0.0	0.0	0.0	0.0
30	1.7	2270.2	0.0	180.1	0.0	0.0	0.0	0.0	0.0
31	1.7	2155.5	0.0	58.9	0.0	0.0	0.0	0.0	0.0
32	0.0	48.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	1.7	2134.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	1.7	2063.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	1.7	1984.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	1.6	1898.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	1.6	1806.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	1.6	1707.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	1.6	1602.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	1.5	1491.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	1.5	1376.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	1.5	1256.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	1.5	1133.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

44	0.6	408.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.9	577.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	1.4	755.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	1.4	520.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	1.3	290.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	1.1	70.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.89	14.44
2	30.86	14.09
3	32.84	13.79
4	34.82	13.54
5	36.81	13.35
6	38.81	13.21
7	40.80	13.13
8	42.80	13.10
9	44.80	13.12
10	46.80	13.20
11	48.80	13.34
12	50.79	13.53
13	52.77	13.77
14	54.75	14.06
15	56.72	14.41
16	58.68	14.81
17	60.63	15.27
18	62.56	15.78
19	64.48	16.34
20	66.39	16.95
21	68.27	17.62
22	70.14	18.33
23	71.99	19.10
24	73.81	19.91
25	75.62	20.78
26	77.40	21.69
27	79.15	22.65
28	80.88	23.66
29	82.58	24.72
30	84.24	25.82
31	85.88	26.97
32	87.49	28.16
33	89.06	29.39
34	90.60	30.67
35	92.11	31.98
36	93.58	33.34
37	95.01	34.74
38	96.40	36.17
39	97.75	37.65
40	99.07	39.16
41	100.34	40.70
42	101.57	42.28
43	102.75	43.89
44	103.89	45.53
45	104.99	47.21
46	106.04	48.91
47	106.67	50.00

Circle Center At X = 42.9 ; Y = 86.7 and Radius, 73.6

*** 1.344 ***

1

Failure Surface Specified By 53 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.89	14.44
2	30.87	14.15
3	32.85	13.90
4	34.84	13.69
5	36.83	13.52
6	38.83	13.39
7	40.83	13.30
8	42.83	13.25
9	44.83	13.24
10	46.83	13.27
11	48.83	13.34
12	50.82	13.45
13	52.82	13.61
14	54.81	13.80
15	56.79	14.03
16	58.78	14.30
17	60.75	14.61
18	62.72	14.97
19	64.68	15.36
20	66.63	15.79
21	68.58	16.26
22	70.51	16.77
23	72.43	17.32
24	74.35	17.90
25	76.25	18.53
26	78.13	19.19
27	80.01	19.89
28	81.86	20.63
29	83.71	21.41
30	85.53	22.22
31	87.34	23.07
32	89.14	23.96
33	90.91	24.88
34	92.67	25.84
35	94.40	26.84
36	96.12	27.87
37	97.81	28.93
38	99.48	30.03
39	101.13	31.16
40	102.76	32.32
41	104.36	33.52
42	105.94	34.74
43	107.50	36.00
44	109.02	37.29
45	110.52	38.62
46	112.00	39.97
47	113.45	41.35
48	114.86	42.76
49	116.25	44.20
50	117.61	45.66

51	118.94	47.16
52	120.24	48.67
53	121.33	50.00

Circle Center At X = 44.3 ; Y = 112.3 and Radius, 99.1

*** 1.370 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.65	23.05
3	50.63	22.81
4	52.62	22.62
5	54.62	22.49
6	56.62	22.41
7	58.62	22.38
8	60.62	22.40
9	62.62	22.48
10	64.61	22.60
11	66.60	22.78
12	68.59	23.01
13	70.57	23.29
14	72.54	23.63
15	74.51	24.01
16	76.46	24.45
17	78.40	24.93
18	80.32	25.47
19	82.24	26.06
20	84.13	26.69
21	86.01	27.38
22	87.87	28.11
23	89.71	28.89
24	91.53	29.72
25	93.33	30.60
26	95.10	31.52
27	96.85	32.49
28	98.58	33.51
29	100.27	34.57
30	101.94	35.67
31	103.58	36.81
32	105.19	38.00
33	106.77	39.23
34	108.31	40.50
35	109.83	41.81
36	111.30	43.16
37	112.74	44.55
38	114.15	45.97
39	115.52	47.43
40	116.84	48.92
41	117.75	50.00

Circle Center At X = 58.7 ; Y = 99.2 and Radius, 76.9

*** 1.372 ***

1

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	42.22	21.11
2	44.14	20.55
3	46.08	20.07
4	48.04	19.67
5	50.02	19.35
6	52.00	19.10
7	54.00	18.94
8	55.99	18.85
9	57.99	18.84
10	59.99	18.92
11	61.99	19.07
12	63.97	19.30
13	65.95	19.61
14	67.91	20.00
15	69.85	20.47
16	71.78	21.02
17	73.68	21.64
18	75.55	22.33
19	77.40	23.10
20	79.21	23.95
21	80.99	24.86
22	82.73	25.85
23	84.43	26.90
24	86.09	28.02
25	87.70	29.21
26	89.26	30.46
27	90.77	31.77
28	92.23	33.14
29	93.63	34.57
30	94.97	36.05
31	96.26	37.58
32	97.48	39.17
33	98.63	40.80
34	99.72	42.47
35	100.75	44.19
36	101.70	45.95
37	102.58	47.75
38	103.40	49.57
39	103.56	50.00

Circle Center At X = 57.2 ; Y = 69.0 and Radius, 50.1

*** 1.387 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	42.22	21.11
2	44.13	20.51
3	46.06	20.00
4	48.02	19.57
5	49.99	19.23
6	51.97	18.98
7	53.96	18.81
8	55.96	18.74
9	57.96	18.76
10	59.96	18.86
11	61.95	19.06
12	63.93	19.35
13	65.90	19.72
14	67.84	20.18
15	69.77	20.73
16	71.66	21.36
17	73.53	22.08
18	75.36	22.88
19	77.16	23.76
20	78.91	24.72
21	80.62	25.76
22	82.28	26.87
23	83.89	28.06
24	85.44	29.32
25	86.94	30.65
26	88.38	32.04
27	89.75	33.50
28	91.05	35.01
29	92.29	36.58
30	93.45	38.21
31	94.54	39.89
32	95.56	41.61
33	96.49	43.38
34	97.35	45.19
35	98.12	47.03
36	98.81	48.91
37	99.00	49.50

Circle Center At X = 56.6 ; Y = 63.4 and Radius, 44.6

*** 1.411 ***

1

Failure Surface Specified By 65 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	20.00	10.00
2	21.98	9.75
3	23.97	9.52
4	25.96	9.32
5	27.95	9.16
6	29.95	9.02
7	31.95	8.91

8	33.95	8.83
9	35.94	8.78
10	37.94	8.76
11	39.94	8.76
12	41.94	8.80
13	43.94	8.87
14	45.94	8.96
15	47.94	9.09
16	49.93	9.24
17	51.92	9.42
18	53.91	9.63
19	55.90	9.87
20	57.88	10.14
21	59.86	10.44
22	61.83	10.77
23	63.80	11.12
24	65.76	11.51
25	67.72	11.92
26	69.67	12.36
27	71.61	12.83
28	73.55	13.33
29	75.48	13.85
30	77.40	14.41
31	79.31	14.99
32	81.22	15.60
33	83.11	16.24
34	85.00	16.90
35	86.88	17.60
36	88.74	18.32
37	90.60	19.07
38	92.44	19.84
39	94.27	20.64
40	96.09	21.47
41	97.90	22.32
42	99.70	23.20
43	101.48	24.11
44	103.25	25.04
45	105.01	26.00
46	106.75	26.98
47	108.47	27.99
48	110.19	29.03
49	111.88	30.09
50	113.56	31.17
51	115.23	32.28
52	116.88	33.41
53	118.51	34.57
54	120.12	35.75
55	121.72	36.95
56	123.30	38.18
57	124.86	39.43
58	126.41	40.70
59	127.93	41.99
60	129.44	43.31
61	130.92	44.65
62	132.39	46.01
63	133.84	47.39
64	135.26	48.79
65	136.46	50.00

Circle Center At X = 38.4 ; Y = 145.9 and Radius, 137.1

*** 1.412 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.63	22.95
3	50.60	22.62
4	52.59	22.36
5	54.58	22.16
6	56.57	22.02
7	58.57	21.95
8	60.57	21.94
9	62.57	22.00
10	64.57	22.11
11	66.56	22.29
12	68.54	22.54
13	70.52	22.84
14	72.48	23.21
15	74.44	23.64
16	76.38	24.14
17	78.30	24.69
18	80.20	25.31
19	82.08	25.98
20	83.94	26.71
21	85.78	27.51
22	87.59	28.36
23	89.37	29.26
24	91.13	30.23
25	92.85	31.25
26	94.53	32.32
27	96.19	33.44
28	97.80	34.62
29	99.38	35.85
30	100.92	37.13
31	102.42	38.45
32	103.87	39.83
33	105.29	41.24
34	106.65	42.70
35	107.97	44.21
36	109.24	45.75
37	110.46	47.34
38	111.63	48.96
39	112.33	50.00

Circle Center At X = 59.9 ; Y = 85.0 and Radius, 63.1

*** 1.414 ***

1

Failure Surface Specified By 38 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	28.89	14.44
2	30.87	14.20
3	32.87	14.01
4	34.86	13.89
5	36.86	13.84
6	38.86	13.85
7	40.86	13.93
8	42.85	14.08
9	44.84	14.29
10	46.82	14.56
11	48.80	14.90
12	50.75	15.31
13	52.70	15.78
14	54.63	16.31
15	56.53	16.91
16	58.42	17.57
17	60.29	18.29
18	62.13	19.07
19	63.94	19.91
20	65.73	20.81
21	67.49	21.77
22	69.21	22.78
23	70.90	23.85
24	72.55	24.98
25	74.16	26.16
26	75.74	27.39
27	77.27	28.68
28	78.76	30.01
29	80.21	31.39
30	81.61	32.82
31	82.96	34.30
32	84.26	35.81
33	85.51	37.37
34	86.72	38.97
35	87.86	40.61
36	88.95	42.29
37	89.99	44.00
38	90.77	45.39

Circle Center At X = 37.5 ; Y = 74.7 and Radius, 60.8

*** 1.430 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	24.44	12.22
2	26.41	11.87
3	28.39	11.58
4	30.38	11.35
5	32.37	11.17
6	34.37	11.04
7	36.37	10.98
8	38.37	10.97

9	40.37	11.02
10	42.36	11.12
11	44.36	11.28
12	46.34	11.50
13	48.33	11.77
14	50.30	12.10
15	52.26	12.49
16	54.21	12.93
17	56.15	13.42
18	58.07	13.98
19	59.98	14.58
20	61.87	15.24
21	63.73	15.95
22	65.58	16.72
23	67.41	17.54
24	69.21	18.41
25	70.98	19.33
26	72.73	20.30
27	74.45	21.31
28	76.15	22.38
29	77.81	23.50
30	79.43	24.66
31	81.03	25.87
32	82.59	27.12
33	84.11	28.42
34	85.60	29.75
35	87.04	31.13
36	88.45	32.56
37	89.82	34.02
38	91.14	35.51
39	92.42	37.05
40	93.66	38.62
41	94.85	40.23
42	96.00	41.87
43	97.10	43.54
44	98.15	45.24
45	99.15	46.97
46	100.11	48.73
47	100.75	50.00

Circle Center At X = 37.7 ; Y = 81.4 and Radius, 70.5

*** 1.431 ***

1

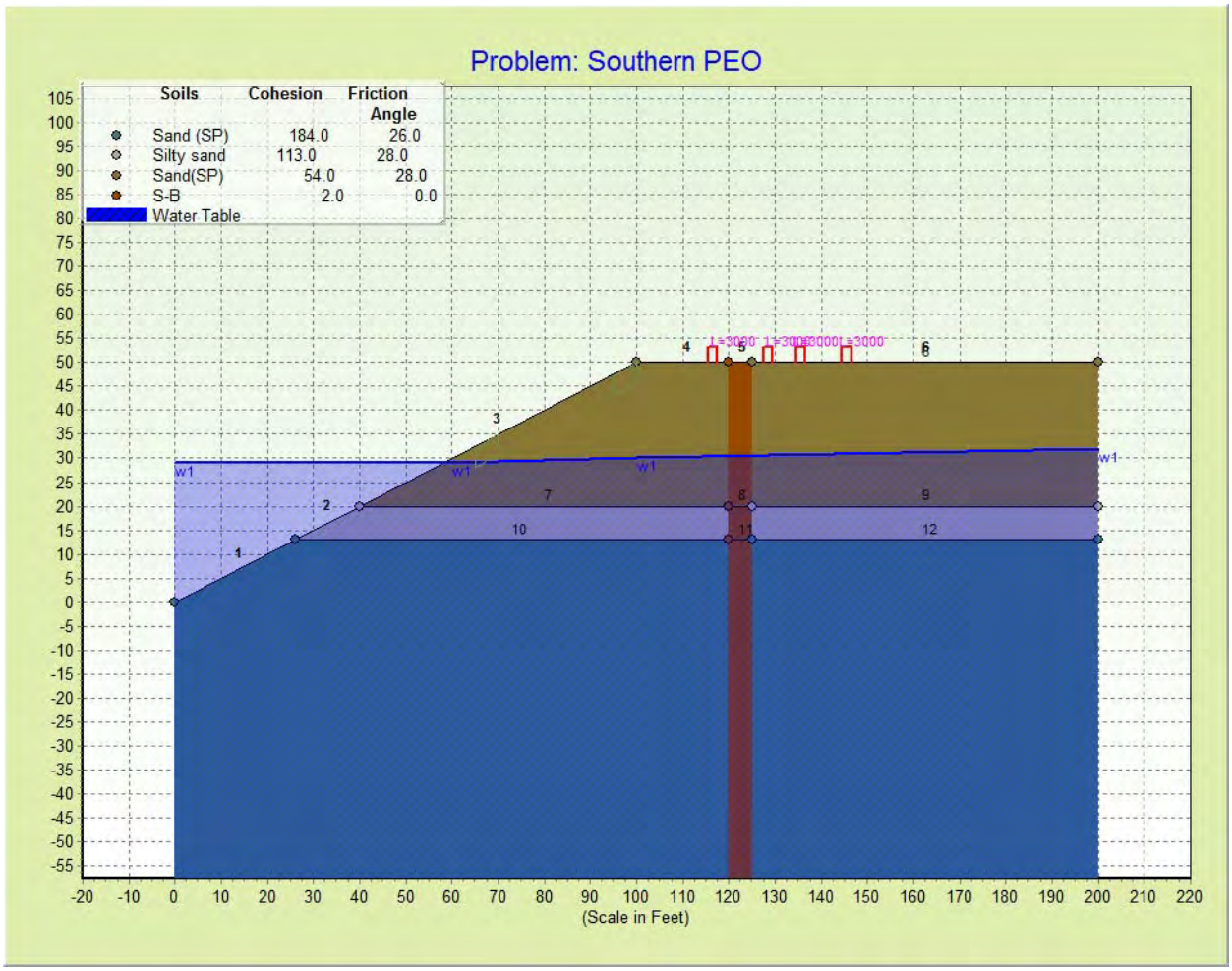
```
            Y            A     X     I     S            F     T

            0.00     25.00     50.00     75.00    100.00    125.00

X      0.00 *---------+-W-------+---------+---------+---------+
            -
            -
            -
            -
            -   7
      25.00 + ..7*
            - ..701
            -...721.
```

```
             -...721..
             -...721.*
             -...721.54
A     50.00 +...729154.
             ....732154..
             ....7.2114..W
             ....7.2214....
             .....73251.....
             .....7.2211....
X     75.00 .....7732511....
             ......7.324199...
             ......773324199...
             .......7.332211999.
             ........7.3.2211..9.
             -.......77.33422166.
I    100.00 +........77.W4482116*
             -.........7..3348.111
             - .........77.33448 2
             -  .........7..333488
             -   .........77..33441/1
             -    *..*.....77...3*
S    125.00 +    *..*......77...*
             -       .........77..2/2
             -        .........777/3
             -           ........73/
             -              ......
             -                 ...4/4
     150.00 +
             -
             -
             -
             -
             -
F    175.00 +
             -
             -
             -
             -
             -
T    200.00 +    *  *    W      *
```

========== DATA SUMMARY ==========



Profile Data

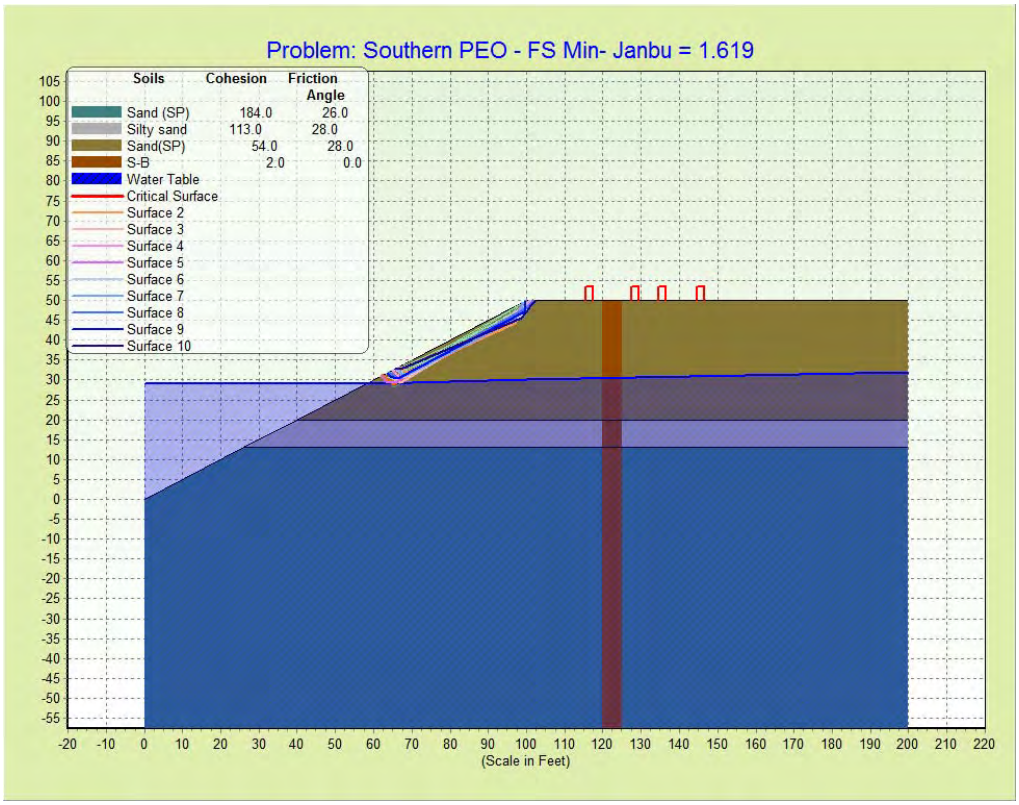
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	120	50	1
5	120	50	125	50	4
6	125	50	200	50	1
7	40	20	120	20	2
8	120	20	125	20	4
9	125	20	200	20	2
10	26	13	120	13	3

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
11	120	13	125	13	4
12	125	13	200	13	3

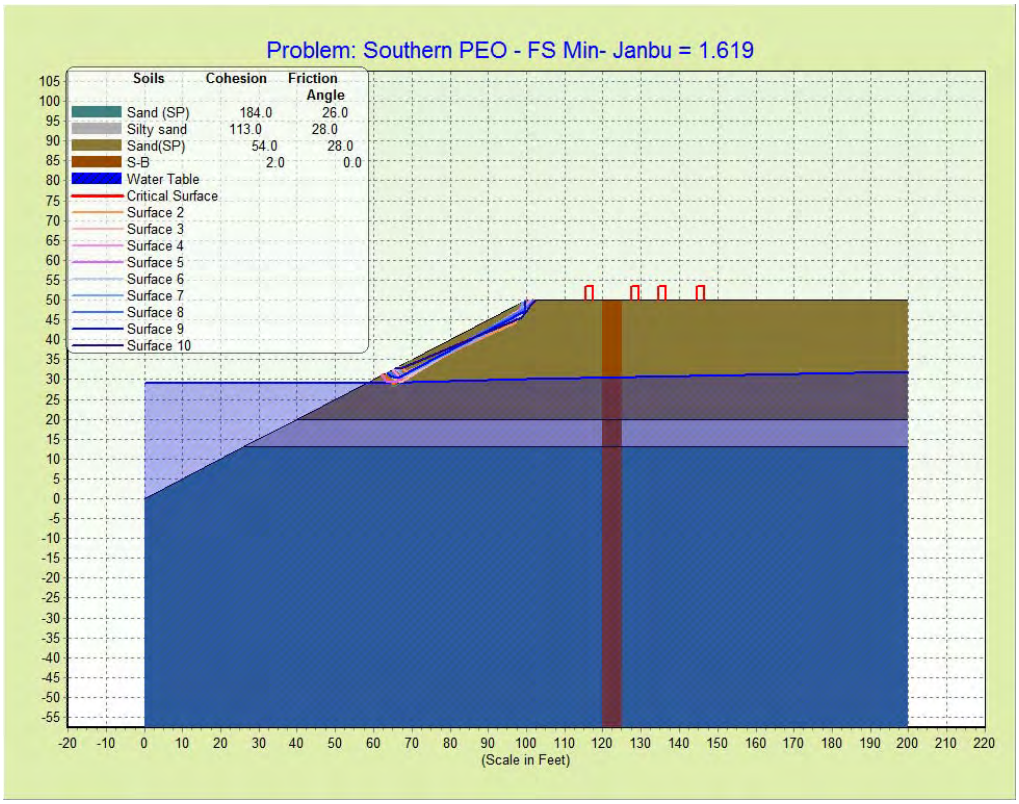
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)
4	110	120	2	0	0	0	1	S-B

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	120.00	50.00	1
5	120.00	50.00	125.00	50.00	4
6	125.00	50.00	200.00	50.00	1
7	40.00	20.00	120.00	20.00	2
8	120.00	20.00	125.00	20.00	4
9	125.00	20.00	200.00	20.00	2
10	26.00	13.00	120.00	13.00	3
11	120.00	13.00	125.00	13.00	4
12	125.00	13.00	200.00	13.00	3

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1

3	117.0	125.0	184.0	26.0	0.00	0.0	1
4	110.0	120.0	2.0	0.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	100.00	30.00
4	200.00	32.00

1

BOUNDARY LOAD(S)

4 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	115.50	117.50	3000.0	0.0
2	127.50	129.50	3000.0	0.0
3	134.50	136.50	3000.0	0.0
4	144.50	146.50	3000.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

20 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 2.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)

1	65.00	30.00	70.00	33.00	4.00
2	95.00	45.00	100.00	48.00	4.00

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.27	31.14
2	63.54	30.01
3	65.26	28.99
4	98.43	46.02
5	99.56	47.67
6	100.97	49.09
7	101.64	50.00

*** 1.619 ***

Individual data on the 9 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.3	124.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.5	427.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.2	90.1	0.0	1.2	0.0	0.0	0.0	0.0	0.0
4	0.3	117.3	0.0	1.4	0.0	0.0	0.0	0.0	0.0
5	32.9	12461.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.1	332.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.4	97.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1.0	151.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.7	33.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.44	33.22
2	67.07	32.95
3	68.75	31.87
4	97.06	44.28
5	98.02	46.04
6	99.09	47.73
7	100.35	49.28

8	100.92	50.00

*** 1.624 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.34	31.67
2	63.82	31.42
3	65.33	30.10
4	67.18	29.35
5	99.79	48.34
6	101.20	49.75
7	101.33	50.00

*** 1.702 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.77	32.39
2	65.71	31.80
3	67.18	30.44
4	98.78	46.32
5	99.48	48.19
6	100.88	49.61
7	100.92	50.00

*** 1.704 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	61.95	30.97
2	62.12	30.82
3	63.54	29.41
4	65.54	29.36
5	97.59	46.85
6	98.65	48.54
7	99.00	49.50

*** 1.708 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.54	32.77
2	66.45	32.08
3	67.87	30.67
4	99.37	46.73
5	100.78	48.15
6	101.57	49.99
7	101.59	50.00

*** 1.710 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.63	32.82
2	66.53	32.38
3	67.95	30.96
4	96.20	44.70
5	97.61	46.12
6	98.74	47.77
7	98.88	49.44

*** 1.712 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.82	31.91
2	64.77	31.40
3	66.42	30.27
4	99.78	47.79
5	101.07	49.32
6	101.71	50.00

*** 1.729 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.44	31.72
2	64.43	30.94
3	66.34	30.35
4	99.34	47.08
5	99.69	49.05
6	99.74	49.87

*** 1.734 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.36	32.68
2	67.01	32.61
3	98.73	45.67
4	99.99	47.23
5	101.21	48.81
6	102.37	50.00

*** 1.742 ***

1

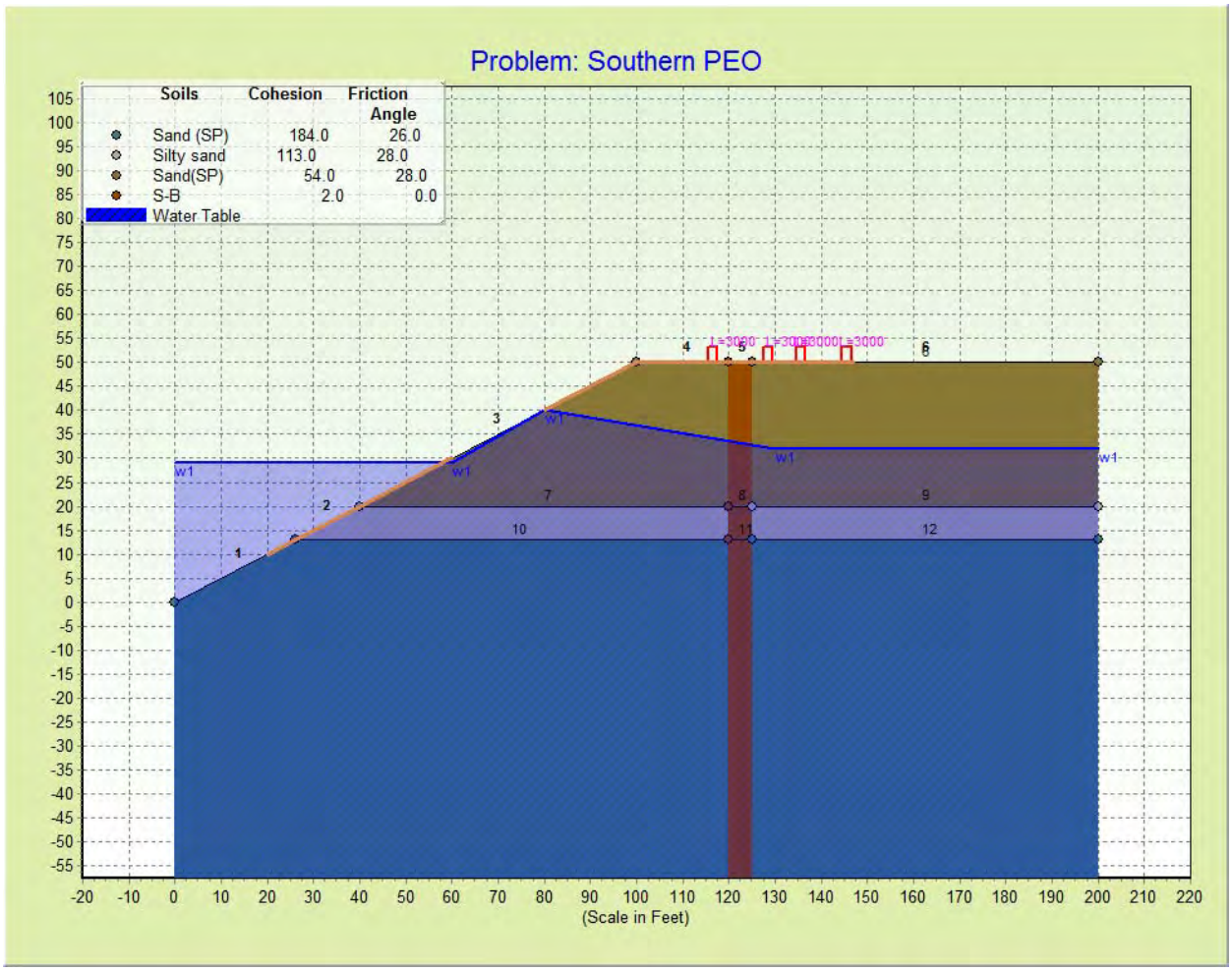
```
            Y            A     X     I     S            F     T

            0.00     25.00     50.00     75.00    100.00    125.00
X      0.00 *---------+-W-------+---------+---------+---------+
            -
            -
            -
            -
            -
      25.00 +    *
            -
            -
            -
            -       *
            -
A     50.00 +
            -
```

```
             -            W
             -            13
             -            12.
             -             .2
X     75.00 +
             -
             -
             -
             -
             -                  25
I    100.00 +            W     11*
             -                  0
             -
             -
             -                   1/1
             -    *  *           *
S    125.00 +    *  *           *
             -                   2/2
             -                   /3
             -                   3/
             -
             -                   4/4
     150.00 +
             -
             -
             -
             -
             -
F    175.00 +
             -
             -
             -
             -
             -
T    200.00 +    *  *    W      *
```

Appendix C.4
During Construction, Rapid Drawdown Condition

========== DATA SUMMARY ==========



Profile Data

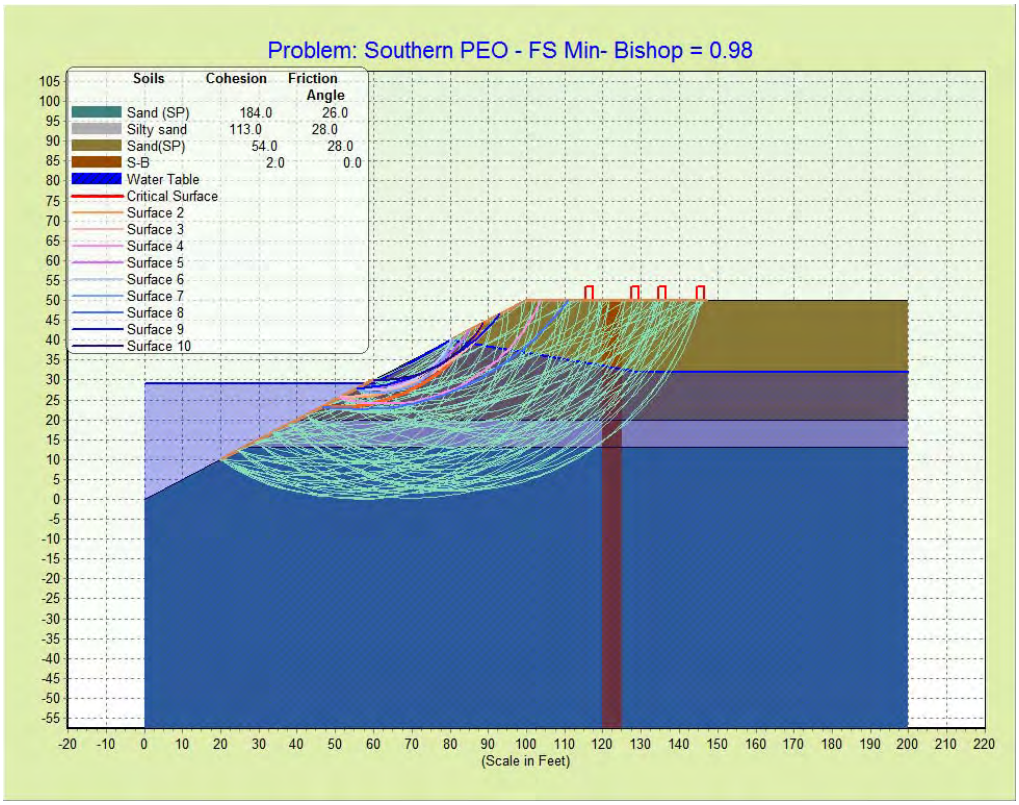
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	120	50	1
5	120	50	125	50	4
6	125	50	200	50	1
7	40	20	120	20	2
8	120	20	125	20	4
9	125	20	200	20	2
10	26	13	120	13	3

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
11	120	13	125	13	4
12	125	13	200	13	3

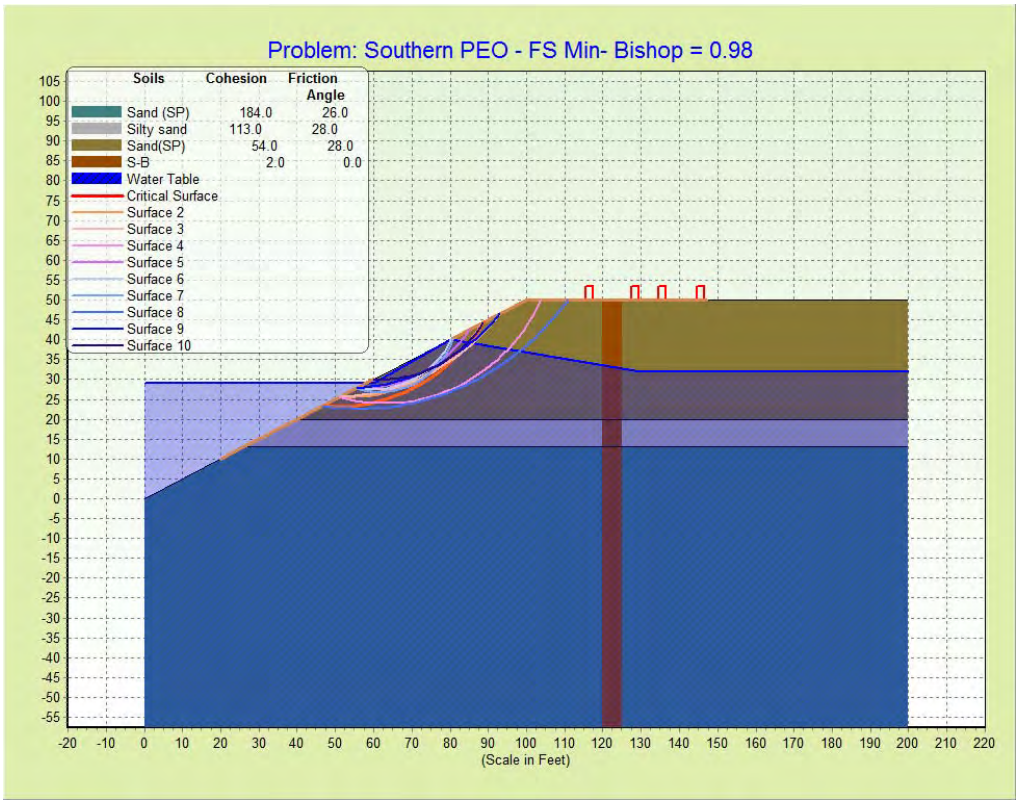
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)
4	110	120	2	0	0	0	1	S-B

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	120.00	50.00	1
5	120.00	50.00	125.00	50.00	4
6	125.00	50.00	200.00	50.00	1
7	40.00	20.00	120.00	20.00	2
8	120.00	20.00	125.00	20.00	4
9	125.00	20.00	200.00	20.00	2
10	26.00	13.00	120.00	13.00	3
11	120.00	13.00	125.00	13.00	4
12	125.00	13.00	200.00	13.00	3

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1

3	117.0	125.0	184.0	26.0	0.00	0.0	1
4	110.0	120.0	2.0	0.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	80.00	40.00
4	130.00	32.00
5	200.00	32.00

1

BOUNDARY LOAD(S)

4 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	115.50	117.50	3000.0	0.0
2	127.50	129.50	3000.0	0.0
3	134.50	136.50	3000.0	0.0
4	144.50	146.50	3000.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 20.00 ft.
and X = 60.00 ft.

Each Surface Terminates Between X = 80.00 ft.
and X = 147.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = 0.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.66	23.21
3	50.66	23.18
4	52.66	23.24
5	54.66	23.38
6	56.64	23.61
7	58.62	23.93
8	60.58	24.34
9	62.52	24.83
10	64.43	25.41
11	66.32	26.07
12	68.18	26.81
13	70.00	27.63
14	71.78	28.54
15	73.53	29.52
16	75.22	30.57
17	76.87	31.71
18	78.47	32.91
19	80.02	34.18
20	81.50	35.52
21	82.93	36.92
22	84.29	38.38
23	85.59	39.90
24	86.82	41.48
25	87.98	43.11
26	88.82	44.41

Circle Center At X = 50.4 ; Y = 68.6 and Radius, 45.4

*** 0.980 ***

Individual data on the 28 slices

Water Force	Water Force	Force	Force	Earthquake Force	Surcharge

Slice No.	Width (ft)	Weight (lbs)	Top (lbs)	Bot (lbs)	Norm (lbs)	Tan (lbs)	Hor (lbs)	Ver (lbs)	Load (lbs)
1	2.0	131.7	719.7	714.6	0.0	0.0	0.0	0.0	0.0
2	2.0	385.5	581.5	724.1	0.0	0.0	0.0	0.0	0.0
3	2.0	618.4	441.9	722.6	0.0	0.0	0.0	0.0	0.0
4	2.0	828.4	302.0	710.1	0.0	0.0	0.0	0.0	0.0
5	2.0	1014.2	162.8	686.6	0.0	0.0	0.0	0.0	0.0
6	2.0	1174.5	25.4	652.2	0.0	0.0	0.0	0.0	0.0
7	1.4	903.1	0.0	433.5	0.0	0.0	0.0	0.0	0.0
8	0.6	392.7	0.0	158.5	0.0	0.0	0.0	0.0	0.0
9	1.9	1394.7	0.0	580.8	0.0	0.0	0.0	0.0	0.0
10	1.9	1475.3	0.0	638.8	0.0	0.0	0.0	0.0	0.0
11	1.9	1528.9	0.0	685.9	0.0	0.0	0.0	0.0	0.0
12	1.9	1556.1	0.0	722.1	0.0	0.0	0.0	0.0	0.0
13	1.8	1557.4	0.0	747.4	0.0	0.0	0.0	0.0	0.0
14	1.8	1533.9	0.0	761.5	0.0	0.0	0.0	0.0	0.0
15	1.7	1486.9	0.0	764.6	0.0	0.0	0.0	0.0	0.0
16	1.7	1418.0	0.0	756.7	0.0	0.0	0.0	0.0	0.0
17	1.6	1329.1	0.0	737.6	0.0	0.0	0.0	0.0	0.0
18	1.6	1222.2	0.0	707.5	0.0	0.0	0.0	0.0	0.0
19	1.5	1088.8	0.0	659.8	0.0	0.0	0.0	0.0	0.0
20	0.0	11.0	0.0	7.4	0.0	0.0	0.0	0.0	0.0
21	1.5	964.7	0.0	620.1	0.0	0.0	0.0	0.0	0.0
22	1.4	808.2	0.0	422.6	0.0	0.0	0.0	0.0	0.0
23	1.4	645.6	0.0	218.5	0.0	0.0	0.0	0.0	0.0
24	0.7	276.2	0.0	30.9	0.0	0.0	0.0	0.0	0.0
25	0.6	205.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1.2	328.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1.2	180.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.8	40.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.11	25.50
3	55.11	25.55
4	57.11	25.68
5	59.09	25.91
6	61.07	26.24
7	63.02	26.65
8	64.96	27.16
9	66.87	27.76
10	68.74	28.45
11	70.59	29.22
12	72.39	30.08
13	74.15	31.03
14	75.87	32.06
15	77.54	33.16
16	79.15	34.35
17	80.70	35.61
18	82.19	36.94
19	83.62	38.34
20	84.98	39.80
21	86.28	41.33
22	87.49	42.92
23	88.38	44.19

Circle Center At X = 53.2 ; Y = 68.0 and Radius, 42.4

*** 0.987 ***

1

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.11	25.65
3	55.10	25.81
4	57.09	26.05
5	59.06	26.36
6	61.03	26.74
7	62.98	27.19
8	64.91	27.71
9	66.82	28.29
10	68.71	28.95
11	70.57	29.68
12	72.41	30.47
13	74.22	31.32
14	75.99	32.24
15	77.73	33.23
16	79.44	34.27
17	81.11	35.38
18	82.73	36.55
19	84.31	37.77
20	85.85	39.05
21	87.34	40.38
22	88.78	41.77
23	90.17	43.21
24	91.51	44.69
25	92.79	46.23
26	93.01	46.50

Circle Center At X = 49.5 ; Y = 81.1 and Radius, 55.6

*** 1.010 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.05	25.08
3	55.01	24.68
4	56.99	24.38
5	58.98	24.16
6	60.98	24.03
7	62.97	23.99
8	64.97	24.04
9	66.97	24.18

10	68.96	24.40
11	70.93	24.72
12	72.89	25.12
13	74.83	25.61
14	76.75	26.18
15	78.64	26.83
16	80.50	27.57
17	82.32	28.40
18	84.10	29.30
19	85.85	30.28
20	87.55	31.33
21	89.20	32.46
22	90.79	33.66
23	92.34	34.94
24	93.82	36.27
25	95.25	37.68
26	96.61	39.14
27	97.91	40.67
28	99.13	42.25
29	100.29	43.88
30	101.37	45.56
31	102.37	47.29
32	103.30	49.06
33	103.74	50.00

Circle Center At X = 62.9 ; Y = 69.1 and Radius, 45.1

*** 1.040 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.56	27.76
3	59.55	27.86
4	61.54	28.08
5	63.51	28.41
6	65.46	28.86
7	67.38	29.42
8	69.27	30.09
9	71.11	30.87
10	72.90	31.76
11	74.64	32.75
12	76.32	33.83
13	77.93	35.02
14	79.47	36.29
15	80.94	37.66
16	82.32	39.10
17	83.61	40.63
18	84.82	42.22
19	85.00	42.50

Circle Center At X = 56.8 ; Y = 62.1 and Radius, 34.3

*** 1.044 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.54	27.52
3	59.54	27.42
4	61.54	27.50
5	63.52	27.76
6	65.47	28.18
7	67.39	28.76
8	69.24	29.51
9	71.03	30.41
10	72.73	31.47
11	74.33	32.66
12	75.83	33.99
13	77.20	35.44
14	78.45	37.00
15	79.56	38.67
16	80.40	40.20

Circle Center At X = 59.6 ; Y = 50.7 and Radius, 23.3

*** 1.070 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.49	27.27
3	59.46	26.95
4	61.46	26.83
5	63.46	26.91
6	65.44	27.18
7	67.38	27.65
8	69.27	28.31
9	71.09	29.15
10	72.81	30.17
11	74.42	31.35
12	75.91	32.69
13	77.26	34.17
14	78.45	35.77
15	79.48	37.49
16	80.34	39.29
17	80.72	40.36

Circle Center At X = 61.7 ; Y = 47.0 and Radius, 20.2

*** 1.070 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.65	23.07
3	50.64	22.87
4	52.63	22.73
5	54.63	22.64
6	56.63	22.62
7	58.63	22.65
8	60.63	22.75
9	62.62	22.90
10	64.61	23.11
11	66.59	23.38
12	68.57	23.71
13	70.53	24.10
14	72.48	24.55
15	74.42	25.05
16	76.34	25.61
17	78.24	26.23
18	80.12	26.90
19	81.98	27.63
20	83.82	28.41
21	85.64	29.25
22	87.43	30.14
23	89.19	31.08
24	90.93	32.08
25	92.63	33.12
26	94.31	34.22
27	95.95	35.36
28	97.55	36.56
29	99.12	37.80
30	100.65	39.08
31	102.15	40.41
32	103.60	41.79
33	105.01	43.20
34	106.38	44.66
35	107.70	46.16
36	108.99	47.70
37	110.22	49.27
38	110.76	50.00

Circle Center At X = 56.5 ; Y = 90.1 and Radius, 67.5

*** 1.076 ***

1

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.55	27.94
3	59.54	28.18
4	61.51	28.49
5	63.47	28.87
6	65.42	29.33
7	67.35	29.86
8	69.26	30.46
9	71.14	31.13
10	73.00	31.87
11	74.83	32.68
12	76.62	33.56
13	78.39	34.51
14	80.11	35.51
15	81.80	36.59
16	83.45	37.72
17	85.05	38.92
18	86.61	40.17
19	88.12	41.49
20	89.58	42.85
21	90.98	44.28
22	92.34	45.75
23	92.96	46.48

Circle Center At X = 52.2 ; Y = 81.3 and Radius, 53.6

*** 1.077 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.00	30.00
2	62.00	29.94
3	64.00	30.00
4	65.99	30.19
5	67.97	30.50
6	69.92	30.93
7	71.84	31.49
8	73.72	32.17
9	75.56	32.96
10	77.34	33.87
11	79.06	34.88
12	80.72	36.00
13	82.30	37.23
14	83.80	38.55
15	85.22	39.96
16	86.54	41.46
17	87.77	43.04
18	88.65	44.33

Circle Center At X = 62.0 ; Y = 61.8 and Radius, 31.9

```
      ***     1.092   ***

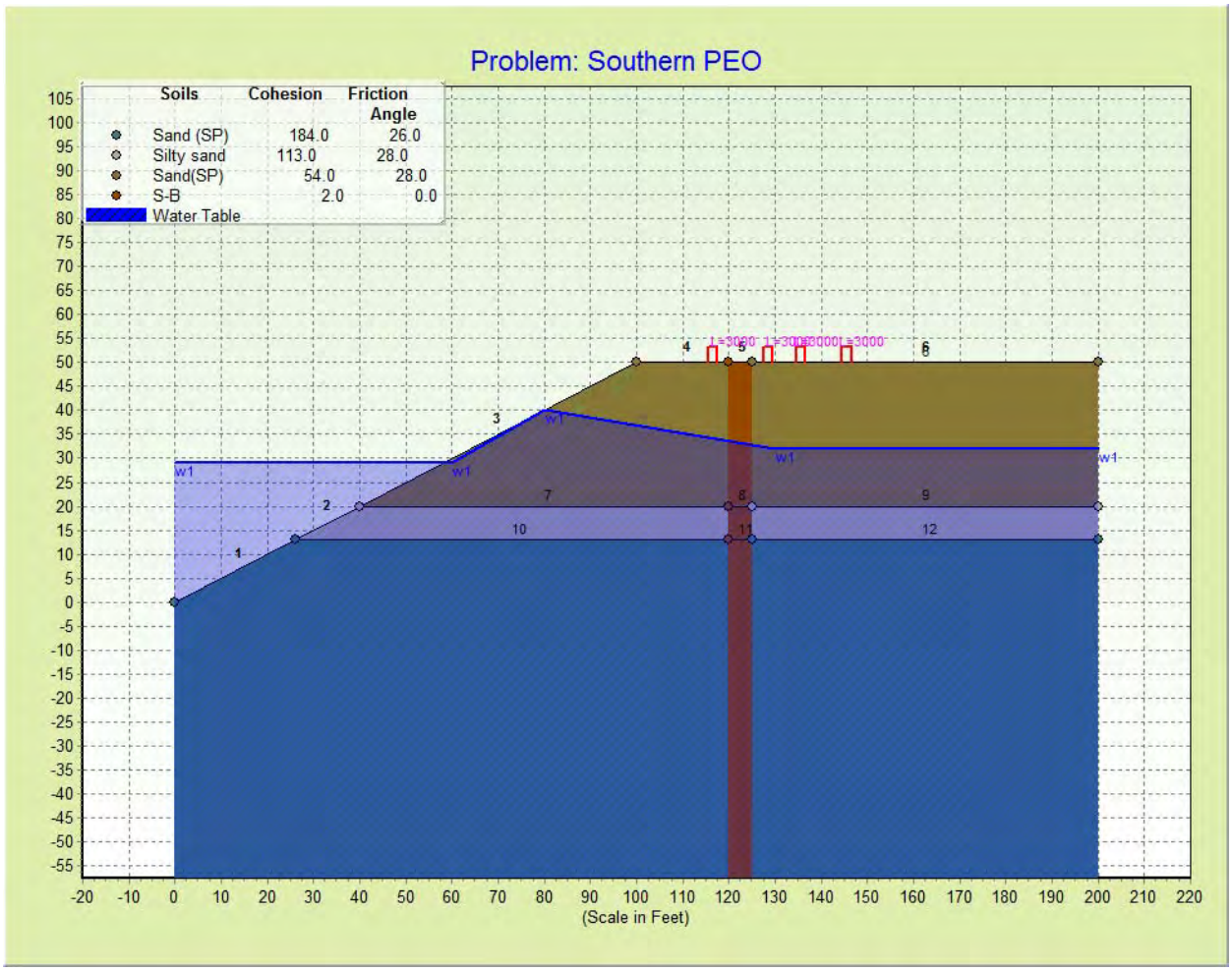

1

                Y            A     X     I     S            F     T

                0.00     25.00     50.00     75.00    100.00    125.00

X       0.00 *---------+-W-------+---------+---------+---------+
             -
             -
             -
             -
             -   .
       25.00 + ...*
             - .....
             -.......
             -........
             -.......*
             .........1
A      50.00 .........12
             .........125
             .........113W
             .........8129.
             .........8113.
             ..........4125.
X      75.00 ..........4.115.
             ..........84.115W
             -..........44.1125
             -...........44..111
             -............44..333
             -.............844...
I     100.00 + .............8844.*
             - ..............88.44
             -  ...............888
             -   ................8
             -    ................1/1
             -    *..*...........*
S     125.00 +    * .*...........*
             -       .....W.......2/2
             -         ............./3
             -           .........3/
             -              ......
             -                 ...4/4
      150.00 +
             -
             -
             -
             -
             -
F     175.00 +
             -
             -
             -
             -
             -
T     200.00 +    *  *    W      *
```

========== DATA SUMMARY ==========



Profile Data

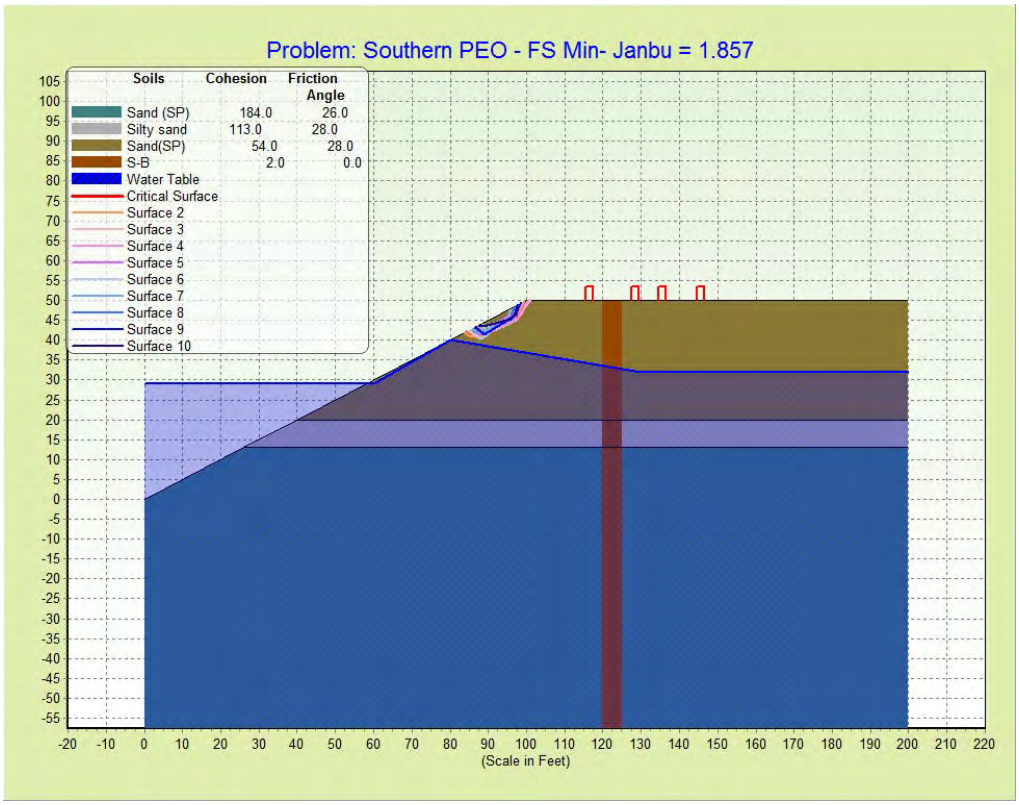
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	120	50	1
5	120	50	125	50	4
6	125	50	200	50	1
7	40	20	120	20	2
8	120	20	125	20	4
9	125	20	200	20	2
10	26	13	120	13	3

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
11	120	13	125	13	4
12	125	13	200	13	3

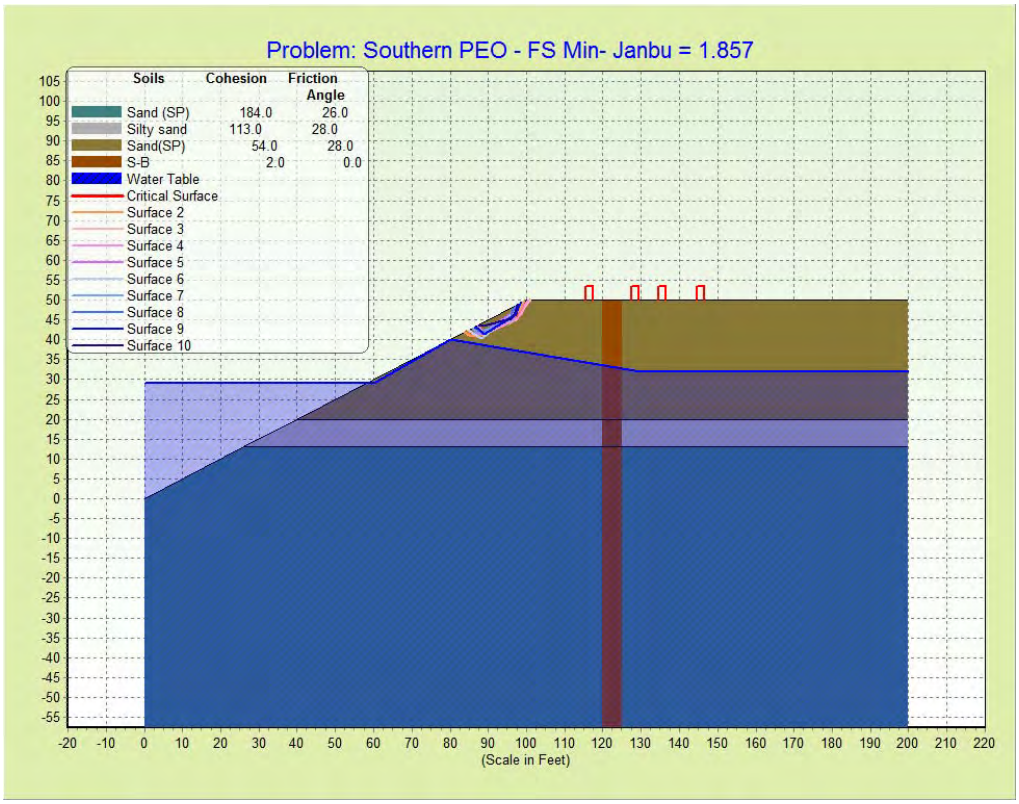
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)
4	110	120	2	0	0	0	1	S-B

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	120.00	50.00	1
5	120.00	50.00	125.00	50.00	4
6	125.00	50.00	200.00	50.00	1
7	40.00	20.00	120.00	20.00	2
8	120.00	20.00	125.00	20.00	4
9	125.00	20.00	200.00	20.00	2
10	26.00	13.00	120.00	13.00	3
11	120.00	13.00	125.00	13.00	4
12	125.00	13.00	200.00	13.00	3

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1

3	117.0	125.0	184.0	26.0	0.00	0.0	1
4	110.0	120.0	2.0	0.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	80.00	40.00
4	130.00	32.00
5	200.00	32.00

1

BOUNDARY LOAD(S)

4 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	115.50	117.50	3000.0	0.0
2	127.50	129.50	3000.0	0.0
3	134.50	136.50	3000.0	0.0
4	144.50	146.50	3000.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

20 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 2.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)

1	87.00	41.00	90.00	43.00	3.00
2	95.00	45.00	98.00	47.00	3.00

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	84.17	42.09
2	85.18	41.19
3	87.15	40.83
4	96.72	45.36
5	98.13	46.78
6	99.34	48.37
7	100.75	49.79
8	100.84	50.00

*** 1.857 ***

Individual data on the 8 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.0	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.0	452.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	9.6	3054.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.4	414.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1.2	241.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.7	83.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.7	49.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.62	41.81
2	85.10	41.02
3	87.10	40.89
4	96.31	44.40
5	97.06	46.26
6	98.37	47.76

7	99.32	49.53
8	99.58	49.79

*** 1.934 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.78	42.89
2	86.00	42.79
3	87.47	41.42
4	97.24	45.15
5	98.59	46.63
6	99.61	48.35
7	100.94	49.85
8	101.05	50.00

*** 1.974 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.21	43.60
2	88.10	42.79
3	89.77	41.68
4	97.74	45.47
5	98.72	47.22
6	99.86	48.86
7	100.53	50.00

*** 2.069 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	84.89	42.45
2	86.12	41.58
3	88.11	41.47
4	96.66	47.23
5	97.80	48.88

6	97.84	48.92

*** 2.136 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	84.78	42.39
2	84.79	42.39
3	86.48	41.32
4	88.24	40.36
5	96.56	46.64
6	97.80	48.21
7	98.34	49.17

*** 2.149 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.78	42.89
2	87.08	41.64
3	96.44	45.28
4	97.04	47.19
5	98.44	48.62
6	98.73	49.37

*** 2.264 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	86.53	43.27
2	87.53	42.40
3	89.38	41.64
4	95.92	45.81
5	96.59	47.70
6	97.77	48.88

*** 2.299 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	86.49	43.24
2	87.36	42.64
3	88.82	41.27
4	97.21	46.41
5	97.89	48.29
6	98.70	49.35

*** 2.334 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.42	43.71
2	88.69	43.46
3	95.80	45.19
4	97.06	46.75
5	97.65	48.66
6	97.87	48.93

*** 2.340 ***

1

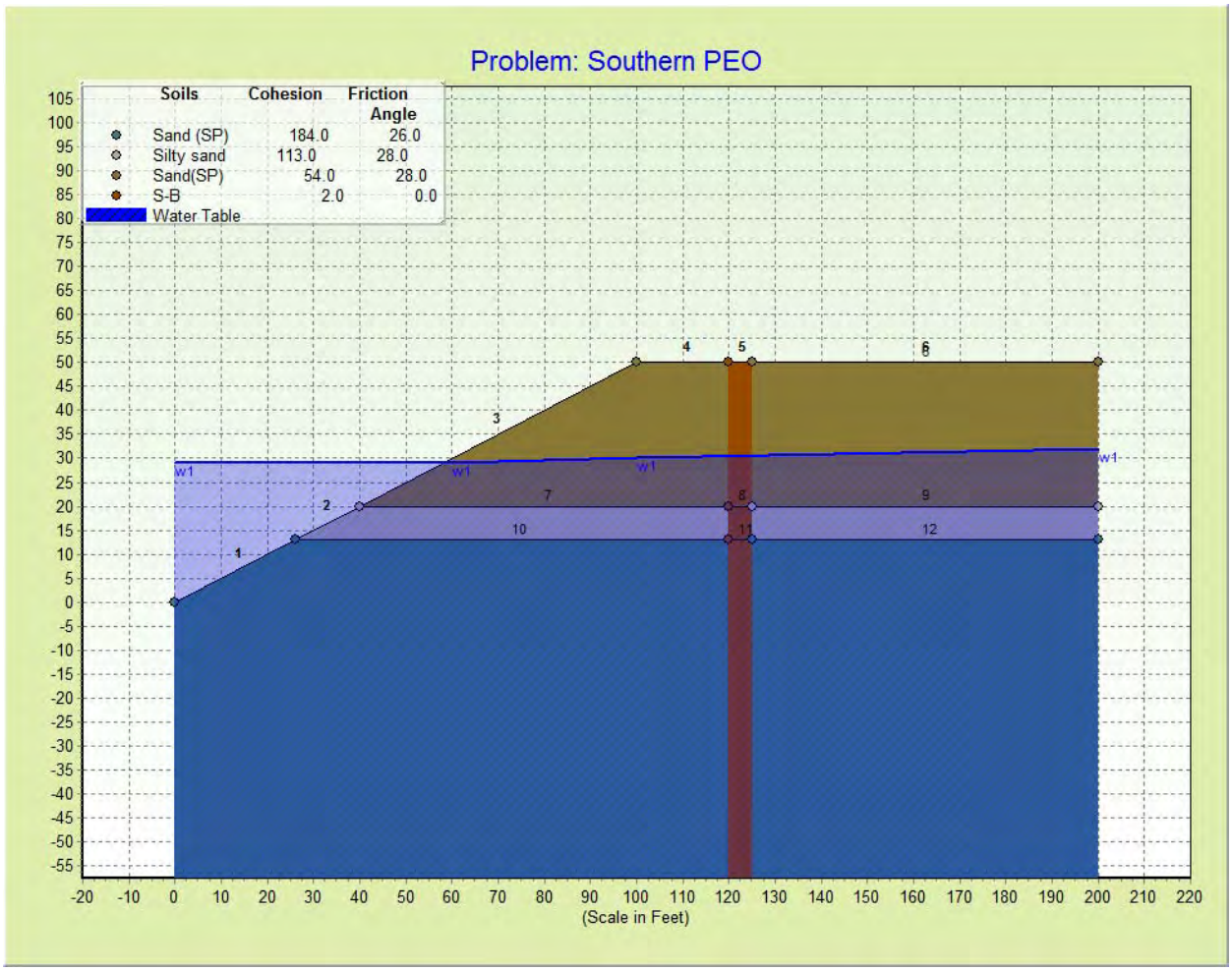
```
            Y            A     X     I     S            F     T

            0.00     25.00     50.00     75.00    100.00    125.00
X      0.00 *---------+-W-------+---------+---------+---------+
            -
            -
            -
            -
            -
      25.00 +    *
            -
            -
            -
            -       *
            -
A     50.00 +
            -
```

```
             -           W
             -
             -
             -
X      75.00 +
             -               W
             -               11
             -               13.
             -                4
             -                 125
I     100.00 +                  1*
             -
             -
             -
             -                    1/1
             -    *  *           *
S     125.00 +    *  *           *
             -            W       2/2
             -                    /3
             -                    3/
             -
             -                    4/4
      150.00 +
             -
             -
             -
             -
             -
F     175.00 +
             -
             -
             -
             -
             -
T     200.00 +    *  *    W      *
```

Appendix C.5
Post-Construction, Normal Groundwater Condition

========== DATA SUMMARY ==========



Profile Data

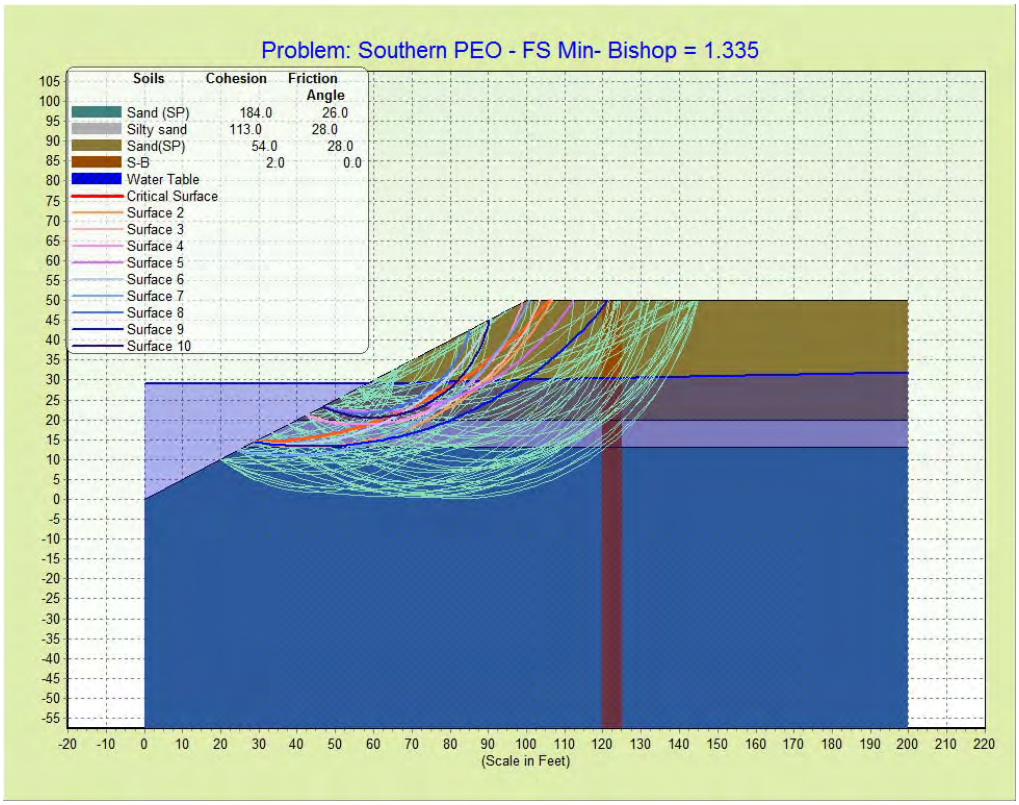
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	120	50	1
5	120	50	125	50	4
6	125	50	200	50	1
7	40	20	120	20	2
8	120	20	125	20	4
9	125	20	200	20	2
10	26	13	120	13	3

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
11	120	13	125	13	4
12	125	13	200	13	3

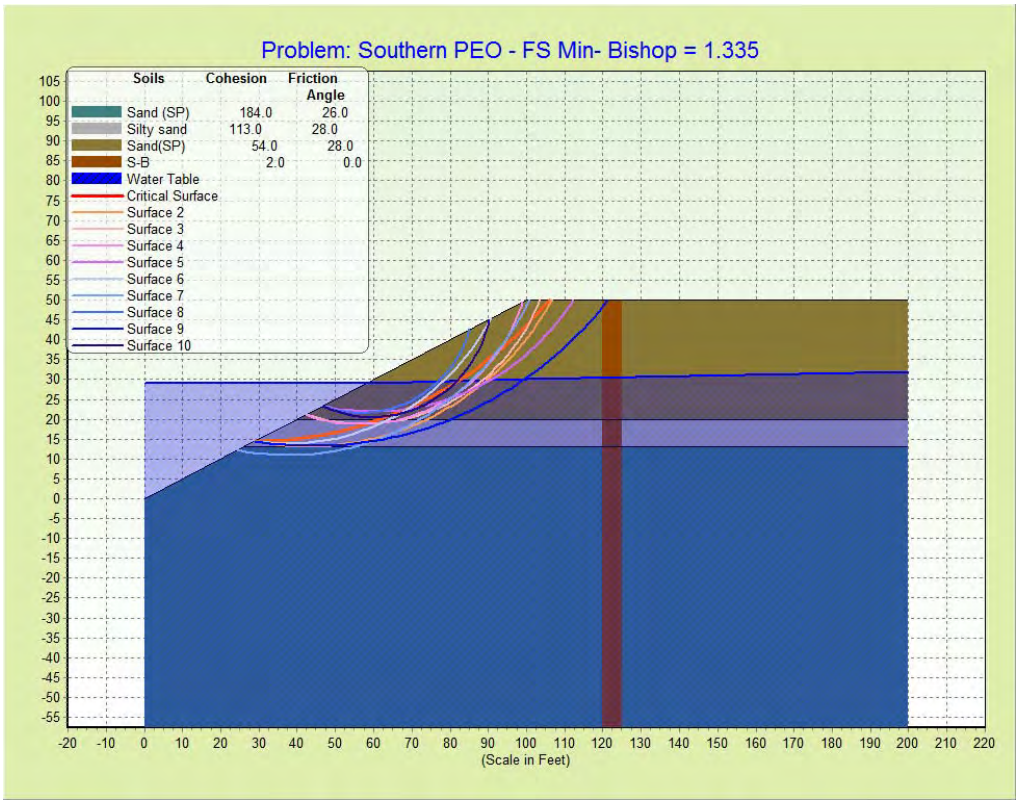
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)
4	110	120	2	0	0	0	1	S-B

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	120.00	50.00	1
5	120.00	50.00	125.00	50.00	4
6	125.00	50.00	200.00	50.00	1
7	40.00	20.00	120.00	20.00	2
8	120.00	20.00	125.00	20.00	4
9	125.00	20.00	200.00	20.00	2
10	26.00	13.00	120.00	13.00	3
11	120.00	13.00	125.00	13.00	4
12	125.00	13.00	200.00	13.00	3

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ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1

3	117.0	125.0	184.0	26.0	0.00	0.0	1
4	110.0	120.0	2.0	0.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	100.00	30.00
4	200.00	32.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 20.00 ft.
and X = 60.00 ft.

Each Surface Terminates Between X = 65.00 ft.
and X = 145.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 45 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	28.89	14.44
2	30.89	14.47
3	32.89	14.53
4	34.89	14.64
5	36.88	14.78
6	38.87	14.96
7	40.86	15.18
8	42.84	15.44
9	44.82	15.74
10	46.79	16.08
11	48.76	16.45
12	50.71	16.87
13	52.66	17.32
14	54.60	17.81
15	56.53	18.34
16	58.45	18.91
17	60.35	19.51
18	62.25	20.15
19	64.13	20.83
20	66.00	21.54
21	67.85	22.29
22	69.69	23.08
23	71.51	23.90
24	73.32	24.76
25	75.11	25.65
26	76.88	26.58
27	78.63	27.55
28	80.37	28.54
29	82.08	29.57
30	83.77	30.64
31	85.45	31.74
32	87.10	32.87
33	88.72	34.03
34	90.33	35.22
35	91.91	36.45
36	93.47	37.70
37	95.00	38.99
38	96.51	40.30
39	97.99	41.65
40	99.44	43.02
41	100.87	44.42
42	102.27	45.85
43	103.64	47.31
44	104.98	48.79
45	106.03	50.00

Circle Center At X = 28.6 ; Y = 116.5 and Radius, 102.1

*** 1.335 ***

Individual data on the 49 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)

1	2.0	112.1	1961.0	1814.9	0.0	0.0	0.0	0.0	0.0
2	2.0	331.5	1820.7	1809.3	0.0	0.0	0.0	0.0	0.0
3	2.0	541.4	1680.0	1798.8	0.0	0.0	0.0	0.0	0.0
4	2.0	741.5	1539.1	1783.5	0.0	0.0	0.0	0.0	0.0
5	2.0	931.4	1398.1	1763.2	0.0	0.0	0.0	0.0	0.0
6	1.1	608.7	730.4	989.6	0.0	0.0	0.0	0.0	0.0
7	0.9	502.8	527.0	748.5	0.0	0.0	0.0	0.0	0.0
8	2.0	1285.5	1117.1	1708.1	0.0	0.0	0.0	0.0	0.0
9	2.0	1449.5	977.4	1673.3	0.0	0.0	0.0	0.0	0.0
10	2.0	1602.6	838.5	1633.6	0.0	0.0	0.0	0.0	0.0
11	2.0	1744.5	700.7	1589.1	0.0	0.0	0.0	0.0	0.0
12	2.0	1875.1	564.1	1539.9	0.0	0.0	0.0	0.0	0.0
13	1.9	1994.3	429.0	1485.8	0.0	0.0	0.0	0.0	0.0
14	1.9	2102.1	295.5	1427.0	0.0	0.0	0.0	0.0	0.0
15	1.9	2198.4	163.9	1363.4	0.0	0.0	0.0	0.0	0.0
16	1.9	2283.2	34.2	1295.1	0.0	0.0	0.0	0.0	0.0
17	1.6	1905.9	0.0	1000.8	0.0	0.0	0.0	0.0	0.0
18	0.4	441.2	0.0	221.3	0.0	0.0	0.0	0.0	0.0
19	1.5	1832.4	0.0	887.0	0.0	0.0	0.0	0.0	0.0
20	0.4	564.3	0.0	261.2	0.0	0.0	0.0	0.0	0.0
21	1.9	2432.9	0.0	1071.9	0.0	0.0	0.0	0.0	0.0
22	1.9	2456.9	0.0	990.9	0.0	0.0	0.0	0.0	0.0
23	1.9	2469.8	0.0	905.3	0.0	0.0	0.0	0.0	0.0
24	1.8	2471.9	0.0	815.1	0.0	0.0	0.0	0.0	0.0
25	1.8	2463.4	0.0	720.4	0.0	0.0	0.0	0.0	0.0
26	1.8	2444.4	0.0	621.2	0.0	0.0	0.0	0.0	0.0
27	1.8	2415.4	0.0	517.5	0.0	0.0	0.0	0.0	0.0
28	1.8	2376.4	0.0	409.4	0.0	0.0	0.0	0.0	0.0
29	1.8	2327.9	0.0	296.9	0.0	0.0	0.0	0.0	0.0
30	1.7	2270.2	0.0	180.1	0.0	0.0	0.0	0.0	0.0
31	1.7	2155.5	0.0	58.9	0.0	0.0	0.0	0.0	0.0
32	0.0	48.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	1.7	2134.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	1.7	2063.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	1.7	1984.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	1.6	1898.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	1.6	1806.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	1.6	1707.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	1.6	1602.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	1.5	1491.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	1.5	1376.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	1.5	1256.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	1.5	1133.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.6	408.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.9	577.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	1.4	755.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	1.4	520.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	1.3	290.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	1.1	70.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.89	14.44
2	30.86	14.09
3	32.84	13.79
4	34.82	13.54
5	36.81	13.35
6	38.81	13.21
7	40.80	13.13

8	42.80	13.10
9	44.80	13.12
10	46.80	13.20
11	48.80	13.34
12	50.79	13.53
13	52.77	13.77
14	54.75	14.06
15	56.72	14.41
16	58.68	14.81
17	60.63	15.27
18	62.56	15.78
19	64.48	16.34
20	66.39	16.95
21	68.27	17.62
22	70.14	18.33
23	71.99	19.10
24	73.81	19.91
25	75.62	20.78
26	77.40	21.69
27	79.15	22.65
28	80.88	23.66
29	82.58	24.72
30	84.24	25.82
31	85.88	26.97
32	87.49	28.16
33	89.06	29.39
34	90.60	30.67
35	92.11	31.98
36	93.58	33.34
37	95.01	34.74
38	96.40	36.17
39	97.75	37.65
40	99.07	39.16
41	100.34	40.70
42	101.57	42.28
43	102.75	43.89
44	103.89	45.53
45	104.99	47.21
46	106.04	48.91
47	106.67	50.00

Circle Center At X = 42.9 ; Y = 86.7 and Radius, 73.6

*** 1.344 ***

1

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	42.22	21.11
2	44.14	20.55
3	46.08	20.07
4	48.04	19.67
5	50.02	19.35
6	52.00	19.10
7	54.00	18.94

8	55.99	18.85
9	57.99	18.84
10	59.99	18.92
11	61.99	19.07
12	63.97	19.30
13	65.95	19.61
14	67.91	20.00
15	69.85	20.47
16	71.78	21.02
17	73.68	21.64
18	75.55	22.33
19	77.40	23.10
20	79.21	23.95
21	80.99	24.86
22	82.73	25.85
23	84.43	26.90
24	86.09	28.02
25	87.70	29.21
26	89.26	30.46
27	90.77	31.77
28	92.23	33.14
29	93.63	34.57
30	94.97	36.05
31	96.26	37.58
32	97.48	39.17
33	98.63	40.80
34	99.72	42.47
35	100.75	44.19
36	101.70	45.95
37	102.58	47.75
38	103.40	49.57
39	103.56	50.00

Circle Center At X = 57.2 ; Y = 69.0 and Radius, 50.1

*** 1.387 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	42.22	21.11
2	44.13	20.51
3	46.06	20.00
4	48.02	19.57
5	49.99	19.23
6	51.97	18.98
7	53.96	18.81
8	55.96	18.74
9	57.96	18.76
10	59.96	18.86
11	61.95	19.06
12	63.93	19.35
13	65.90	19.72
14	67.84	20.18
15	69.77	20.73
16	71.66	21.36

17	73.53	22.08
18	75.36	22.88
19	77.16	23.76
20	78.91	24.72
21	80.62	25.76
22	82.28	26.87
23	83.89	28.06
24	85.44	29.32
25	86.94	30.65
26	88.38	32.04
27	89.75	33.50
28	91.05	35.01
29	92.29	36.58
30	93.45	38.21
31	94.54	39.89
32	95.56	41.61
33	96.49	43.38
34	97.35	45.19
35	98.12	47.03
36	98.81	48.91
37	99.00	49.50

Circle Center At X = 56.6 ; Y = 63.4 and Radius, 44.6

*** 1.411 ***

1

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.63	22.95
3	50.60	22.62
4	52.59	22.36
5	54.58	22.16
6	56.57	22.02
7	58.57	21.95
8	60.57	21.94
9	62.57	22.00
10	64.57	22.11
11	66.56	22.29
12	68.54	22.54
13	70.52	22.84
14	72.48	23.21
15	74.44	23.64
16	76.38	24.14
17	78.30	24.69
18	80.20	25.31
19	82.08	25.98
20	83.94	26.71
21	85.78	27.51
22	87.59	28.36
23	89.37	29.26
24	91.13	30.23
25	92.85	31.25
26	94.53	32.32

27	96.19	33.44
28	97.80	34.62
29	99.38	35.85
30	100.92	37.13
31	102.42	38.45
32	103.87	39.83
33	105.29	41.24
34	106.65	42.70
35	107.97	44.21
36	109.24	45.75
37	110.46	47.34
38	111.63	48.96
39	112.33	50.00

Circle Center At X = 59.9 ; Y = 85.0 and Radius, 63.1

*** 1.414 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.89	14.44
2	30.87	14.20
3	32.87	14.01
4	34.86	13.89
5	36.86	13.84
6	38.86	13.85
7	40.86	13.93
8	42.85	14.08
9	44.84	14.29
10	46.82	14.56
11	48.80	14.90
12	50.75	15.31
13	52.70	15.78
14	54.63	16.31
15	56.53	16.91
16	58.42	17.57
17	60.29	18.29
18	62.13	19.07
19	63.94	19.91
20	65.73	20.81
21	67.49	21.77
22	69.21	22.78
23	70.90	23.85
24	72.55	24.98
25	74.16	26.16
26	75.74	27.39
27	77.27	28.68
28	78.76	30.01
29	80.21	31.39
30	81.61	32.82
31	82.96	34.30
32	84.26	35.81
33	85.51	37.37
34	86.72	38.97
35	87.86	40.61

36	88.95	42.29
37	89.99	44.00
38	90.77	45.39

Circle Center At X = 37.5 ; Y = 74.7 and Radius, 60.8

*** 1.430 ***

1

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	24.44	12.22
2	26.41	11.87
3	28.39	11.58
4	30.38	11.35
5	32.37	11.17
6	34.37	11.04
7	36.37	10.98
8	38.37	10.97
9	40.37	11.02
10	42.36	11.12
11	44.36	11.28
12	46.34	11.50
13	48.33	11.77
14	50.30	12.10
15	52.26	12.49
16	54.21	12.93
17	56.15	13.42
18	58.07	13.98
19	59.98	14.58
20	61.87	15.24
21	63.73	15.95
22	65.58	16.72
23	67.41	17.54
24	69.21	18.41
25	70.98	19.33
26	72.73	20.30
27	74.45	21.31
28	76.15	22.38
29	77.81	23.50
30	79.43	24.66
31	81.03	25.87
32	82.59	27.12
33	84.11	28.42
34	85.60	29.75
35	87.04	31.13
36	88.45	32.56
37	89.82	34.02
38	91.14	35.51
39	92.42	37.05
40	93.66	38.62
41	94.85	40.23
42	96.00	41.87
43	97.10	43.54
44	98.15	45.24

45	99.15	46.97
46	100.11	48.73
47	100.75	50.00

Circle Center At X = 37.7 ; Y = 81.4 and Radius, 70.5

*** 1.431 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.57	22.72
3	50.51	22.24
4	52.48	21.89
5	54.47	21.67
6	56.47	21.58
7	58.47	21.63
8	60.46	21.82
9	62.43	22.14
10	64.38	22.59
11	66.29	23.17
12	68.16	23.88
13	69.98	24.71
14	71.74	25.66
15	73.43	26.73
16	75.05	27.91
17	76.58	29.20
18	78.02	30.59
19	79.36	32.07
20	80.61	33.63
21	81.74	35.28
22	82.76	37.00
23	83.66	38.79
24	84.44	40.63
25	85.10	42.52
26	85.11	42.55

Circle Center At X = 56.7 ; Y = 51.3 and Radius, 29.7

*** 1.435 ***

1

Failure Surface Specified By 53 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.89	14.44
2	30.87	14.15
3	32.85	13.90

4	34.84	13.69
5	36.83	13.52
6	38.83	13.39
7	40.83	13.30
8	42.83	13.25
9	44.83	13.24
10	46.83	13.27
11	48.83	13.34
12	50.82	13.45
13	52.82	13.61
14	54.81	13.80
15	56.79	14.03
16	58.78	14.30
17	60.75	14.61
18	62.72	14.97
19	64.68	15.36
20	66.63	15.79
21	68.58	16.26
22	70.51	16.77
23	72.43	17.32
24	74.35	17.90
25	76.25	18.53
26	78.13	19.19
27	80.01	19.89
28	81.86	20.63
29	83.71	21.41
30	85.53	22.22
31	87.34	23.07
32	89.14	23.96
33	90.91	24.88
34	92.67	25.84
35	94.40	26.84
36	96.12	27.87
37	97.81	28.93
38	99.48	30.03
39	101.13	31.16
40	102.76	32.32
41	104.36	33.52
42	105.94	34.74
43	107.50	36.00
44	109.02	37.29
45	110.52	38.62
46	112.00	39.97
47	113.45	41.35
48	114.86	42.76
49	116.25	44.20
50	117.61	45.66
51	118.94	47.16
52	120.24	48.67
53	121.33	50.00

Circle Center At X = 44.3 ; Y = 112.3 and Radius, 99.1

*** 1.442 ***

Failure Surface Specified By 29 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	46.67	23.33
2	48.51	22.56
3	50.40	21.91
4	52.33	21.38
5	54.29	20.97
6	56.27	20.69
7	58.26	20.54
8	60.26	20.52
9	62.26	20.62
10	64.25	20.85
11	66.22	21.20
12	68.16	21.68
13	70.06	22.29
14	71.93	23.01
15	73.74	23.85
16	75.50	24.81
17	77.19	25.88
18	78.81	27.05
19	80.35	28.32
20	81.81	29.69
21	83.18	31.15
22	84.45	32.70
23	85.62	34.32
24	86.68	36.01
25	87.64	37.77
26	88.48	39.58
27	89.20	41.45
28	89.80	43.36
29	90.24	45.12

Circle Center At X = 59.7 ; Y = 51.8 and Radius, 31.3

*** 1.451 ***

1

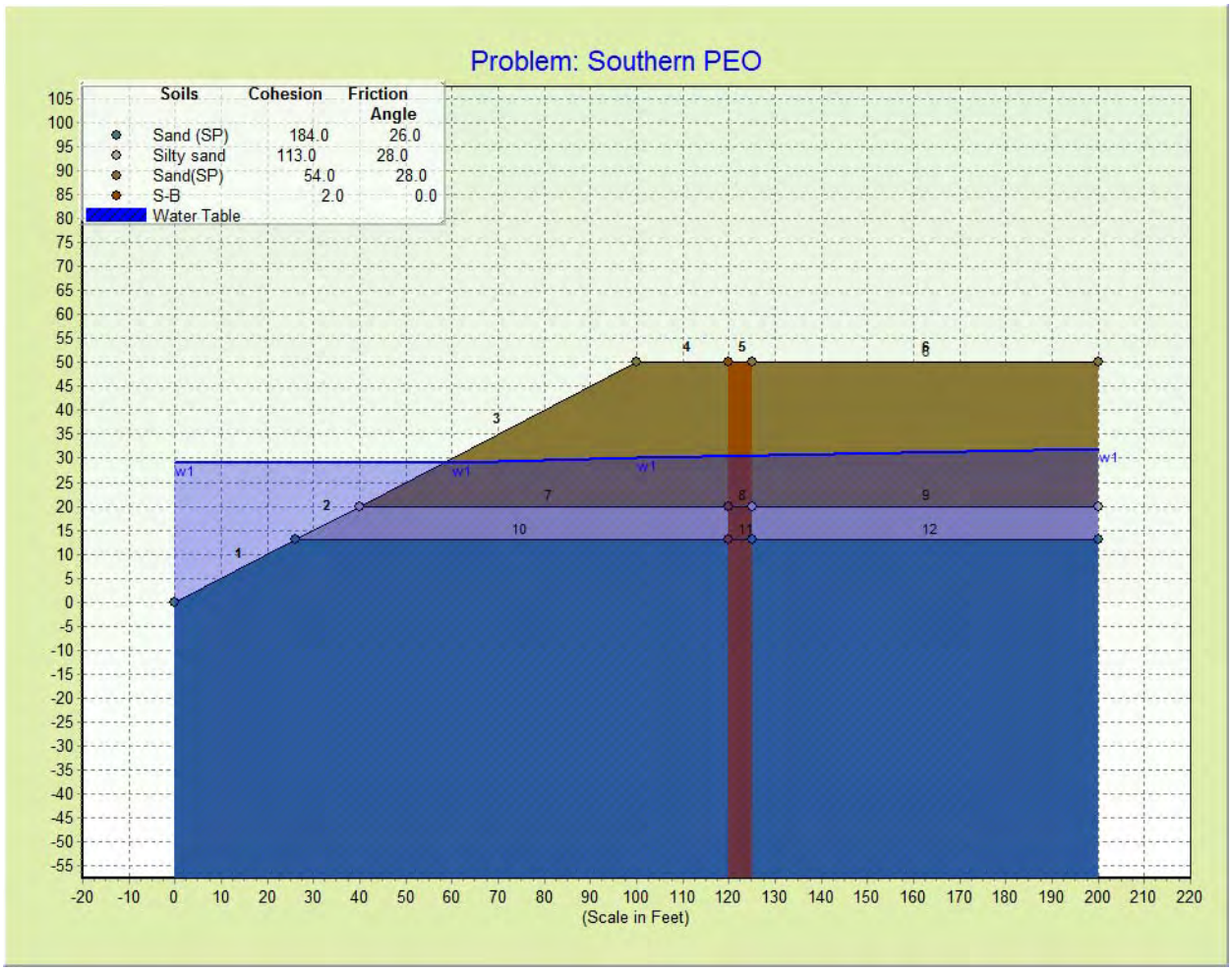
```
            Y            A     X     I     S            F     T

            0.00     25.00     50.00     75.00    100.00    125.00

X      0.00 *---------+-W-------+---------+---------+---------+
            -
            -
            -
            -
            -   .
      25.00 + ...*
            - ...71
            -...721.
            -...721..
            -...721.*
            -....21.35
A     50.00 +....26135.
            .....72135..
            ......2115..W
            ......2215....
            ......92318....
```

```
             .......2211....
X     75.00 .......923118...
             ........923166...
             ........9923166888
             .........992211666.
             ..........9.2211.06.
             -..........99522144.
I    100.00 +...........W.552114*
             -............9955.111
             - ............99.55 2
             -  ............999.55
             -   .............99..
             -    *..*..........9*
S    125.00 +    *..*...........*
             -       .............
             -        ............
             -           .........
             -              ......
             -                 ...
     150.00 +
             -
             -
             -
             -
             -
F    175.00 +
             -
             -
             -
             -
             -
T    200.00 +    *  *    W      *
```

========== DATA SUMMARY ==========



Profile Data

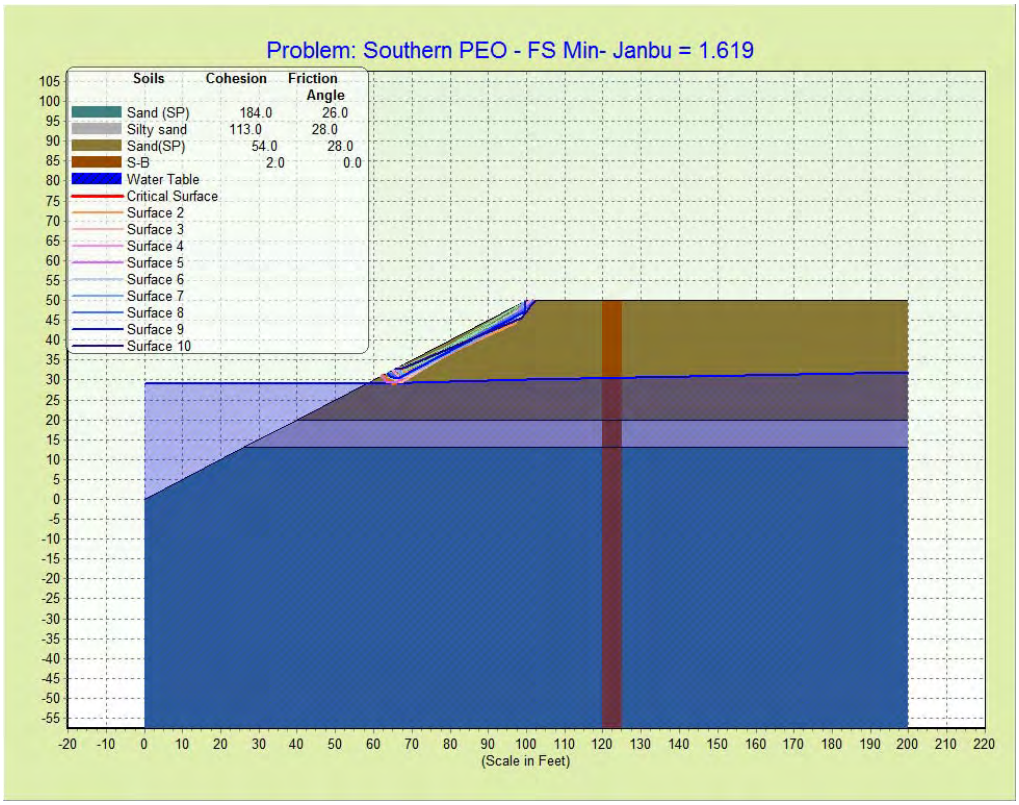
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	120	50	1
5	120	50	125	50	4
6	125	50	200	50	1
7	40	20	120	20	2
8	120	20	125	20	4
9	125	20	200	20	2
10	26	13	120	13	3

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
11	120	13	125	13	4
12	125	13	200	13	3

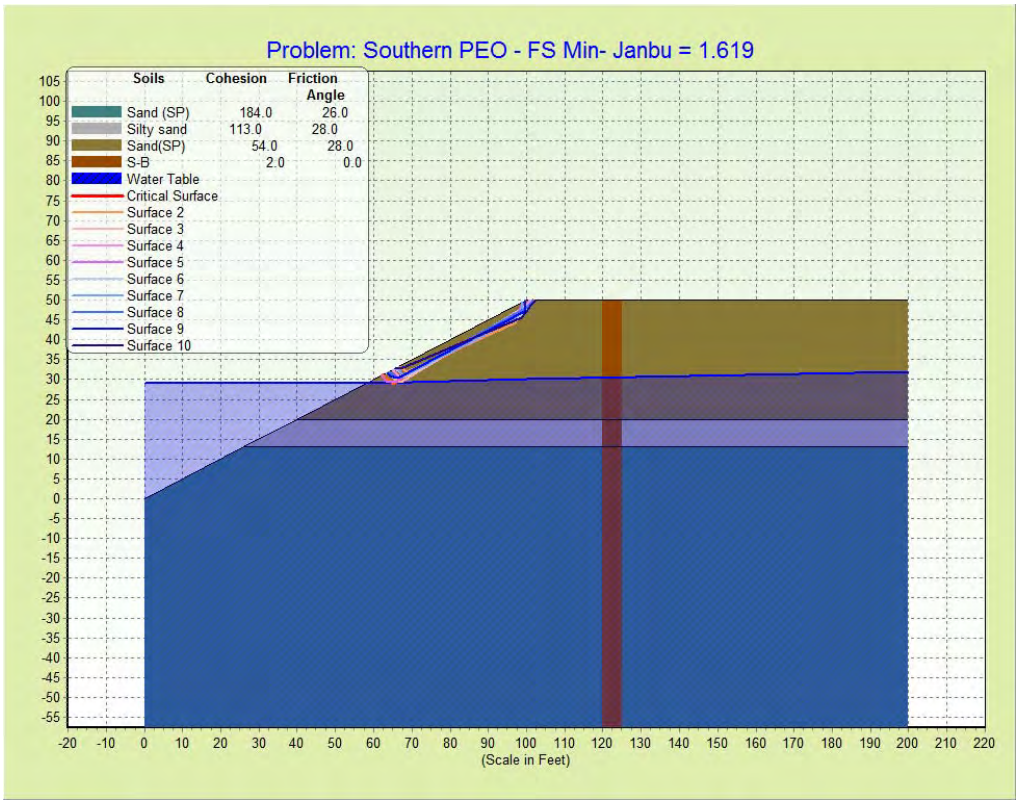
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)
4	110	120	2	0	0	0	1	S-B

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	120.00	50.00	1
5	120.00	50.00	125.00	50.00	4
6	125.00	50.00	200.00	50.00	1
7	40.00	20.00	120.00	20.00	2
8	120.00	20.00	125.00	20.00	4
9	125.00	20.00	200.00	20.00	2
10	26.00	13.00	120.00	13.00	3
11	120.00	13.00	125.00	13.00	4
12	125.00	13.00	200.00	13.00	3

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1

3	117.0	125.0	184.0	26.0	0.00	0.0	1
4	110.0	120.0	2.0	0.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 4 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	100.00	30.00
4	200.00	32.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

20 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 2.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	65.00	30.00	70.00	33.00	4.00
2	95.00	45.00	100.00	48.00	4.00

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.27	31.14

2	63.54	30.01
3	65.26	28.99
4	98.43	46.02
5	99.56	47.67
6	100.97	49.09
7	101.64	50.00

*** 1.619 ***

Individual data on the 9 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.3	124.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.5	427.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.2	90.1	0.0	1.2	0.0	0.0	0.0	0.0	0.0
4	0.3	117.3	0.0	1.4	0.0	0.0	0.0	0.0	0.0
5	32.9	12461.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.1	332.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.4	97.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1.0	151.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.7	33.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.44	33.22
2	67.07	32.95
3	68.75	31.87
4	97.06	44.28
5	98.02	46.04
6	99.09	47.73
7	100.35	49.28
8	100.92	50.00

*** 1.624 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.34	31.67
2	63.82	31.42
3	65.33	30.10
4	67.18	29.35
5	99.79	48.34

6	101.20	49.75
7	101.33	50.00

*** 1.702 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.77	32.39
2	65.71	31.80
3	67.18	30.44
4	98.78	46.32
5	99.48	48.19
6	100.88	49.61
7	100.92	50.00

*** 1.704 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	61.95	30.97
2	62.12	30.82
3	63.54	29.41
4	65.54	29.36
5	97.59	46.85
6	98.65	48.54
7	99.00	49.50

*** 1.708 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.54	32.77
2	66.45	32.08
3	67.87	30.67
4	99.37	46.73
5	100.78	48.15
6	101.57	49.99
7	101.59	50.00

*** 1.710 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.63	32.82
2	66.53	32.38
3	67.95	30.96
4	96.20	44.70
5	97.61	46.12
6	98.74	47.77
7	98.88	49.44

*** 1.712 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.82	31.91
2	64.77	31.40
3	66.42	30.27
4	99.78	47.79
5	101.07	49.32
6	101.71	50.00

*** 1.729 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.44	31.72
2	64.43	30.94
3	66.34	30.35
4	99.34	47.08
5	99.69	49.05
6	99.74	49.87

*** 1.734 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.36	32.68
2	67.01	32.61
3	98.73	45.67
4	99.99	47.23
5	101.21	48.81
6	102.37	50.00

*** 1.742 ***

1

```
            Y            A     X     I     S            F     T

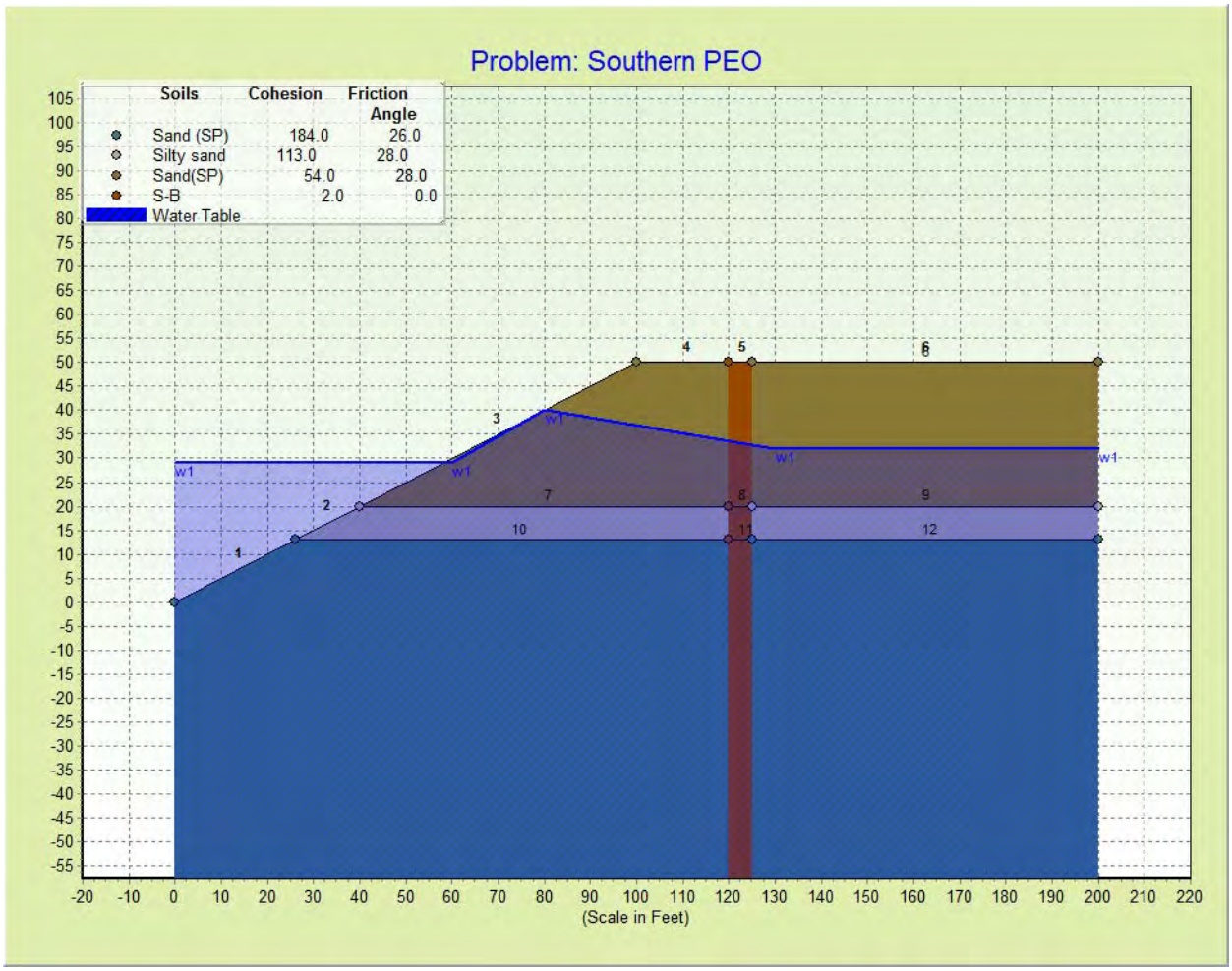
            0.00     25.00     50.00     75.00    100.00    125.00

X      0.00 *---------+-W-------+---------+---------+---------+
            -
            -
            -
            -
            -
      25.00 +    *
            -
            -
            -
            -       *
            -
A     50.00 +
            -
            -           W
            -           13
            -           12.
            -           .2
X     75.00 +
            -
            -
            -
            -
            -                 25
I    100.00 +           W     11*
            -                  0
            -
            -
            -
            -    *  *           *
S    125.00 +    *  *           *
            -
            -
            -
```

```
                -
                -
        150.00 +
                -
                -
                -
                -
                -
F       175.00 +
                -
                -
                -
                -
                -
T       200.00 +     *   *    W       *
```

Appendix C.6
Post-Construction, Rapid Drawdown Condition

========== DATA SUMMARY ==========



Profile Data

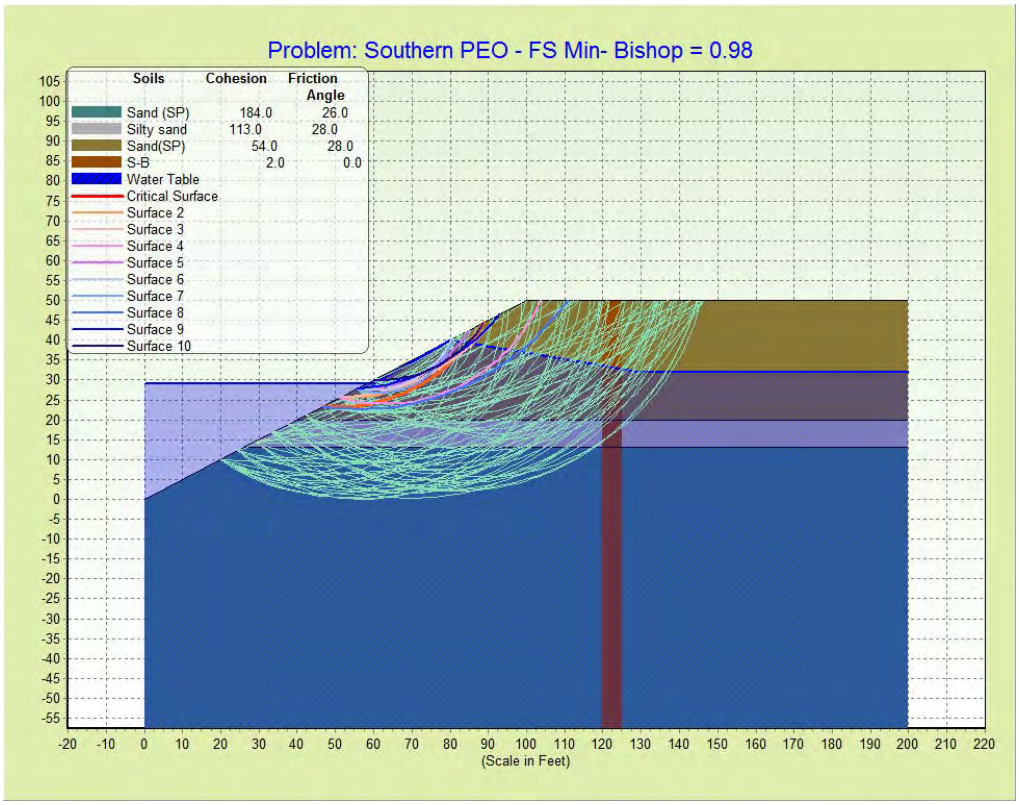
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	120	50	1
5	120	50	125	50	4
6	125	50	200	50	1
7	40	20	120	20	2
8	120	20	125	20	4
9	125	20	200	20	2
10	26	13	120	13	3

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
11	120	13	125	13	4
12	125	13	200	13	3

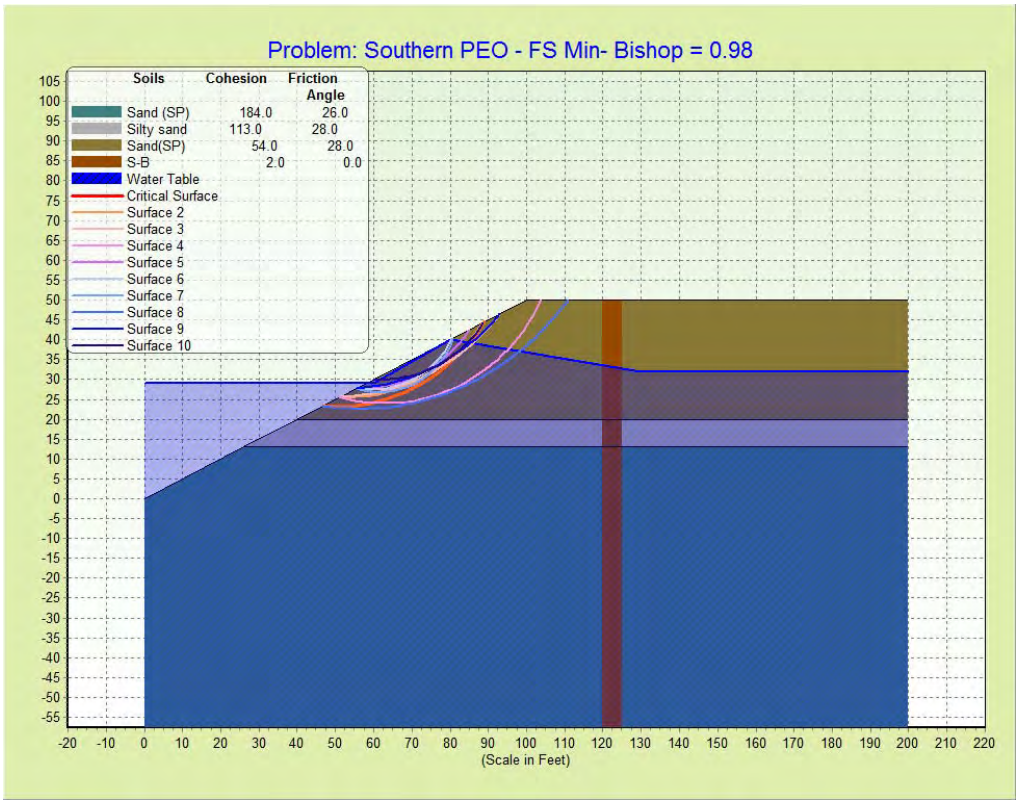
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)
4	110	120	2	0	0	0	1	S-B

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	120.00	50.00	1
5	120.00	50.00	125.00	50.00	4
6	125.00	50.00	200.00	50.00	1
7	40.00	20.00	120.00	20.00	2
8	120.00	20.00	125.00	20.00	4
9	125.00	20.00	200.00	20.00	2
10	26.00	13.00	120.00	13.00	3
11	120.00	13.00	125.00	13.00	4
12	125.00	13.00	200.00	13.00	3

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1

3	117.0	125.0	184.0	26.0	0.00	0.0	1
4	110.0	120.0	2.0	0.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	80.00	40.00
4	130.00	32.00
5	200.00	32.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 20.00 ft.
and X = 60.00 ft.

Each Surface Terminates Between X = 80.00 ft.
and X = 147.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

2.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.66	23.21
3	50.66	23.18
4	52.66	23.24
5	54.66	23.38
6	56.64	23.61
7	58.62	23.93
8	60.58	24.34
9	62.52	24.83
10	64.43	25.41
11	66.32	26.07
12	68.18	26.81
13	70.00	27.63
14	71.78	28.54
15	73.53	29.52
16	75.22	30.57
17	76.87	31.71
18	78.47	32.91
19	80.02	34.18
20	81.50	35.52
21	82.93	36.92
22	84.29	38.38
23	85.59	39.90
24	86.82	41.48
25	87.98	43.11
26	88.82	44.41

Circle Center At X = 50.4 ; Y = 68.6 and Radius, 45.4

*** 0.980 ***

Individual data on the 28 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.0	131.7	719.7	714.6	0.0	0.0	0.0	0.0	0.0
2	2.0	385.5	581.5	724.1	0.0	0.0	0.0	0.0	0.0
3	2.0	618.4	441.9	722.6	0.0	0.0	0.0	0.0	0.0
4	2.0	828.4	302.0	710.1	0.0	0.0	0.0	0.0	0.0
5	2.0	1014.2	162.8	686.6	0.0	0.0	0.0	0.0	0.0
6	2.0	1174.5	25.4	652.2	0.0	0.0	0.0	0.0	0.0
7	1.4	903.1	0.0	433.5	0.0	0.0	0.0	0.0	0.0
8	0.6	392.7	0.0	158.5	0.0	0.0	0.0	0.0	0.0
9	1.9	1394.7	0.0	580.8	0.0	0.0	0.0	0.0	0.0
10	1.9	1475.3	0.0	638.8	0.0	0.0	0.0	0.0	0.0
11	1.9	1528.9	0.0	685.9	0.0	0.0	0.0	0.0	0.0
12	1.9	1556.1	0.0	722.1	0.0	0.0	0.0	0.0	0.0
13	1.8	1557.4	0.0	747.4	0.0	0.0	0.0	0.0	0.0
14	1.8	1533.9	0.0	761.5	0.0	0.0	0.0	0.0	0.0
15	1.7	1486.9	0.0	764.6	0.0	0.0	0.0	0.0	0.0
16	1.7	1418.0	0.0	756.7	0.0	0.0	0.0	0.0	0.0
17	1.6	1329.1	0.0	737.6	0.0	0.0	0.0	0.0	0.0
18	1.6	1222.2	0.0	707.5	0.0	0.0	0.0	0.0	0.0

19	1.5	1088.8	0.0	659.8	0.0	0.0	0.0	0.0	0.0
20	0.0	11.0	0.0	7.4	0.0	0.0	0.0	0.0	0.0
21	1.5	964.7	0.0	620.1	0.0	0.0	0.0	0.0	0.0
22	1.4	808.2	0.0	422.6	0.0	0.0	0.0	0.0	0.0
23	1.4	645.6	0.0	218.5	0.0	0.0	0.0	0.0	0.0
24	0.7	276.2	0.0	30.9	0.0	0.0	0.0	0.0	0.0
25	0.6	205.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1.2	328.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	1.2	180.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.8	40.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.11	25.50
3	55.11	25.55
4	57.11	25.68
5	59.09	25.91
6	61.07	26.24
7	63.02	26.65
8	64.96	27.16
9	66.87	27.76
10	68.74	28.45
11	70.59	29.22
12	72.39	30.08
13	74.15	31.03
14	75.87	32.06
15	77.54	33.16
16	79.15	34.35
17	80.70	35.61
18	82.19	36.94
19	83.62	38.34
20	84.98	39.80
21	86.28	41.33
22	87.49	42.92
23	88.38	44.19

Circle Center At X = 53.2 ; Y = 68.0 and Radius, 42.4

*** 0.987 ***

1

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.11	25.65
3	55.10	25.81
4	57.09	26.05
5	59.06	26.36
6	61.03	26.74
7	62.98	27.19

8	64.91	27.71
9	66.82	28.29
10	68.71	28.95
11	70.57	29.68
12	72.41	30.47
13	74.22	31.32
14	75.99	32.24
15	77.73	33.23
16	79.44	34.27
17	81.11	35.38
18	82.73	36.55
19	84.31	37.77
20	85.85	39.05
21	87.34	40.38
22	88.78	41.77
23	90.17	43.21
24	91.51	44.69
25	92.79	46.23
26	93.01	46.50

Circle Center At X = 49.5 ; Y = 81.1 and Radius, 55.6

*** 1.010 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	25.56
2	53.05	25.08
3	55.01	24.68
4	56.99	24.38
5	58.98	24.16
6	60.98	24.03
7	62.97	23.99
8	64.97	24.04
9	66.97	24.18
10	68.96	24.40
11	70.93	24.72
12	72.89	25.12
13	74.83	25.61
14	76.75	26.18
15	78.64	26.83
16	80.50	27.57
17	82.32	28.40
18	84.10	29.30
19	85.85	30.28
20	87.55	31.33
21	89.20	32.46
22	90.79	33.66
23	92.34	34.94
24	93.82	36.27
25	95.25	37.68
26	96.61	39.14
27	97.91	40.67
28	99.13	42.25
29	100.29	43.88

30	101.37	45.56
31	102.37	47.29
32	103.30	49.06
33	103.74	50.00

Circle Center At X = 62.9 ; Y = 69.1 and Radius, 45.1

*** 1.040 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.56	27.76
3	59.55	27.86
4	61.54	28.08
5	63.51	28.41
6	65.46	28.86
7	67.38	29.42
8	69.27	30.09
9	71.11	30.87
10	72.90	31.76
11	74.64	32.75
12	76.32	33.83
13	77.93	35.02
14	79.47	36.29
15	80.94	37.66
16	82.32	39.10
17	83.61	40.63
18	84.82	42.22
19	85.00	42.50

Circle Center At X = 56.8 ; Y = 62.1 and Radius, 34.3

*** 1.044 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.54	27.52
3	59.54	27.42
4	61.54	27.50
5	63.52	27.76
6	65.47	28.18
7	67.39	28.76
8	69.24	29.51
9	71.03	30.41

10	72.73	31.47
11	74.33	32.66
12	75.83	33.99
13	77.20	35.44
14	78.45	37.00
15	79.56	38.67
16	80.40	40.20

Circle Center At X = 59.6 ; Y = 50.7 and Radius, 23.3

*** 1.070 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.49	27.27
3	59.46	26.95
4	61.46	26.83
5	63.46	26.91
6	65.44	27.18
7	67.38	27.65
8	69.27	28.31
9	71.09	29.15
10	72.81	30.17
11	74.42	31.35
12	75.91	32.69
13	77.26	34.17
14	78.45	35.77
15	79.48	37.49
16	80.34	39.29
17	80.72	40.36

Circle Center At X = 61.7 ; Y = 47.0 and Radius, 20.2

*** 1.070 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.67	23.33
2	48.65	23.07
3	50.64	22.87
4	52.63	22.73
5	54.63	22.64
6	56.63	22.62
7	58.63	22.65
8	60.63	22.75

9	62.62	22.90
10	64.61	23.11
11	66.59	23.38
12	68.57	23.71
13	70.53	24.10
14	72.48	24.55
15	74.42	25.05
16	76.34	25.61
17	78.24	26.23
18	80.12	26.90
19	81.98	27.63
20	83.82	28.41
21	85.64	29.25
22	87.43	30.14
23	89.19	31.08
24	90.93	32.08
25	92.63	33.12
26	94.31	34.22
27	95.95	35.36
28	97.55	36.56
29	99.12	37.80
30	100.65	39.08
31	102.15	40.41
32	103.60	41.79
33	105.01	43.20
34	106.38	44.66
35	107.70	46.16
36	108.99	47.70
37	110.22	49.27
38	110.76	50.00

Circle Center At X = 56.5 ; Y = 90.1 and Radius, 67.5

*** 1.076 ***

1

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	55.56	27.78
2	57.55	27.94
3	59.54	28.18
4	61.51	28.49
5	63.47	28.87
6	65.42	29.33
7	67.35	29.86
8	69.26	30.46
9	71.14	31.13
10	73.00	31.87
11	74.83	32.68
12	76.62	33.56
13	78.39	34.51
14	80.11	35.51
15	81.80	36.59
16	83.45	37.72
17	85.05	38.92

18	86.61	40.17
19	88.12	41.49
20	89.58	42.85
21	90.98	44.28
22	92.34	45.75
23	92.96	46.48

Circle Center At X = 52.2 ; Y = 81.3 and Radius, 53.6

*** 1.077 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.00	30.00
2	62.00	29.94
3	64.00	30.00
4	65.99	30.19
5	67.97	30.50
6	69.92	30.93
7	71.84	31.49
8	73.72	32.17
9	75.56	32.96
10	77.34	33.87
11	79.06	34.88
12	80.72	36.00
13	82.30	37.23
14	83.80	38.55
15	85.22	39.96
16	86.54	41.46
17	87.77	43.04
18	88.65	44.33

Circle Center At X = 62.0 ; Y = 61.8 and Radius, 31.9

*** 1.092 ***

1

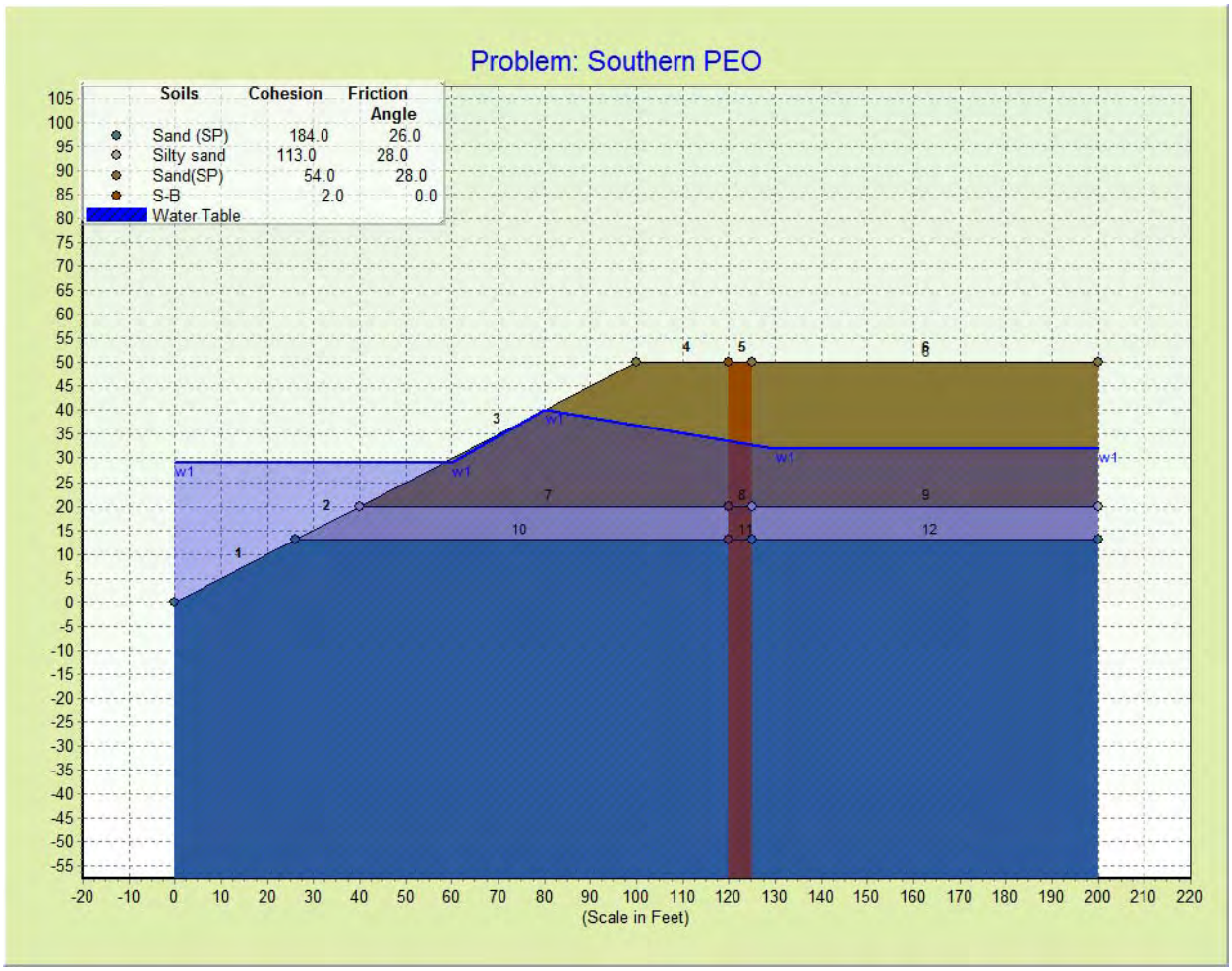
```
            Y            A     X     I     S            F     T

            0.00     25.00     50.00     75.00    100.00    125.00

X       0.00 *---------+-W-------+---------+---------+---------+
             -
             -
             -
             -
             -   .
       25.00 + ...*
             - .....
             -.......
```

```
             -........
             -.......*
             .........1
A     50.00 .........12
             .........125
             .........113W
             .........8129.
             .........8113.
             ..........4125.
X     75.00 ..........4.115.
             ..........84.115W
             -..........44.1125
             -...........44..111
             -............44..333
             -.............844...
I    100.00 + .............8844.*
             - ..............88.44
             -  ...............888
             -   ................8
             -    ...............
             -    *..*...........*
S    125.00 +    * .*...........*
             -       .....W.......
             -         ...........
             -           .........
             -              ......
             -                 ...
     150.00 +
             -
             -
             -
             -
             -
F    175.00 +
             -
             -
             -
             -
             -
T    200.00 +    *  *    W      *
```

========== DATA SUMMARY ==========



Profile Data

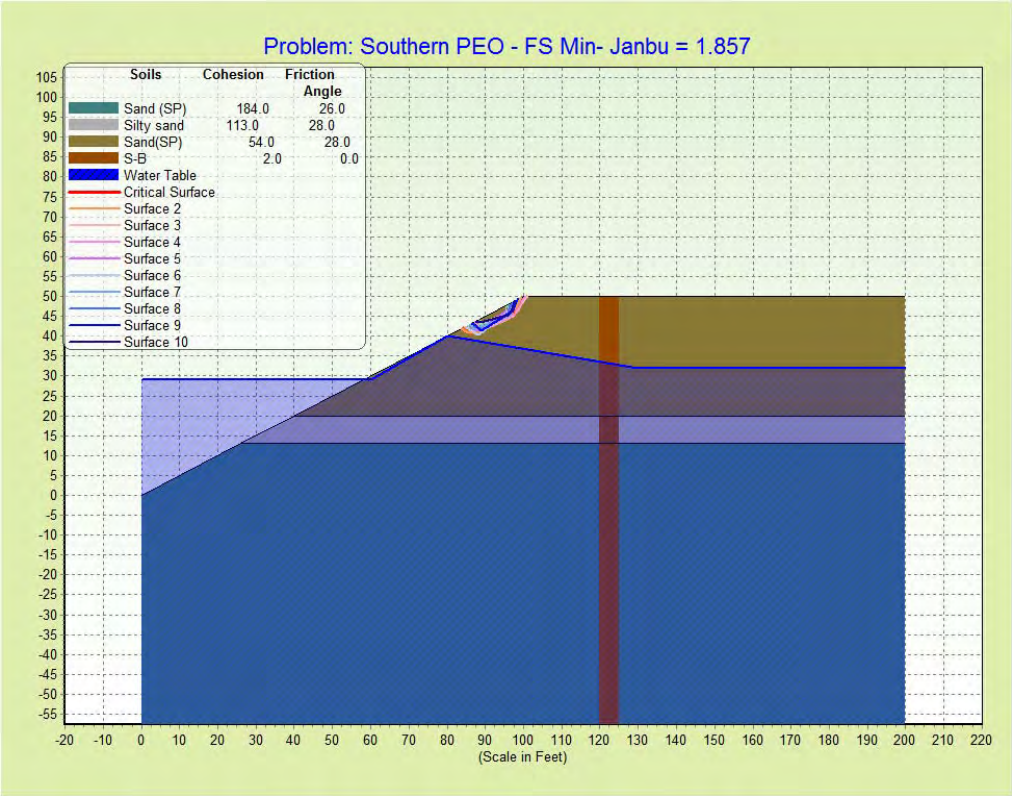
Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	0	26	13	3
2	26	13	40	20	2
3	40	20	100	50	1
4	100	50	120	50	1
5	120	50	125	50	4
6	125	50	200	50	1
7	40	20	120	20	2
8	120	20	125	20	4
9	125	20	200	20	2
10	26	13	120	13	3

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
11	120	13	125	13	4
12	125	13	200	13	3

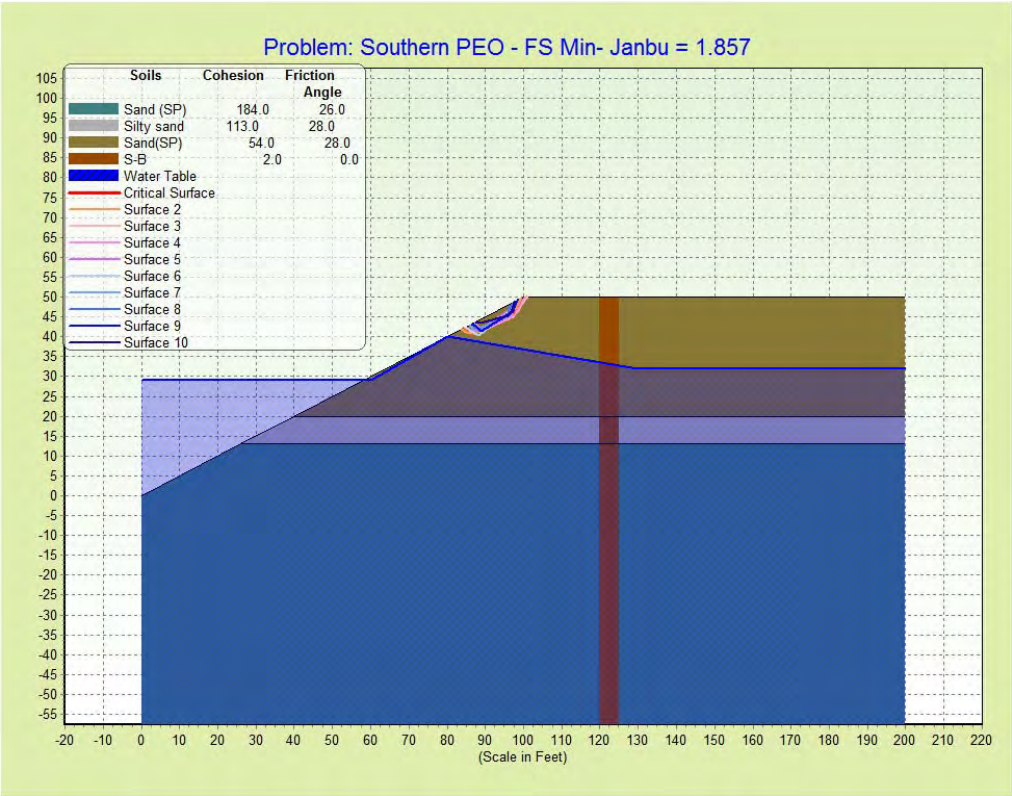
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	111	118	54	28	0	0	1	Sand(SP)
2	110	115	113	28	0	0	1	Silty sand
3	117	125	184	26	0	0	1	Sand (SP)
4	110	120	2	0	0	0	1	S-B

========== All Surfaces Generated ==========



========== 10 Most Critical Surfaces ==========



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Southern PEO

BOUNDARY COORDINATES

6 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	0.00	26.00	13.00	3
2	26.00	13.00	40.00	20.00	2
3	40.00	20.00	100.00	50.00	1
4	100.00	50.00	120.00	50.00	1
5	120.00	50.00	125.00	50.00	4
6	125.00	50.00	200.00	50.00	1
7	40.00	20.00	120.00	20.00	2
8	120.00	20.00	125.00	20.00	4
9	125.00	20.00	200.00	20.00	2
10	26.00	13.00	120.00	13.00	3
11	120.00	13.00	125.00	13.00	4
12	125.00	13.00	200.00	13.00	3

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	111.0	118.0	54.0	28.0	0.00	0.0	1
2	110.0	115.0	113.0	28.0	0.00	0.0	1

3	117.0	125.0	184.0	26.0	0.00	0.0	1
4	110.0	120.0	2.0	0.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	29.00
2	60.00	29.00
3	80.00	40.00
4	130.00	32.00
5	200.00	32.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

20 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 2.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	87.00	41.00	90.00	43.00	3.00
2	95.00	45.00	98.00	47.00	3.00

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	84.17	42.09
2	85.18	41.19
3	87.15	40.83
4	96.72	45.36
5	98.13	46.78
6	99.34	48.37
7	100.75	49.79
8	100.84	50.00

*** 1.857 ***

Individual data on the 8 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.0	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.0	452.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	9.6	3054.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.4	414.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1.2	241.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.7	83.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.7	49.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.62	41.81
2	85.10	41.02
3	87.10	40.89
4	96.31	44.40
5	97.06	46.26
6	98.37	47.76
7	99.32	49.53
8	99.58	49.79

*** 1.934 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.78	42.89
2	86.00	42.79
3	87.47	41.42
4	97.24	45.15

5	98.59	46.63
6	99.61	48.35
7	100.94	49.85
8	101.05	50.00

*** 1.974 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.21	43.60
2	88.10	42.79
3	89.77	41.68
4	97.74	45.47
5	98.72	47.22
6	99.86	48.86
7	100.53	50.00

*** 2.069 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	84.89	42.45
2	86.12	41.58
3	88.11	41.47
4	96.66	47.23
5	97.80	48.88
6	97.84	48.92

*** 2.136 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	84.78	42.39
2	84.79	42.39
3	86.48	41.32
4	88.24	40.36
5	96.56	46.64
6	97.80	48.21

7	98.34	49.17

*** 2.149 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.78	42.89
2	87.08	41.64
3	96.44	45.28
4	97.04	47.19
5	98.44	48.62
6	98.73	49.37

*** 2.264 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	86.53	43.27
2	87.53	42.40
3	89.38	41.64
4	95.92	45.81
5	96.59	47.70
6	97.77	48.88

*** 2.299 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	86.49	43.24
2	87.36	42.64
3	88.82	41.27
4	97.21	46.41
5	97.89	48.29
6	98.70	49.35

*** 2.334 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.42	43.71
2	88.69	43.46
3	95.80	45.19
4	97.06	46.75
5	97.65	48.66
6	97.87	48.93

*** 2.340 ***

1

```
            Y            A     X     I     S            F     T

            0.00     25.00     50.00     75.00    100.00    125.00
X      0.00 *---------+-W-------+---------+---------+---------+
             -
             -
             -
             -
             -
      25.00 +    *
             -
             -
             -
             -       *
             -
A     50.00 +
             -
             -           W
             -
             -
             -
X     75.00 +
             -                W
             -                11
             -                13.
             -                 4
             -                  125
I    100.00 +                    1*
             -
             -
             -
             -
             -    *  *            *
S    125.00 +    *  *            *
             -            W
             -
             -
```

```
                -
                -
        150.00 +
                -
                -
                -
                -
                -
F       175.00 +
                -
                -
                -
                -
                -
T       200.00 +     *   *    W       *
```

Appendix D
Photographs of OPT and Conventional Slurry Wall Construction

CONVENTIONAL SLURRY WALL CONSTRUCTION

ONE-PASS SLURRY WALL CONSTRUCTION

ONE-PASS SLURRY WALL CONSTRUCTION