Subsurface Exploration & Geotechnical Evaluation
Lovettsville Park Retaining Walls
Lovettsville, VA
Specialized Engineering Project No. 125522

Prepared for:

Loudoun County
Department of Construction & Waste Management
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January 5, 2015

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January 5, 2015

LOUDOUN COUNTY
Dept. of Construction & Waste Mgmt.
211 Gibson Street, N. W.
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Attention: Mr. Mark E. Hoffman, PE
Civil Engineer

Reference: Subsurface Exploration and Geotechnical Evaluation
Engineering Services Contract QQ-01683B-4C
LOVETTSVILLE PARK RETAINING WALLS
East Broadway & Lovettsville Road
Lovettsville, Virginia
Specialized Engineering Project No. 125522 (RW)

Dear Mr. Hoffman:

Specialized Engineering is pleased to submit our final report concerning the subsurface exploration and geotechnical evaluation for the proposed Retaining Walls at Lovettsville Park in Lovettsville, Loudoun County, Virginia.

The report explains the exploration procedures, describes the general site and subsurface conditions, and presents evaluations and recommendations relevant to geotechnical considerations for the project. If project characteristics presented in this report are changed, this office should be notified so that the design recommendations may be reviewed and revised, as necessary.

If you have any questions concerning this report or require additional assistance on the project, please do not hesitate to contact us.

Respectfully submitted,
Specialized Engineering

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APPENDICES

1.0 EXECUTIVE SUMMARY

Specialized Engineering has completed the subsurface exploration and geotechnical evaluation of the **PROPOSED RETAINING WALLS AT LOVETTSVILLE PARK** project located in Lovettsville, Loudoun County, Virginia. The subsurface exploration consisted of drilling a total of six (6) test borings, designated RW-1 through RW-6, at the locations shown on Boring Plan. The drilling was extended to depths ranging from 8 feet to 25 feet below existing site grades. Spoon and/or auger refusal was encountered in three (3) of the six (6) borings at depths ranging from 8 feet to 14 feet below the existing ground surface grades.

This geotechnical exploration was performed in general accordance with the "*Detailed Soil/Site Investigation*" of the "*Facilities Standard Manual*" of Loudoun County.

The data developed during this study indicate that the subsoil and groundwater conditions at the site are generally adaptable for the construction of the proposed retaining walls provided the recommendations in the report are followed. The proposed retaining wall can be designed and constructed as segmental retaining walls or as concrete cantilevered retaining walls.

The global stability analyses indicated the minimum geogrid length required to achieve a targeted Factor of Safety (FOS) not less than 1.3 for each of the segmental walls. The actual geogrid reinforcement length should be decided by the wall designer to achieve adequate FOS for external and internal stability of the segmental retaining wall.

The global stability analyses indicated the minimum heal length required to achieve a targeted Factor of Safety (FOS) not less than 1.3 for each of the concrete retaining walls. The actual heal length should be decided by the wall designer to achieve adequate FOS against sliding, overturning and bearing in addition to the structural design of the retaining wall.

It should be noted that global stability analyses of the three proposed retaining walls was based on the provided grading plan. In case the grading plan is changed, the stability analyses should be revised accordingly.

Excavations during the development of the site can generally be achieved with conventional earth-moving equipment (dozers, pans and hoes) to the anticipated excavation depths. However, ripping and/or hoe-ramming of weathered but dense rock may be required in localized areas where equipment refusal was encountered at shallow depths.

Encountering groundwater is not anticipated during the development of this site. However, perched water should be anticipated at different elevations during foundation excavations and installation of underground utilities, especially if the work is performed during wetter months or following prolonged periods of heavy precipitation. It is our

opinion that conventional dewatering measures such as diversion ditches, interceptor drains and sump pumps should be adequate.

Recommendations relative to earthwork and the design and construction of the proposed retaining wall are presented in the report.

The owner/designer should not rely solely upon the executive summary and must read and evaluate the entire contents of this report, prior to utilizing our engineering recommendations in the preparation of design and construction documents.

2.0 PROJECT INFORMATION

2.1 AUTHORIZATION

This subsurface exploration and geotechnical evaluation for **PROPOSED RETAINING WALLS AT LOVETTSVILLE PARK** projects located in the Lovettsville, Virginia, project was planned and performed in accordance with the scope of services outlined in our proposal No. B14-10988 dated November 14, 2014. Mr. Mark E. Hoffman, PE, of Loudoun County authorized the work.

2.2 PROJECT DESCRIPTION

Specialized Engineering competed a subsurface exploration and geotechnical evaluation of the proposed Lovettsville Park project in 2012 (SE Project No. 125522, dated November 7, 2012).

Based on the provided drawings, we understand the project will now include the construction of three retaining walls. Retaining Walls No. 1 and No. 2 are to be located between the Soccer Fields and the proposed Gravel Parking Lot, both a proposed height of up to 9 feet. Retaining Wall No. 3 is to be located on the south side of the park separating the Soccer fields from the adjacent property, with an estimated height of up to 12 feet.

The structural concept and loading conditions for the walls were not provided to us. However, based on past experience with similar projects, we anticipate the retaining walls will either be MSE structures or cantilevered concrete walls.

If any of the noted information is incorrect or has changed, please inform Specialized Engineering so that we may review the geotechnical data and amend the recommendations presented in this report, if appropriate.

2.3 PURPOSE AND SCOPE OF WORK

The scope of services for this study included a site reconnaissance of the project area and the determination of subsurface conditions through field exploration and laboratory testing. The study included an evaluation of the site and subsurface conditions relative to the proposed construction and the preparation of a report of findings. The subsurface exploration was developed to address the following:

- Develop data relative to subsurface soil, rock and groundwater conditions to relevant depths at locations adjacent to the proposed retaining walls.
- An evaluation of the data as it relates to the proposed site development.

- Address problem areas, if any, with special reference to seasonal high water table conditions, shallow rock and the presence of highly plastic soils susceptible to shrinkage and swelling associated with changes in the natural moisture contents of these soils.

- Provide an evaluation of the suitability of on-site materials for use as controlled structural fill behind the retaining walls. Provide recommendations for site preparation, including placement and compaction of fill soils.

- Provide an assessment of the suitability of in-situ soil formations for providing adequate support of retaining walls foundations.

- Evaluate the global stability of the retaining walls targeting a minimum Factor of Safety (FOS) of 1.25.

- Provide geotechnical recommendations related to support the design and construction of the retaining walls.

- Provide IBC 2009 soil site classification and site seismic response coefficients S_s and S_1.

- Comments and recommendations relating to other observed geotechnical conditions, which could impact development.

The scope of our services did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, groundwater, or air, on or below or around this site. Any statements in this report or on the boring logs regarding odors, colors, unusual or suspicious items or conditions are strictly for the information of our client.

Specialized Engineering did not provide any service to investigate or detect the presence of mold, moisture as related to mold or other biological contaminates in or around any structure, or any service that was designed or intended to prevent or lower the risk of the occurrence of the amplification of the same. As such, Specialized Engineering cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.

2.4 SUBSURFACE EXPLORATION

The subsurface exploration consisted of drilling a total of six (6) test borings, designated RW-1 through RW-6, with two test borings adjacent to the location of each of the three retaining walls and as shown on the Boring Plan. The test borings were extended to depths ranging from 8 feet to 25 feet below existing site grades. The test borings were drilled on the site by a track-mounted 7720 drill rig utilizing 2-1/4" I.D. continuous flight hollow-stem augers at the locations shown on the Boring Plan. The drilling was extended to the planned depths of 15 to 25 feet or to spoon/ auger refusal depths. Spoon and/or

auger refusal was encountered in three (3) of the six (6) borings at depths ranging from 8 feet to 14 feet below the existing ground surface grades. The depths of individual test borings are indicated on the boring logs in the appendices of this report.

Specialized Engineering proposed the test borings and established their locations in the field utilizing a handheld GPS unit. Ground surface elevations were interpolated from the provided project site plan. The locations and elevations of the soil test borings, therefore, should be deemed accurate to the degree implied by the method used.

Drilling of the test borings and the associated soil sampling were conducted in accordance with the procedures generally recognized and accepted as standard methods of exploration of subsurface conditions related to earthwork and foundation engineering projects. Representative soil samples were obtained by employing split-spoon sampling procedures in general accordance with ASTM D1586 test method. Soil samples obtained from the borings were identified according to boring number and depths, and a representative portion of each sample was sealed in a moisture-tight glass jar to protect against moisture loss. The soil samples from the test borings were subsequently transported to the Specialized Engineering laboratory for visual classification and further evaluation.

The location of the site and the locations of the individual test borings are shown on the Vicinity Map and Test Boring Location Plans provided in **APPENDIX A**. The findings of the Specialized Engineering test borings are presented on the Test Boring Logs included in **APPENDIX B**.

2.6 LABORATORY TESTING

Our geotechnical engineer visually classified the soil samples in the laboratory in general accordance with ASTM D 2488. Tests for natural moisture content (ASTM D 2216), Atterberg limits (ASTM D 4318), and percent finer than No. 200 sieve (ASTM D 1140) were conducted on representative jar samples. The laboratory test results are presented in **APPENDIX C.**

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 SITE LOCATION AND DESCRIPTION

The Lovettsville Park site is located on the west side of Milltown Road, south of the intersection of Milltown Road and Lovettsville road in Lovettsville, Virginia. Access to the site is from Milltown Road on the east side of the site. The site is currently mostly open fields with some wooded areas along existing fence lines. The site of the proposed retaining wall is located in the southwest portion of the park bounding the proposed soccer fields.

3.2 AREA GEOLOGY

According to the *Geologic Map of Loudoun County Virginia (2006)*, the subject site is located within the Blue Ridge Physiographic Province; specifically within the Mesoproterozoic aged basement rocks that form the core of the Blue Ridge anticlinorium.

Specifically, the eastern half of the site is underlain by biotite granite Gneiss and the western half of the site is underlain by a garnetiferous leucocratic Metagranite. The rocks typically weather to a variable depth of fine-grained residual soils overlying with a relatively abrupt transition to "decomposed rock" (saprolite) or competent rock.

3.3 MAPPED SOILS

Based upon a review of the Loudoun County Soils Map, the following soils are mapped at the project site: Mongle loam, 0-7% slope, Soil Mapping Unit (SMU) 10B; Middleburg silt loam, 1-7% slope, SMU 17B; Purcellville and Tankerville soils, 7-15% slope, SMU 20C; Purcellville Swampoodle Complex, 2-7% slope, SMU 22B; Purcellville silt loam, 2-7% slope, SMU 23B; Eubank loam, 2-7% slope, SMU 28B; and Swampoodle silt loam, 1-7% slope, SMU 38B.

The Mongle loam (SMU 10B) consists of a very deep somewhat poorly drained, loamy to silty soils with seasonal water tables in concave drainage positions; developed in alluvium and colluvium from mixed acid and basic rocks. The depth to bedrock is generally greater than 5 feet and the soils are very poor in terms of percolation. The soils map shows this Class IV W soil only in along a small portion of the in the center of the site along an existing stream.

The Middleburg silt loam (SMU 17B) consists of a very deep, well drained, loamy soils in concave upland positions (swales) with seasonal perched water tables; developed in recent colluvium derived from mixed acid and basic rock. The depth to bedrock is generally greater than 5 feet and the soils are given a poor potential with problems due to short duration water tables. The soils map shows these Class III W soils present in the central and eastern portions of the site

The Purcellville and Tankerville soils (SMU 20C) consists of a complex of very deep, well drained silty Purecelleville soils and moderately deep, well drained loamy soils on convex upland positions; developed in residuum weathered from mixed granite gneiss and meatdiabase rock. The depth to bedrock is generally greater than 6 feet in Purcellville soils and 30 inches in Tankerville soils. The soils have fair potential with the depth to rock less than 60 inches in some areas. The soils map shows this Class II R soils covering areas in the central area and eastern area of the site.

The Purcellville Swampoodle Complex (SMU 22B) consists of a complex of very deep, well drained silty Purcellville soils and very deep, moderately drained silty Swampoodle soils in broad, nearly level to concave upland positions; developed in residuum weathered from mixed granite gneiss and metadiabase rock. These soils have a fair potention with problems due to shallow seasonal water tables. The soils map shows these Class II WP soils present in the western area of the site.

The Purcellville silt loam (SMU 23B) consists of a very deep, well drained silty to loamy soil on undulating and gently sloping uplands; developed in residuum weathered from mixed granite gneiss and metabiabase. These soils are classified with a good potential (Class I) and are present on the higher elevations at the site.

The Eubank loam (SMU 28B) consists of a very deep, well drained loamy soil on undulating and gently sloping uplands; developed in residuum weathered from mixed gneiss, metadiabase, and other metamorphosed granite rocks. These soils are classified with a good potential (Class I) and are present on the higher elevations at the northeast corner of the site.

The Swampoodle silt loam (SMU 38B) consists of very deep, moderately well drained silty soils with seasonal water tables in broad, nearly level to concave upland positions; developed in residuum derived from mixed acid and basic rocks. The depth to bedrock is generally greater than 5 feet and the soils are classified with a poor potential due to a seasonal high water table and areas of shrink-swell clays. The soils map shows this Class IV WP soil in a limited area on the western portion of the site.

A soil map, scale 1: 200, of the proposed site is included in **APPENDIX A**.

3.4 SUBSOIL CONDITIONS

Approximately9 to 12 inches of topsoil was encountered at the location of six (6) test borings drilled. Below the topsoil, two (2) natural soil/rock strata representative of the underlying geologic formation were encountered in the test borings. The two (2) natural soil/rock strata are briefly described hereunder:

STRATUM I – RESIDUAL SOILS

Stratum I was encountered below the topsoil in all six (6) test borings drilled and extended to depths ranging from 8 feet to 24 feet below existing surface grades. The residual soils of this stratum generally consist of brown, reddish brown and grayish brown, micaceous silty sands, sandy silts and silty clay (USCS Designations: ML, SM and CL) with rock fragments.

The Standard Penetration test (SPT) "N" values within the soils of Stratum I ranged from 3 blows per foot (bpf) to 53 bpf, with higher values likely due to the presence of rock fragments. The N-values encountered within the granular soils of this stratum generally indicate that the relative densities ranging from medium dense to dense. The

N-values encountered within the clayey soils, which were located close to ground surface, generally indicate soft consistency.

A summary of the results of the laboratory tests performed on representative soil samples from this stratum is presented in **APPENDIX C**.

STRATUM II – DECOMPOSED TO WEATHERED ROCK

Decomposed to weathered rock was encountered, below the soils of Stratum I in four (4) of the six (6) test borings and extended to auger refusal at a depth of 13.5 feet or to boring termination depths varying from 15 feet to 25 feet below existing surface grades.

Decomposed rock is generally considered to be a soil like material with SPT N-values in excess of 60 bpf. When removed via the sampling apparatus they are generally given soil composition classifications; however, in situ the materials are very dense rock-like to rock materials. The Standard Penetration tests within the decomposed to weathered rock of Stratum II resulted in (SPT) "N" values generally ranging from 61 bpf to 50 blows per 2 inches of penetration.

Weathered rock is usually denser material than the 50 blows per one inch penetration. Spoon and/or auger refusal, which generally defines rock/bedrock, was encountered in three (3) of the six (6) borings at depths ranging from 8 feet to 14 feet below the existing ground surface grades.

The description of subsurface conditions presented above is of a generalized nature, provided to highlight the major soil strata encountered. The test boring logs included in the appendix should be reviewed for specific information regarding the individual test locations. The stratification lines shown on the test boring logs represent the conditions only at the actual test locations. Variations may occur and should be expected between test locations. The stratification lines represent the approximate boundary between subsurface materials and the actual transition may be gradual.

3.5 GROUNDWATER CONDITIONS

Groundwater was not encountered during the drilling operations in any of the six (6) test borings drilled. Due to safety concerns, the test borings were backfilled immediately upon completion of drilling and accordingly the 24-hour groundwater level readings were not obtained. Cave-in depth in the borings ranged from 5 to 20 feet below existing grades.

The groundwater observations presented in this report were recorded at the time of our field activities. Fluctuation in groundwater levels should be anticipated. We recommend that the Contractor determine the actual groundwater levels at the time of construction to determine groundwater impact on the proposed construction procedure.

4.0 GEOTECHNICAL EVALUATION

4.1 GLOBAL STABILITY ANALYSES

The global stability of the three proposed retaining walls were analyzed at the most critical cross section of each wall which represent the highest part of the wall.

The slope stability analysis, on each of the cross sections above, was performed utilizing GSTABL7, which incorporates STEDwin. GSTABL7 is a 2-dimensional, limit equilibrium slope stability program based upon the original PCSTABL6-1986, developed by Purdue University. STEDwin is a Windows®-based pre- and post-processor for STABL6H and other derivations of PCSTABL6 1986. The program is utilized to generate potential failure circles with randomly selected radii and centers. The safety factors were calculated using the modified Bishop method.

The slope stability analyses were performed on the selected critical section of each retaining wall, utilizing selected conservative soil parameters and groundwater scheme based on the findings of the test borings. The slope stability analysis was performed targeting a Factor of Safety (FOS) of 1.3 for Global Stability. The location of each selected cross section is shown on the site plan included in **APPENDIX A** The detailed CADD-drawn cross-sections and the computer output of the stability analysis of the section and the plot indicating the ten (10) most critical failure circles with their corresponding factors of safety are included in **APPENDIX D**.

The results of the global stability analyses are summarized in the following tables:

Table 1- SEGMENTAL RETAINING WALLS

Retaining Wall	Max. Wall Height (feet)	FOS	Remarks (Conditions required to achieve FOS)
No. 1	9	1.43	Minimum Geogrid length is 6 feet
No. 2	9	1.59	Minimum Geogrid length is 7 feet
No. 3	12	1.44	Minimum Geogrid length is 7 feet

Note: The minimum geogrid lengths listed in the table are required to achieve an acceptable factor of safety (FOS) for the global stability of the retaining wall. However, the other conditions of external stability of the segmental retaining wall, such as overturning or sliding, may require a longer geogrid in order to achieve acceptable FOS for each case.

Table 2- CONCRETE RETAINING WALLS

Retaining Wall	Max. Wall Height (feet)	FOS	Remarks (Conditions required to achieve FOS)
No. 1	9	1.55	Minimum heel length of 3 feet at depth of 2.5 feet
No. 2	9	1.57	Minimum heel length of 3 feet at depth of 2.5 feet
No. 3	12	1.48	Minimum heel length of 3 feet at depth of 2.5 feet

Note: The depth of 2.5 feet is required for frost depth. However, the minimum heal length specified above is required to achieve the targeted FOS for global stability of the retaining wall. The actual length should be decided by the wall designer to achieve adequate FOS against sliding, overturning and bearing.

4.2 GENERAL EVALUATION

The data developed during this study indicate that the subsoil and groundwater conditions are generally suitable for the three (3) proposed retaining walls provided the recommendations presented hereafter are followed.

The proposed retaining walls can be designed and constructed as segmental retaining walls with face elements and geogrid reinforcements or as conventional cantilever concrete retaining walls.

Shallow foundations of the retaining walls are considered adequate for the support of the proposed retaining walls. The footings should be supported on the undisturbed, suitable-bearing natural soils of Stratum I, except moderately to highly plastic clays and elastic silts (LL>40 and PI>20) if encountered, or on controlled structural fill placed on suitable natural soils.

Excavations during the development of the site can generally be achieved with conventional earth-moving equipment (dozers, pans and hoes) to the anticipated shallow excavation depths. However, ripping and/or hoe-ramming of weathered but dense rock may be required in localized areas where the recorded N-values were 50 blows for a penetration of 6 inches or less and where equipment refusal was encountered at shallow depths. Ripping, hoe-ramming or blasting of dense rock may be needed at isolated locations during the excavations for deeper sections of utility lines.

Encountering groundwater is not anticipated during the development of this site. However, perched water should be anticipated at different elevations during foundation excavations and installation of underground utilities, especially if the work is performed during wetter months or following prolonged periods of heavy precipitation. It is our opinion that conventional dewatering measures such as diversion ditches, interceptor drains and sump pumps should be adequate.

The soils of Stratum I and Stratum II, except layers of soils with LL>40 and PI>20, may be suitable for use in engineered fills, subject to moisture adjustment and approval of the Geotechnical Engineer of Record.

5.0 RECOMMENDATIONS

5.1 RETAINING WALL DESIGN (SEGMENTAL)

For the Segmental Retaining Wall (SRW), supported on suitable natural soils of Stratum I or controlled structural fill prepared in accordance with Section 5.3 "Site Preparation and Earthwork", the design should be governed by the following parameters:

- The design lateral pressures should be based upon the following parameters:

Angle of Internal Friction (ϕ)	= 28°
Bulk Unit Weight (γ_{bulk})	= 122 pcf
Active Coefficient of Earth Pressures, K_a:	= 0.36
Passive Coefficient of Earth Pressures, K_p	= 2.80

- Surcharge loading from adjacent structures, and back slopes, if any, should be taken into account when designing the walls.

- The allowable bearing pressures for gravity retaining wall systems bearing on the firm natural soils of Stratum I of structural fill placed under controlled conditions are estimated to be on the order of 2,500 pounds per square foot.

- The footing subgrade of the wall should be embedded at least 8 inches or deeper as recommended by the wall designer and segmental unit manufacturer.

- Appropriate drainage measures should be provided behind the walls as determined by the wall designer.

- Based on the results of the global stability analyses, the minimum length of geogrids for segmental walls shall be 6 feet for RW-1 and 7 feet for RW-2 and RW-3.

- The backfill for the retaining wall is to be composed of controlled granular soils, and benched into the natural soils behind the wall.

- Fill placed behind the retaining walls should be compacted to at least ninety five percent (95%) of the maximum dry density as per ASTM D698 test method. The moisture content of the subgrade soils should be within plus or minus two (±2) percentage points of the optimum moisture content.

- Heavy compaction and construction equipment should not operate closer than 5 feet to the walls, so as not to impose additional pressure on the walls and reduce the potential for causing damage to the walls. Small vibratory rollers, such as hand held tampers or walk-behind rollers should be used to compact the fill in the vicinity to the walls.

5.2 RETAINING WALL DESIGN (CANTILEVER)

If any of the retaining walls are to be constructed as a reinforced concrete cantilever walls, the wall design should be governed by the following parameters:

- The footing subgrade of the wall should be embedded at least 2.5 feet below the finished grades in front of the wall for frost heave protection.

- Soils classified as sandy silt/silty sand (ML/SM) can be used to backfill the retaining wall in the retained fill area. The Liquid Limit (LL) and Plasticity Index (PI) of the material should not exceed 40 and 12, respectively.

- If the soils conforming to the above requirements are used to backfill the walls (retained fill), the design lateral earth pressures should be based upon the following parameters:

Angle of Internal Friction (ϕ)	= 28°
Bulk Unit Weight (γ_{bulk})	= 120 pcf'
Coefficient of Earth Pressures:	
Active, K_a	= 0.36
Passive, K_p	= 2.80

Alternatively, an equivalent fluid pressure value could be used to estimate the lateral earth pressure:

Equivalent Fluid Pressure	= k_a x γ_{bulk}
(Active Conditions)	= 45H* psf

H* is the height of the retaining wall.

A friction factor of 0.35 should be used for wall foundation/soil sliding.

- Surcharge loading from adjacent structures, and back slopes, if any, should be taken into account when designing the walls.

- The allowable bearing pressures for gravity retaining wall systems bearing on the firm natural soils of Stratum I or structural fill placed under controlled conditions are estimated to be on the order of 2,500 pounds per square foot.

- Appropriate drainage measures should be provided behind the wall as determined by the wall designer.

- Fill against the retaining wall should be compacted to a minimum of 95 percent of the maximum dry density per AASHTO T-99 or ASTM D-698.
- Heavy compaction and construction equipment should not operate closer than 5 feet to the wall, so as not to impose additional pressure on the wall and reduced the potential for causing damage to the wall. Small vibratory rollers, such as hand held tampers or walk-behind rollers should be used to compact the fill in the vicinity to the wall

5.3 SITE PREPARATION AND EARTHWORK

The following recommendations are intended for the satisfactory performance of the earthwork that may be involved to attain the planned grades across the site.

- Areas to support the retaining walls should be stripped of any vegetation and topsoil. The depth of this excavation is expected to range from approximately 6 inches to 10 inches and may differ at the other unexplored areas of the site. The average thickness of the topsoil in this farm field is estimated to be on the order of one foot.

  Soft/loose soil, root mats and moderately to highly plastic soils with LL>40 and PI>20, wherever encountered near the planned grades, should be undercut to a suitable undisturbed subgrade as recommended by the Geotechnical Engineer of Record.

  If highly plastic soils (LL>40 and PI>20) are encountered at and below the planned subgrade elevations of the pavements for drive lanes and parking areas, the upper 2 feet of the moderately to highly plastic soils (LL>40 and PI>20), should be excavated and replaced with engineered fill consisting of approved soils.

- Following the stripping and excavation of all unsuitable materials, grading operations may proceed. Prior to fill placement, the site should be observed by the Geotechnical Engineer of Record or his qualified representative for proper stripping and preparation for receiving the fill.

- The bottom of the stripped areas should be proof rolled in the presence of the Geotechnical Engineer of Record with at least two (2) passes of a loaded dump truck that has a minimum axle load of 10 tons or similar equipment. All loose and soft areas should be excavated to suitable-bearing subgrade. The excavated materials should be replaced with soils satisfying the controlled fill requirements detailed later in this report. The excavated fills should be evaluated for suitability to be reused by the Geotechnical Engineer of Record or his qualified representative.

- Controlled structural fill placement required to achieve the planned grades within the building pad should extend laterally on all sides beyond the building footprint a minimum distance of 10 feet at the building pad subgrade elevations. The edge of the fill should be placed at a maximum slope of 1H: 1V. The building pads should be prepared by excavation or by placing controlled structural fill to an elevation 10 inches below the floor level of slabs-on-grade. The footings should be excavated after the building areas have been properly prepared.

- Material satisfactory for controlled structural fill should include clean soil or bankrun sand and gravel (GW, GM, and SM). GC and SC materials may be used provided that the density and the liquid limit and plasticity index of the finer fraction of the material satisfy the following limitations:

Maximum Dry Density	$\geq$ 105 pcf
Liquid Limit (%)	$\leq$ 40
Plasticity Index	$\leq$ 20

  CL and ML materials satisfying the above requirements and limitations may be used with approval of the Geotechnical Engineer of Record. Highly plastic clays and elastic silts (MH, CH) should not be used as controlled fill. The fill materials should be free from topsoil, organics and rock fragments having a major dimension greater than 3 inches.

- The excavated soils of Stratum I and II, except soils with LL>40 and PI>20, may be suitable for reuse in controlled structural fill, subject to the approval Geotechnical Engineer of Record and moisture adjustments and the maximum dry density requirement specified above. Moisture conditioning of on-site material should be anticipated.

- Fill placement should be in a maximum 8-inch thick, loose, horizontal lifts compacted uniformly with the proper equipment.

- Structural fill shall be compacted to at least 95 percent of the maximum dry density as determined by ASTM D698 (Standard Proctor). Moisture content of the compacted fill shall be within plus or minus two (±2) percentage points of the optimum moisture content.

For proper site preparation, the earthwork should be performed under the supervision of and to the satisfaction of the Geotechnical Engineer of Record.

5.4 SEISMIC CONSIDERATIONS

Based on the subsurface conditions encountered at the site, structural design shall use the following site coefficients for seismic design based on Section 1615 of the International Building Code (2012):

Seismic Site Class	D
Spectral response acceleration at short periods, S_s	0.16
Spectral response acceleration at 1-second period, S_1	0.051
Site coefficient, F_a	1.6
Site coefficient, F_v	2.4

Based on information obtained from our soil test borings and our review and knowledge of local geology, it is our opinion that the potential for liquefaction of the soils at the site due to earthquake activity is relatively low.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 CONSTRUCTION QUALITY CONTROL

To assess that the in-situ soil conditions or those developed during the construction are as anticipated during the design stage, construction control, continuous observation and testing are recommended as follows:

- Potential areas of cut to be used as fill should be sampled and compared to the Standard Proctor, to determine, what if any moisture conditioning is required.

- Controlled fill placement for the retaining walls should be monitored by the soils technician under the overall supervision of the Geotechnical Engineer of Record.

6.2 RESPONSIBILITY OF DEVELOPER

Review and approval of plans, specifications, and reports by Loudoun County and the Town of Lovettsville with or without recommendations, should in no way relieve the developer of the responsibility for the design, construction and performance of the structures and pavements on the project and damage to surrounding properties.

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, Part 1926, Subpart P". This document was issued to better allow for the safety of workers entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavations or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the Contractor could be liable for substantial penalties.

The Contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The Contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the Contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in all local, state, and federal safety regulations.

We are providing this information solely as a service to our client. Specialized Engineering does not assume responsibility for construction site safety or the Contractor's or other parties' compliance with local, state, and federal safety or other regulations.

6.4 CONSTRUCTION OBSERVATIONS

All development and construction work should be performed under the observation of the Geotechnical Engineer or his qualified representative or the Town or County staff.

7.0 REPORT LIMITATIONS

The recommendations submitted are based on the available subsurface information obtained by Specialized Engineering and preliminary project information furnished by Loudoun County for the proposed project. The sole purpose of this exploration is to determine an appropriate foundation design recommendation. Recommendations contained in this report are based on findings from the relatively limited number of test borings performed. Specialized Engineering's Professional staff may have adjusted the scope of work proposed based on field conditions, equipment capabilities', client schedule, or any other factor during the course of design. The work adjustments may have been relocation of borings or probes, adjustments in depth of borings or probes, addition or deletion of scope items as deemed prudent at the time of the exploration. Variations in soil conditions between the borings may not become evident until construction. If deviations from the subsurface conditions noted in this report are encountered during construction, that may change the geotechnical foundation recommendation, Specialized Engineering should be notified immediately to determine if changes in the foundation recommendations are required. If Specialized Engineering is not retained to perform these functions, we will not be responsible for the impact of those conditions on the geotechnical recommendations for the project.

Specialized Engineering's findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No warranties are implied or expressed.

After the plans and specifications are more complete, Specialized Engineering should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the

design documents. At that time, it may be necessary to submit supplementary recommendations, or perform additional exploration.

The opinions, conclusions and recommendations expressed in this report are based upon the subsurface conditions revealed by our field exploration, laboratory testing, and the result of analyses and studies performed for this project, based on our professional engineer's interpretation. We are not responsible for interpretations of our findings, or data contained within the report, by others. We recommend the project specification contain a statement indicating that this report is for informational purposes only and should not be considered part of the contract documents. The data contained in this report may not be adequate for the contractor's purposes; the contractor should make his own tests and analyses prior to bidding. The contractor may not rely on this report to assess field conditions other than the proposed design recommendation. Field conditions may be much more difficult that the contractor anticipates.

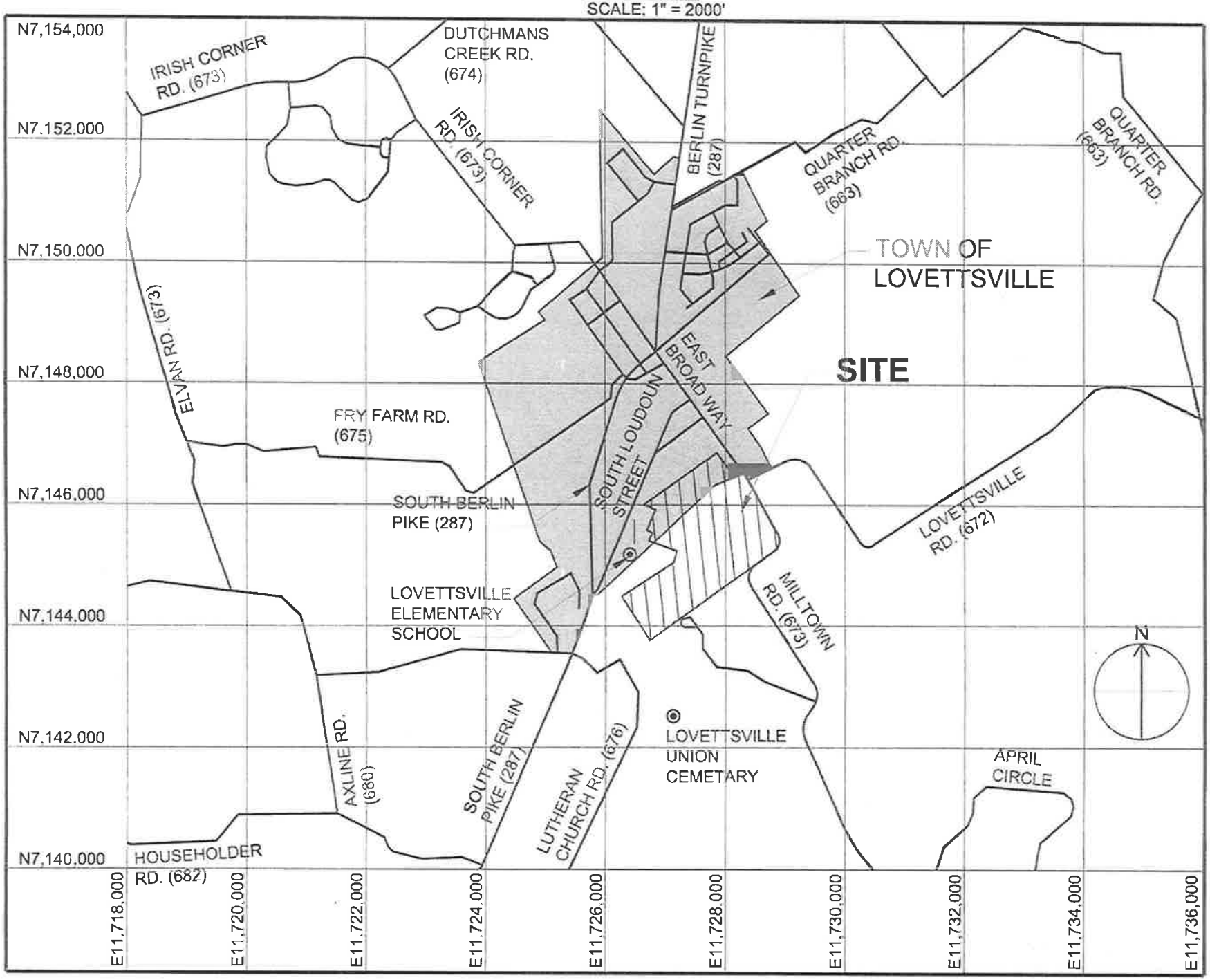
This report has been prepared for the exclusive use of Loudoun County and their engineering consultants to aid in the evaluation of this site and to assist in the design of the **PROPOSED RETAINING WALLS AT LOVETTSVILLE PARK** project located in the Lovettsville, Loudoun County, Virginia.

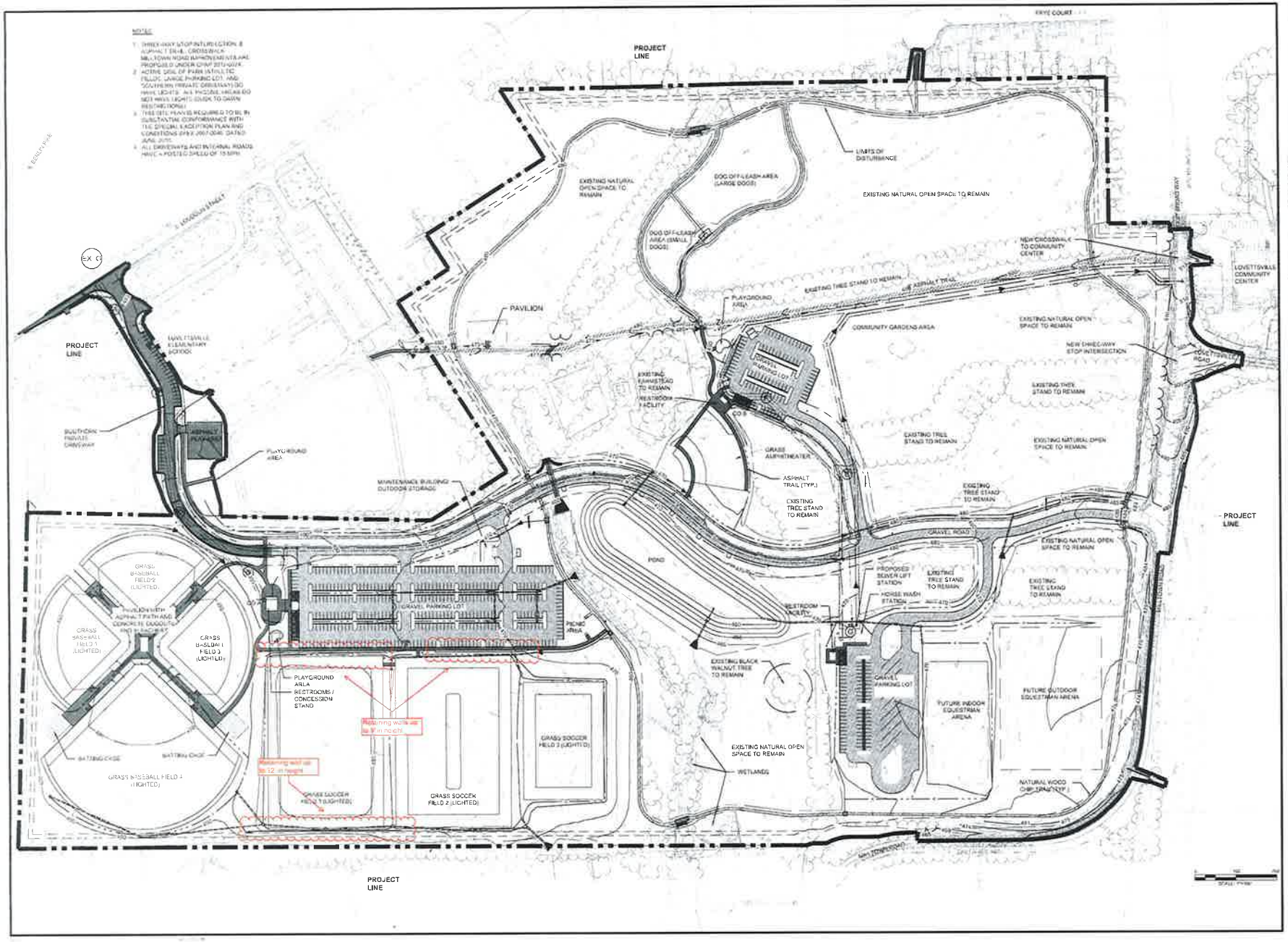
APPENDIX A

VICINITY MAP & TEST BORING LOCATION PLAN


672
12565 Milltown Rd, Lovett
673
S Loudoun St
Image © 2012 Commonwealth of Virginia

VICINITY MAP
SCALE: 1" = 2000'





LOUDOUN COUNTY VIRGINIA 1757

LSY

LSY ARCHITECTS ATKINS

DEPT OF TRANSP 601 SYCOLIN ROAD LEESBURG VA 20175

1102.04 MARK HOFFMAN PERMIT 09-16-14

N

LOVETTSVILLE COMMUNITY PARK SITE PLAN

CATOCTIN ELECTION DISTRICT LOUDOUN COUNTY VIRGINIA

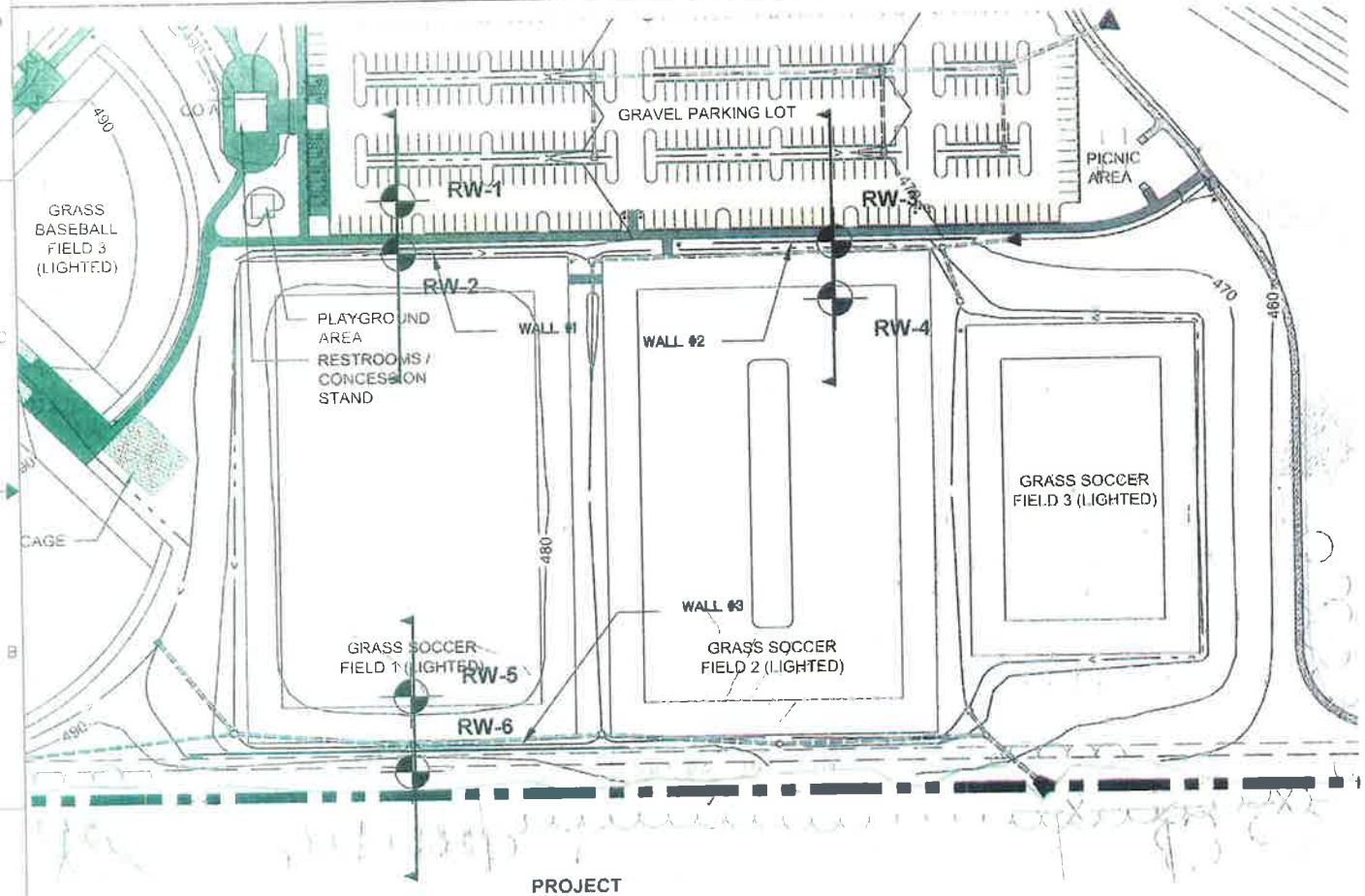
OVERALL SITE PLAN

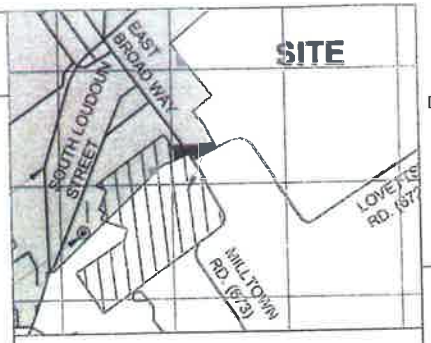
COMMONWEALTH OF VIRGINIA GEORGE EDWARD CLARK, IV Lic. No 042003 09/12/14 PROFESSIONAL ENGINEER

GEC
RJB / JB
EB / WJ
05-12-2014

CS1.00

17 OF 124
SHEET NUMBER





VICINITY MAP
Scale 1" = 2000'

LEGEND

- BORING LOCATION

- WALL PROFILE LOCATION

LOVETTSVILLE PARK - RETAINING WALLS
SPECIALIZED ENGINEERING PROJECT NO.: 125522
12565 MILLTOWN ROAD
LOVETTSVILLE, VA

SPECIALIZED ENGINEERING
Construction Quality & water/environmental Consulting
Geotechnical & Forensic Engineering
484-B International Blvd. Suite 104 Frederick, Maryland 21701
Phone: 301-695-4190 Fax: 301-662-8122

NO.	DATE	REVISIONS	BY	CHK	APP'D
0	01/07/15	ISSUED FOR USE	ILH	DSS	DSS

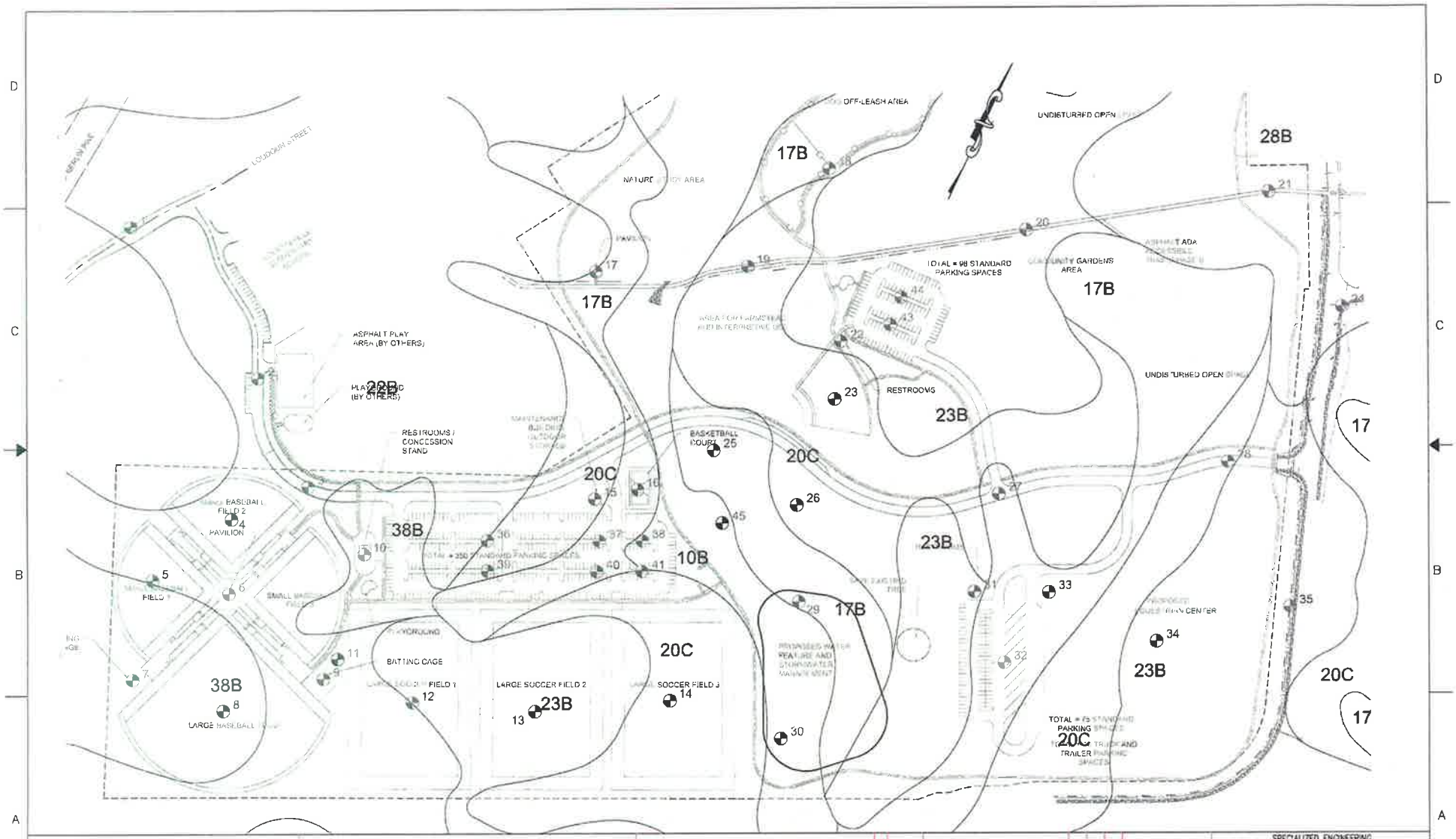
SCALE 1" = 100' DESIGNED GRAWN NAN

SPECIALIZED ENGINEERING
FREDERICK, MD

BORING LOCATION PLAN

JOB NO.	DRAWING NUMBER	REV
125522	125522-RW	0

11 x 17



LOVETTSVILLE PARK
SPECIALIZED ENGINEERING PROJECT NO.: 125522
12565 MILLTOWN ROAD
LOVETTSVILLE, VA

SPECIALIZED ENGINEERING
Construction Quality Control • Environmental Consulting
Geotechnical & Forensic Engineering
4845 International Dr, Suite 104, Frederick, Maryland 21703
Phone 301-607-4180 Fax 301-662-6122

NO.	DATE	REVISIONS	BY	CHK	APP'D
0	08/17/12		ELM	DSS	DSS

SCALE 1" = 200' DESIGNED DRAWN: MAN

SPECIALIZED ENGINEERING
HANOVER, MD

SOILS MAP

PROJ. NO.	DRAWING NUMBER	REV
125522	125522-01	0

11 x 17 "D" SIZE

APPENDIX B

TEST BORING LOGS

SPECIALIZED ENGINEERING

Construction Quality Control • Environmental Consulting
Geotechnical & Forensic Engineering

BORING NUMBER RW-1

CLIENT Loudoun County
PROJECT NUMBER 125522
DATE STARTED 12/22/14 **COMPLETED** 12/22/14
DRILLING CONTRACTOR Connelley and Associates Inc.
DRILLING METHOD HSA
LOGGED BY I. Helms **CHECKED BY** Al Nouri
NOTES Cave-in depth upon completion:

PROJECT NAME Lovettsville Park Retaining Walls
PROJECT LOCATION Lovettsville, VA
GROUND ELEVATION 478 ft **HOLE SIZE** 2.25 in.
GROUND WATER LEVELS:
AT TIME OF DRILLING None
AT END OF DRILLING None
AFTER DRILLING Backfilled upon completion

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	SAMPLE DEPTH (ft)	RECOVERY %	BLOW COUNTS (N VALUE)	% < #4 SIEVE	% < #200 SIEVE	▲ SPT N VALUE ▲ PL MC LL 20 40 60 80
			TOPSOIL (11")	SS S-1	0.0 1.5	78	WOH-1-2 (3)			
			LEAN CLAY: reddish brown, moist, very soft, (CL)							
475			**SILTY SAND**: grayish brown, moist, medium dense to dense, (SM)	SS S-2	2.5 4.0	100	4-7-13 (20)			
	5			SS S-3	5.0 6.5	89	15-17-20 (37)			
470				SS S-4	8.5 9.3	89	23-50/3"			>>
	10		**DECOMPOSED ROCK**: grayish brown, very dense							
465			Auger refusal at 13.5 ft End of boring at 13.5 feet.							

BORING NUMBER RW-2

SPECIALIZED ENGINEERING
Construction Quality Control • Environmental Consulting
Geotechnical & Forensic Engineering

CLIENT Loudoun County
PROJECT NUMBER 125522
DATE STARTED 12/22/14 **COMPLETED** 12/22/14
DRILLING CONTRACTOR Connelley and Associates Inc.
DRILLING METHOD HSA
LOGGED BY I. Helms **CHECKED BY** Al Nouri
NOTES Cave-in depth upon completion:

PROJECT NAME Lovettsville Park Retaining Walls
PROJECT LOCATION Lovettsville, VA
GROUND ELEVATION 478 ft **HOLE SIZE** 2.25 in.
GROUND WATER LEVELS:
AT TIME OF DRILLING None
AT END OF DRILLING None
AFTER DRILLING Backfilled upon completion

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	SAMPLE DEPTH (ft)	RECOVERY %	BLOW COUNTS (N VALUE)	% < #4 SIEVE	% < #200 SIEVE	▲ SPT N VALUE ▲ PL MC LL 20 40 60 80
			TOPSOIL (9")	SS S-1	0.0 1.5	67	1-1-2 (3)			
			LEAN CLAY: reddish brown, moist, very soft, (CL)							
475			**SILTY SAND**: brown and reddish brown, moist, dense, (SM)	SS S-2	2.5 4.0	100	13-18-20 (38)	100.0	48.3	
	5			SS S-3	5.0 6.5	100	10-18-24 (42)			
470			Hard drilling below 7 ft Auger refusal at 8 ft End of boring at 8.0 feet.							

GEOTECH BH PLOTS 125522 LOVETTSVILLE PARK RETAINING WALLS.GPJ GINT US.GDT 1/7/15

BORING NUMBER RW-3

SPECIALIZED ENGINEERING
Construction Quality Control • Environmental Consulting
Geotechnical & Forensic Engineering

CLIENT Loudoun County
PROJECT NUMBER 125522
DATE STARTED 12/22/14 **COMPLETED** 12/22/14
DRILLING CONTRACTOR Connelley and Associates Inc.
DRILLING METHOD HSA
LOGGED BY I. Helms **CHECKED BY** Al Nouri
NOTES Cave-in depth upon completion:

PROJECT NAME Lovettsville Park Retaining Walls
PROJECT LOCATION Lovettsville, VA
GROUND ELEVATION 471 ft **HOLE SIZE** 2.25 in.
GROUND WATER LEVELS:
AT TIME OF DRILLING None
AT END OF DRILLING None
AFTER DRILLING Backfilled upon completion

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	SAMPLE DEPTH (ft)	RECOVERY %	BLOW COUNTS (N VALUE)	% < #4 SIEVE	% < #200 SIEVE	▲ SPT N VALUE ▲ PL MC LL 20 40 60 80
470			**TOPSOIL (12")**	SS S-1	0.0 1.5	78	1-1-2 (3)			
			LEAN CLAY: reddish brown, moist, very soft, (CL)							
			SANDY SILT: dark brown, moist, very dense to medium dense, (ML)	SS S-2	2.5 4.0	78	24-30-31 (61)			
	5			SS S-3	5.0 6.5	100	13-13-14 (27)			
465										
			SILTY SAND: gray and brown, moist, dense, (SM)	SS S-4	8.5 10.0	100	13-18-18 (36)			
	10									
460			Hard drilling below 12 ft							
			Auger refusal at 14 ft							
			End of boring at 14.0 feet.							

SPECIALIZED ENGINEERING

Construction Quality Control • Environmental Consulting
Geotechnical & Forensic Engineering

BORING NUMBER RW-4

CLIENT Loudoun County
PROJECT NUMBER 125522
DATE STARTED 12/22/14 **COMPLETED** 12/22/14
DRILLING CONTRACTOR Connelley and Associates Inc.
DRILLING METHOD HSA
LOGGED BY I. Helms **CHECKED BY** Al Nouri
NOTES Cave-in depth upon completion:

PROJECT NAME Lovettsville Park Retaining Walls
PROJECT LOCATION Lovettsville, VA
GROUND ELEVATION 474 ft **HOLE SIZE** 2.25 in.
GROUND WATER LEVELS:
AT TIME OF DRILLING None
AT END OF DRILLING None
AFTER DRILLING Backfilled upon completion

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	SAMPLE DEPTH (ft)	RECOVERY %	BLOW COUNTS (N VALUE)	% < #4 SIEVE	% < #200 SIEVE	▲ SPT N VALUE ▲ PL MC LL 20 40 60 80
			TOPSOIL (9")	SS S-1	0.0 1.5	11	1-1-2 (3)			
			SILTY SAND: brown and gray, moist, loose, (SM)	SS S-2	2.5 4.0	100	6-9-12 (21)			
470	5		**SANDY SILT**: dark brown, moist, medium dense, (ML)	SS S-3	5.0 6.5	100	7-10-16 (26)			H
465	10		**SILTY SAND**: dark brown, moist, dense, (SM)	SS S-4	8.5 10.0	100	18-18-17 (35)			
460			**DECOMPOSED ROCK**: brown, very dense	SS S-5	13.5 14.2	100	42-50/2"			>>
			End of boring at 14.3 feet.							

BORING NUMBER RW-5

SPECIALIZED ENGINEERING
Construction Quality Control • Environmental Consulting
Geotechnical & Forensic Engineering

CLIENT Loudoun County
PROJECT NUMBER 125522
DATE STARTED 12/22/14 **COMPLETED** 12/22/14
DRILLING CONTRACTOR Connelley and Associates Inc.
DRILLING METHOD HSA
LOGGED BY I. Helms **CHECKED BY** Al Nouri
NOTES Cave-in depth upon completion:

PROJECT NAME Lovettsville Park Retaining Walls
PROJECT LOCATION Lovettsville, VA
GROUND ELEVATION 498 ft **HOLE SIZE** 2.25 in.
GROUND WATER LEVELS:
AT TIME OF DRILLING None
AT END OF DRILLING None
AFTER DRILLING Backfilled upon completion

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	SAMPLE DEPTH (ft)	RECOVERY %	BLOW COUNTS (N VALUE)	% < #4 SIEVE	% < #200 SIEVE	▲ SPT N VALUE ▲ PL MC LL 20 40 60 80
			TOPSOIL (13")	SS S-1	0.0 1.5	72	WOH-1-3 (4)			
495			**SILTY SAND**: grayish brown, moist, loose to medium dense, (SM)	SS S-2	2.5 4.0	89	3-3-6 (9)	100.0	45	
	5			SS S-3	5.0 6.5	89	4-5-6 (11)			
490				SS S-4	8.5 10.0	100	5-5-8 (13)			
	10									
485			**SANDY SILT**: brown, moist, medium dense, (ML)	SS S-5	13.5 15.0	100	10-12-13 (25)			
	15									
480			**DECOMPOSED ROCK**: light grayish brown, very dense	SS S-6	18.5 19.9	88	24-40-50/5"			>>
	20									
475				SS S-7	23.5 24.3	100	39-50/4"			>>
			End of boring at 24.4 feet.							

GEOTECH BH PLOTS 125522 LOVETTSVILLE PARK RETAINING WALLS.GPJ GINT US.GDT 1/7/15

BORING NUMBER RW-6

SPECIALIZED ENGINEERING
Construction Quality Control • Environmental Consulting
Geotechnical & Forensic Engineering

CLIENT Loudoun County
PROJECT NUMBER 125522
DATE STARTED 12/22/14 **COMPLETED** 12/22/14
DRILLING CONTRACTOR Connelley and Associates Inc.
DRILLING METHOD HSA
LOGGED BY I. Helms **CHECKED BY** Al Nouri
NOTES Cave-in depth upon completion:

PROJECT NAME Lovettsville Park Retaining Walls
PROJECT LOCATION Lovettsville, VA
GROUND ELEVATION 499 ft **HOLE SIZE** 2.25 in.
GROUND WATER LEVELS:
AT TIME OF DRILLING None
AT END OF DRILLING None
AFTER DRILLING Backfilled upon completion

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	SAMPLE DEPTH (ft)	RECOVERY %	BLOW COUNTS (N VALUE)	% < #4 SIEVE	% < #200 SIEVE	▲ SPT N VALUE ▲ PL MC LL 20 40 60 80
			TOPSOIL (11")	SS S-1	0.0 1.5	56	WOH-1-2 (3)			
			LEAN CLAY: reddish brown, moist, very soft, (CL)							
495	5		**SANDY SILT**: light gray and brown, moist, medium dense, (ML)	SS S-2	2.5 4.0	100	4-5-6 (11)			
				SS S-3	5.0 6.5	89	3-5-7 (12)			
490	10		**SILTY SAND**: grayish brown, moist, medium dense to very dense, (SM)	SS S-4	8.5 10.0	100	8-12-10 (22)			
485	15			SS S-5	13.5 15.0	100	14-22-21 (43)			
480	20			SS S-6	18.5 20.0	89	17-24-29 (53)			
475	25		**DECOMPOSED ROCK**: grayish brown, very dense	SS S-7	23.5 25.0	100	21-31-37 (68)			
			End of boring at 25.0 feet.							

GEOTECH BH PLOTS 125522 LOVETTSVILLE PARK RETAINING WALLS.GPJ GINT US.GDT 1/7/15

APPENDIX C

LABORATORY TEST RESULTS

SPECIALIZED ENGINEERING
Construction Quality Control • Environmental Consulting
Geotechnical & Forensic Engineering

SUMMARY OF LABORATORY RESULTS

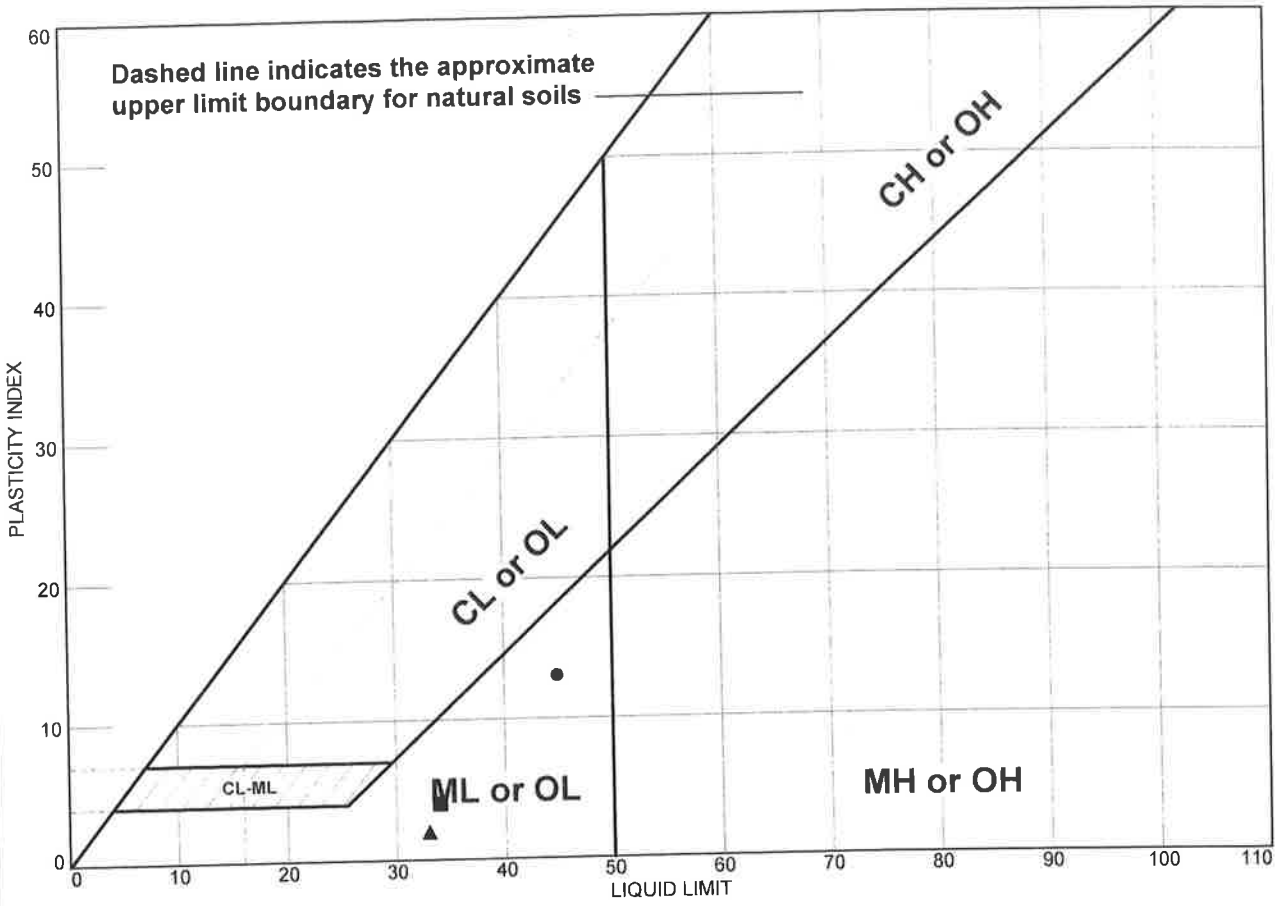
CLIENT Loudoun County
PROJECT NUMBER 125522
PROJECT NAME Lovettsville Park Retaining Walls
PROJECT LOCATION Lovettsville, VA

Borehole	Depth (ft)	Classification	Liquid Limit	Plastic Limit	Plasticity Index	Moisture Content (%)	% < #4 Sieve	% < #200 Sieve	Other Tests
RW-1	0.0	CL (V)				24.4			
RW-1	2.5	SM (V)				7.2			
RW-1	5.0	SM (v)				8.3			
RW-1	8.5	DROCK				4.3			
RW-2	0.0	CL (V)				24.9			
RW-2	2.5	SM				15.3	100	48.3	
RW-2	5.0	ML	45	32	13	26.5			
RW-3	0.0	CL (V)				25.9			
RW-3	2.5	ML (V)				16.4			
RW-3	5.0	ML (V)				14			
RW-3	8.5	SM (V)				7.9			
RW-4	0.0	SM (V)				51.1			
RW-4	2.2	SM				13.5	90.5	33.4	
RW-4	5.0	ML	34	30	4	16.1			
RW-4	8.5	SM (V)				9.8			
RW-4	13.5	DROCK				4.8			
RW-5	0.0	SM (V)				16.1			
RW-5	2.5	SM				16.5	100	45	
RW-5	5.0	ML	33	31	2	13.5			
RW-5	8.5	SM (V)				18.6			
RW-5	13.5	ML (V)				24			
RW-6	0.0	CL (V)				27.6			
RW-6	2.5	ML (V)				17.3			
RW-6	5.0	ML (V)				11.6			
RW-6	8.5	SM (V)				11.4			
RW-6	13.5	SM (V)				7.3			
RW-6	18.5	SM (V)				9			

(V) = Visual Classification USCS

7504 Connelly Drive, Suite G, Hanover, Maryland 21076 (410) 768-4800 / (410) 768-4803 fax

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	RW-2, S-3	45	32	13			
■	RW-4, S-3	34	30	4			
▲	RW-5, S-3	33	31	2			

Project No. 125522 **Client:** Loudon County

Project: Lovettsville Park

●**Location:** RW-2 **Depth:** 5' **Sample Number:** S-3

■**Location:** RW-4 **Depth:** 5' **Sample Number:** S-3

▲**Location:** RW-5 **Depth:** 5' **Sample Number:** S-3

Remarks:

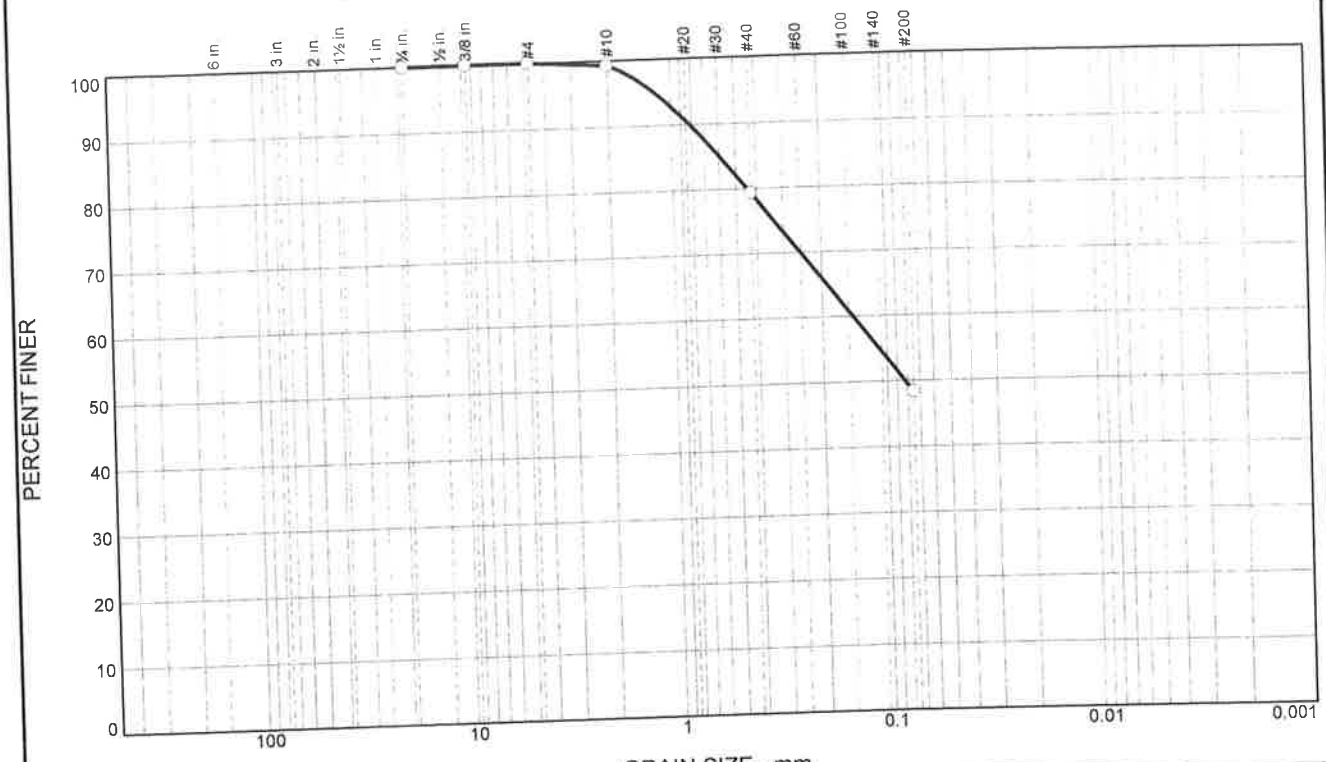
●Date: 1/7/15

Specialized Engineering

Hanover, Maryland

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.7	20.1	30.9	48.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	100.0		
#4	100.0		
#10	99.3		
#40	79.2		
#200	48.3		

* (no specification provided)

Soil Description

RW-2, S-2

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.8200 D_{85}= 0.5963 D_{60}= 0.1436
D_{50}= 0.0826 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: RW-2
Sample Number: S-2 **Depth:** 2.5'

Date: 1/5/15

Specialized Engineering

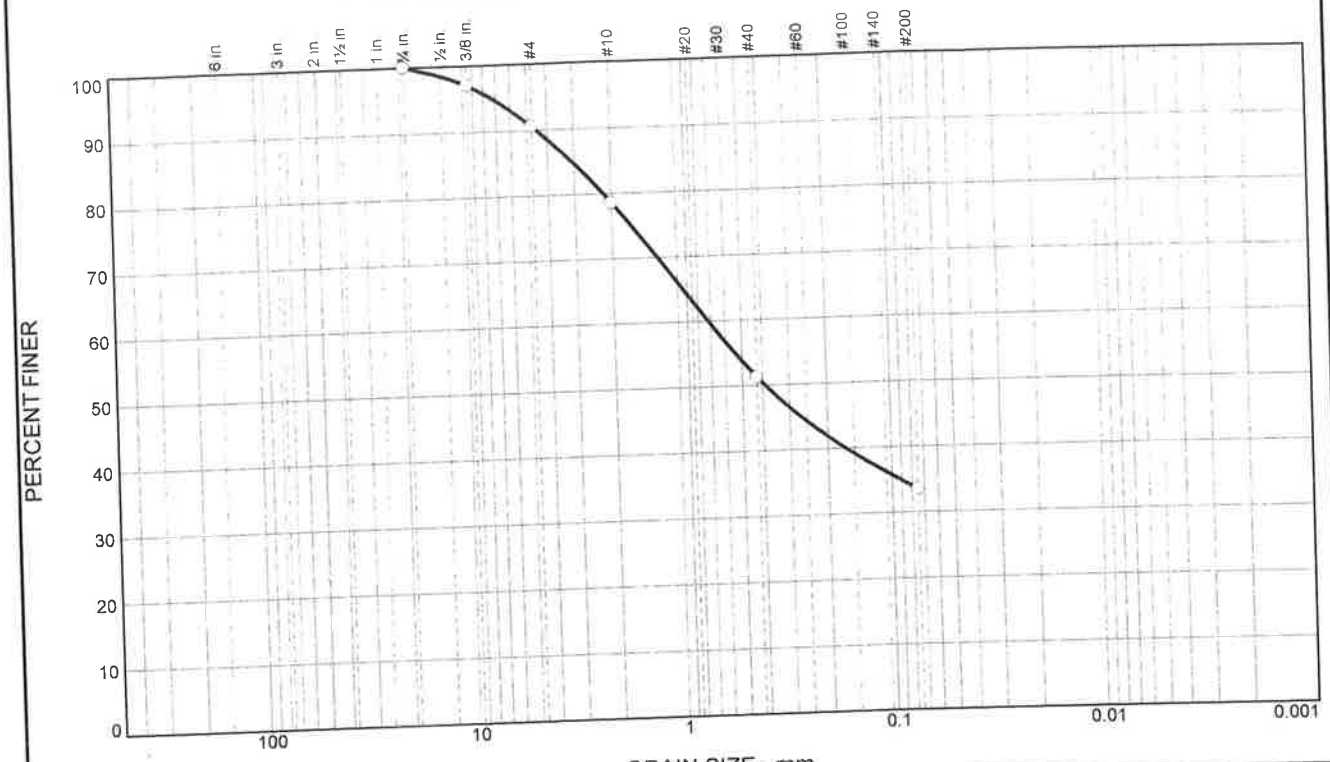
Hanover, Maryland

Client: Loudon County
Project: Lovettsville Park

Project No: 125522

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.5	12.0	27.3	17.8	33.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	97.0		
#4	90.5		
#10	78.5		
#40	51.2		
#200	33.4		

* (no specification provided)

Soil Description

RW-4, S-2

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 4.5398 D_{85}= 3.0731 D_{60}= 0.7187
D_{50}= 0.3918 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: RW-4
Sample Number: S-2 **Depth:** 2.2'

Date: 1/5/15

Specialized Engineering

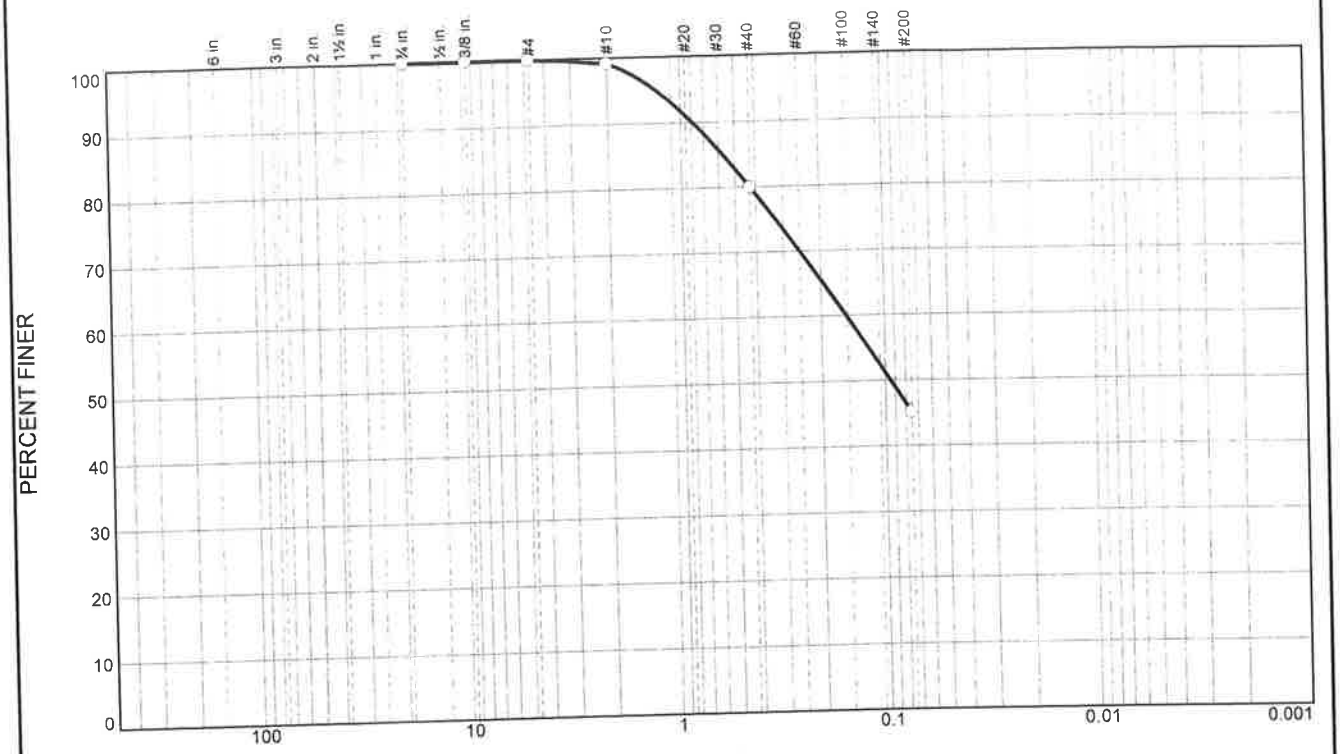
Hanover, Maryland

Client: Loudon County
Project: Lovettsville Park

Project No: 125522

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.9	19.2	34.9	45.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	100.0		
#4	100.0		
#10	99.1		
#40	79.9		
#200	45.0		

* (no specification provided)

Soil Description

RW-5, S-2

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.7915 D_{85}= 0.5721 D_{60}= 0.1528
D_{50}= 0.0948 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: RW-5
Sample Number: S-2 **Depth:** 2.5'

Date: 1/5/15

Specialized Engineering

Hanover, Maryland

Client: Loudon County
Project: Lovettsville Park

Project No: 125522

Figure

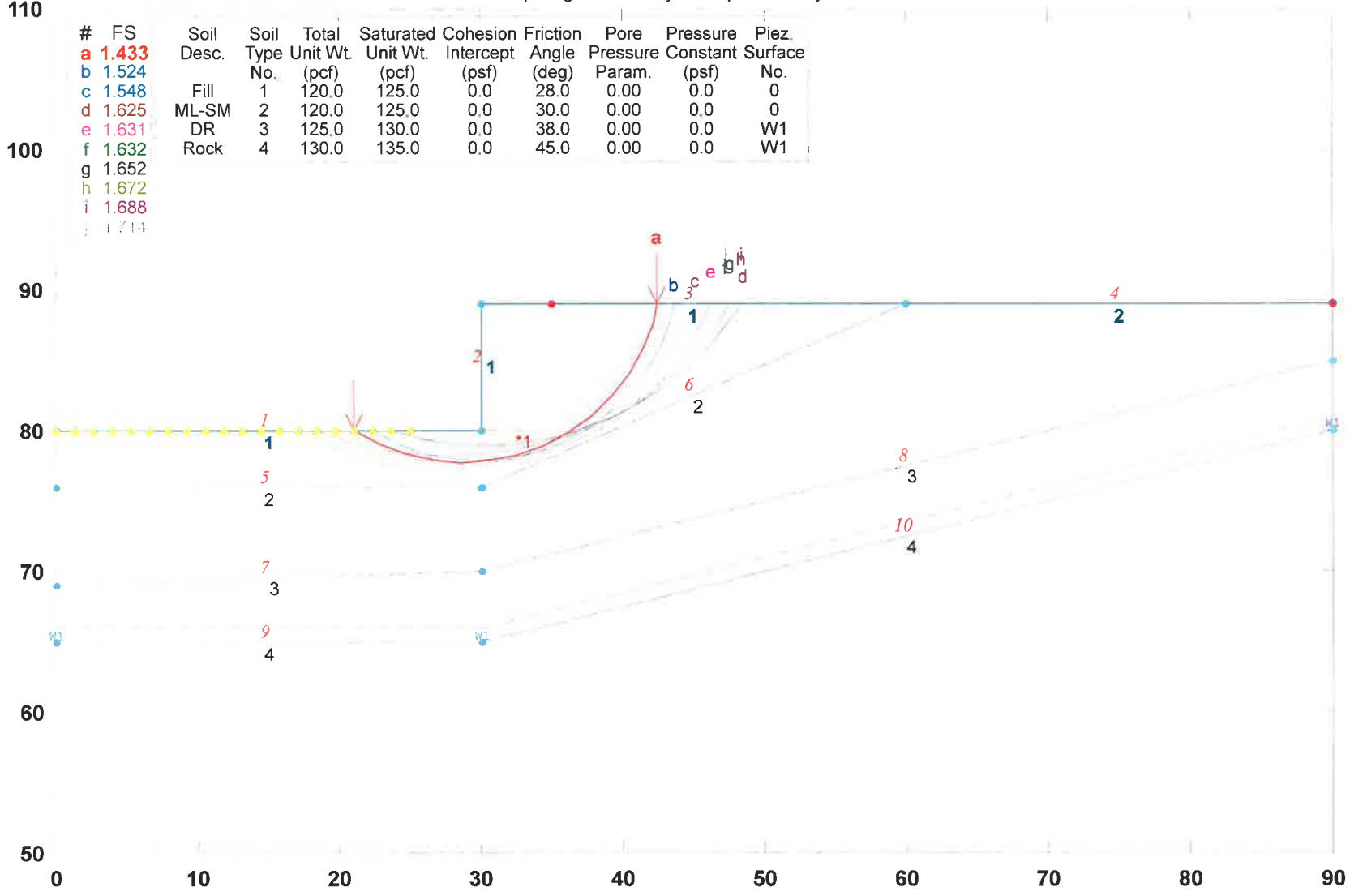
APPENDIX D

GLOBAL STABILITY ANALYSIS

Lovettsville Park - Retaining Wall 1 RW-1S (Segmental Retaining Wall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\rw-1s.pl2 Run By: SPECIALIZED ENGINEERING 1/5/2015 01:25PM

#	FS	Soil Desc.	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.
a	1.433									
b	1.524									
c	1.548	Fill	1	120.0	125.0	0.0	28.0	0.00	0.0	0
d	1.625	ML-SM	2	120.0	125.0	0.0	30.0	0.00	0.0	0
e	1.631	DR	3	125.0	130.0	0.0	38.0	0.00	0.0	W1
f	1.632	Rock	4	130.0	135.0	0.0	45.0	0.00	0.0	W1
g	1.652									
h	1.672									
i	1.688									
j	1.714									

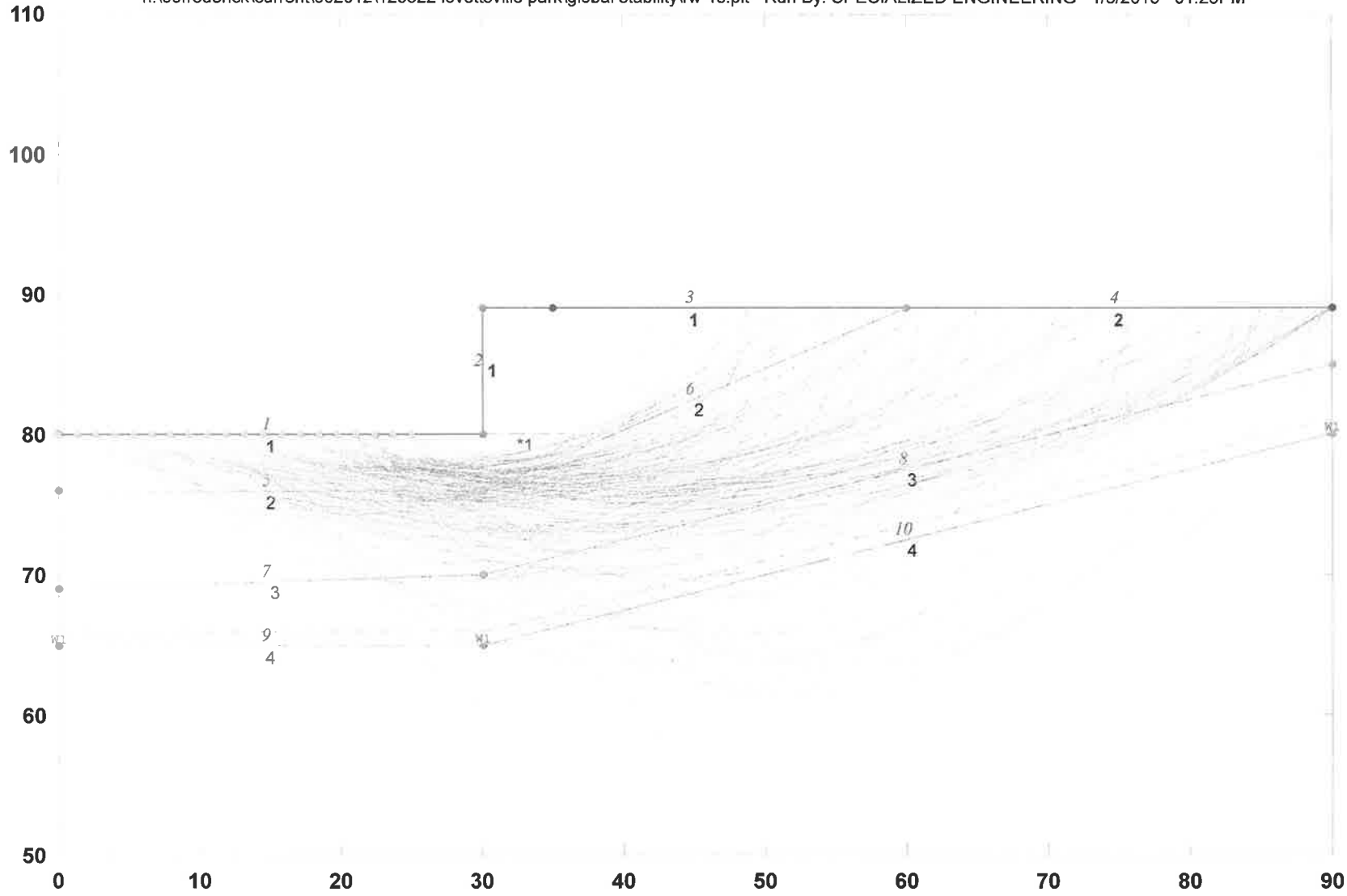


GSTABL7 v.2 FSmin=1.433

Safety Factors Are Calculated By The Modified Bishop Method

Lovettsville Park - Retaining Wall 1 RW-1S (Segmental Retaining Wall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\rw-1s.plt Run By: SPECIALIZED ENGINEERING 1/5/2015 01:25PM



*** GSTABL7 ***

** GSTABL7 by Dr. Garry H. Gregory, Ph.D.,P.E.,D.GE **

** Original Version 1.0, January 1996; Current Ver. 2.005.3, Feb. 2013 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 1/5/2015
Time of Run: 01:25PM
Run By: SPECIALIZED ENGINEERING
Input Data Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-1s.in
Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-1s.OUT
Unit System: English
Plotted Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-1s.PLT
PROBLEM DESCRIPTION: Lovettsville Park - Retaining Wall 1
RW-1S (Segmental Retaining Wall)

BOUNDARY COORDINATES
4 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	80.00	30.00	80.01	1
2	30.00	80.01	30.01	89.00	1
3	30.01	89.00	60.00	89.00	1
4	60.00	89.00	90.00	89.00	2
5	0.00	76.00	30.00	76.00	2
6	30.00	76.00	60.00	89.00	2
7	0.00	69.00	30.00	70.00	3
8	30.00	70.00	90.00	85.00	3
9	0.00	65.00	30.00	65.00	4
10	30.00	65.00	90.00	80.00	4

User Specified Y-Origin = 50.00(ft)
User Specified X-Plus Value = 10.00(ft)
Default Y-Plus Value = 0.00(ft)

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	120.0	125.0	0.0	28.0	0.00	0.0	0
2	120.0	125.0	0.0	30.0	0.00	0.0	0
3	125.0	130.0	0.0	38.0	0.00	0.0	1
4	130.0	135.0	0.0	45.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 3 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	66.00
2	30.00	66.00
3	90.00	81.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	30.00	80.00	36.00	80.01

A Critical Failure Surface Searching Method, Using A Random

Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 0.00(ft)
and X = 25.00(ft)
Each Surface Terminates Between X = 35.00(ft)
and X = 90.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 50.00(ft)
2.00(ft) Line Segments Define Each Trial Failure Surface.
Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -60.0
And -15.0 deg.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 18.879 FS Min = 1.433 FS Ave = 5.176
Standard Deviation = 3.373 Coefficient of Variation = 65.17 %
Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.053	80.007
2	22.800	79.033
3	24.668	78.319
4	26.618	77.877
5	28.612	77.718
6	30.608	77.845
7	32.565	78.255
8	34.445	78.939
9	36.207	79.885
10	37.817	81.071
11	39.242	82.475
12	40.451	84.068
13	41.422	85.816
14	42.134	87.686
15	42.429	89.000

Circle Center At X = 28.725 ; Y = 91.720 ; and Radius = 14.002
Factor of Safety
*** 1.433 ***
Individual data on the 16 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.7	102.1	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.9	298.5	0.0	0.0	0.	0.	0.0	0.0	0.0
3	2.0	447.2	0.0	0.0	0.	0.	0.0	0.0	0.0
4	2.0	529.1	0.0	0.0	0.	0.	0.0	0.0	0.0
5	1.4	374.3	0.0	0.0	0.	0.	0.0	0.0	0.0
6	0.0	8.0	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.6	801.7	0.0	0.0	0.	0.	0.0	0.0	0.0
8	2.0	2572.3	0.0	0.0	0.	0.	0.0	0.0	0.0
9	1.9	2345.9	0.0	0.0	0.	0.	0.0	0.0	0.0
10	1.8	2027.9	0.0	0.0	0.	0.	0.0	0.0	0.0
11	1.6	1646.4	0.0	0.0	0.	0.	0.0	0.0	0.0
12	1.4	1235.3	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.2	831.7	0.0	0.0	0.	0.	0.0	0.0	0.0
14	1.0	472.6	0.0	0.0	0.	0.	0.0	0.0	0.0
15	0.7	192.0	0.0	0.0	0.	0.	0.0	0.0	0.0
16	0.3	23.3	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 15 Coordinate Points

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

1	22.368	80.007
2	24.137	79.073
3	26.019	78.398
4	27.978	77.995
5	29.975	77.871
6	31.968	78.030
7	33.920	78.469
8	35.790	79.178
9	37.541	80.143
10	39.139	81.346
11	40.552	82.762
12	41.751	84.363
13	42.712	86.117
14	43.417	87.988
15	43.642	89.000

Circle Center At X = 29.848 ; Y = 92.028 ; and Radius = 14.158

Factor of Safety

*** 1.524 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.105	80.006
2	18.882	79.088
3	20.742	78.353
4	22.667	77.810
5	24.637	77.463
6	26.631	77.316
7	28.631	77.370
8	30.614	77.626
9	32.562	78.080
10	34.454	78.728
11	36.272	79.562
12	37.996	80.576
13	39.609	81.758
14	41.095	83.096
15	42.439	84.578
16	43.627	86.187
17	44.647	87.907
18	45.154	89.000

Circle Center At X = 27.085 ; Y = 97.115 ; and Radius = 19.807

Factor of Safety

*** 1.548 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	18.421	80.006
2	20.304	79.332
3	22.235	78.810
4	24.201	78.443
5	26.190	78.234
6	28.189	78.185
7	30.186	78.294
8	32.168	78.563
9	34.122	78.989
10	36.036	79.569
11	37.898	80.300
12	39.695	81.176
13	41.417	82.194
14	43.053	83.345
15	44.591	84.623
16	46.023	86.019
17	47.339	87.525
18	48.433	89.000

Circle Center At X = 27.810 ; Y = 103.246 ; and Radius = 25.065

Factor of Safety

*** 1.625 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.053	80.007
2	22.852	79.134
3	24.738	78.469
4	26.687	78.021
5	28.675	77.794
6	30.675	77.793
7	32.662	78.016
8	34.612	78.462
9	36.499	79.124
10	38.300	79.994
11	39.992	81.061
12	41.552	82.311
13	42.963	83.729
14	44.205	85.297
15	45.262	86.994
16	46.122	88.800
17	46.191	89.000

Circle Center At X = 29.688 ; Y = 95.520 ; and Radius = 17.755

Factor of Safety

*** 1.631 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.684	80.008
2	25.601	79.436
3	27.566	79.064
4	29.559	78.895
5	31.558	78.932
6	33.544	79.173
7	35.494	79.617
8	37.388	80.258
9	39.207	81.090
10	40.931	82.105
11	42.541	83.291
12	44.022	84.635
13	45.356	86.125
14	46.531	87.743
15	47.260	89.000

Circle Center At X = 30.203 ; Y = 98.361 ; and Radius = 19.477

Factor of Safety

*** 1.632 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.684	80.008
2	25.603	79.444
3	27.569	79.076
4	29.562	78.906
5	31.561	78.937
6	33.548	79.168
7	35.502	79.596
8	37.402	80.219
9	39.231	81.028
10	40.970	82.017
11	42.600	83.175
12	44.107	84.490
13	45.474	85.950
14	46.688	87.540
15	47.587	89.000

Circle Center At X = 30.256 ; Y = 98.832 ; and Radius = 19.939

Factor of Safety

*** 1.652 ***

Failure Surface Specified By 19 Coordinate Points

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

1	18.421	80.006
2	20.267	79.237
3	22.172	78.628
4	24.122	78.182
5	26.103	77.904
6	28.100	77.796
7	30.099	77.857
8	32.085	78.088
9	34.045	78.487
10	35.964	79.051
11	37.828	79.776
12	39.623	80.657
13	41.338	81.687
14	42.958	82.859
15	44.473	84.165
16	45.872	85.595
17	47.144	87.138
18	48.280	88.784
19	48.404	89.000

Circle Center At X = 28.378 ; Y = 101.310 ; and Radius = 23.516

Factor of Safety

*** 1.672 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.684	80.008
2	25.614	79.483
3	27.585	79.142
4	29.579	78.986
5	31.578	79.017
6	33.566	79.236
7	35.525	79.640
8	37.438	80.225
9	39.287	80.987
10	41.057	81.918
11	42.732	83.011
12	44.297	84.256
13	45.739	85.642
14	47.045	87.157
15	48.203	88.787
16	48.326	89.000

Circle Center At X = 30.243 ; Y = 100.296 ; and Radius = 21.322

Factor of Safety

*** 1.688 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	80.007
2	24.204	79.212
3	26.114	78.621
4	28.078	78.241
5	30.071	78.076
6	32.070	78.128
7	34.052	78.397
8	35.993	78.880
9	37.870	79.570
10	39.661	80.460
11	41.345	81.539
12	42.902	82.794
13	44.313	84.211
14	45.563	85.773
15	46.635	87.461
16	47.392	89.000

Circle Center At X = 30.588 ; Y = 96.447 ; and Radius = 18.380

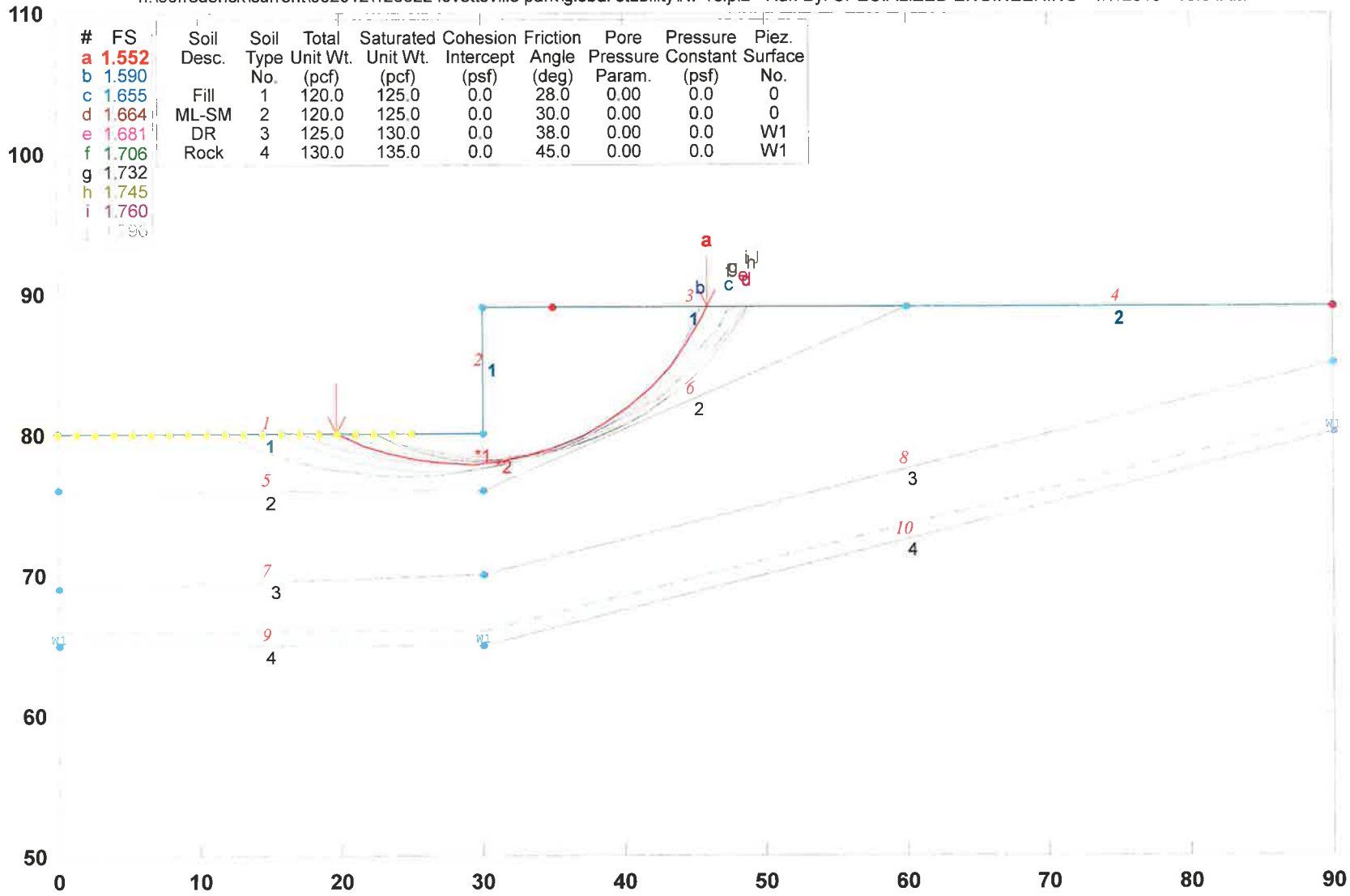
Factor of Safety

*** 1.714 ***

**** END OF GSTABL7 OUTPUT ****

Lovettsville Park - Retaining Wall 1 RW-1c (Concrete Cantilever Retaining W.)

h:\00frederick\current\002012\125522 lovettsville park\global stability\rw-1c.pl2 Run By: SPECIALIZED ENGINEERING 1/7/2015 10:04AM

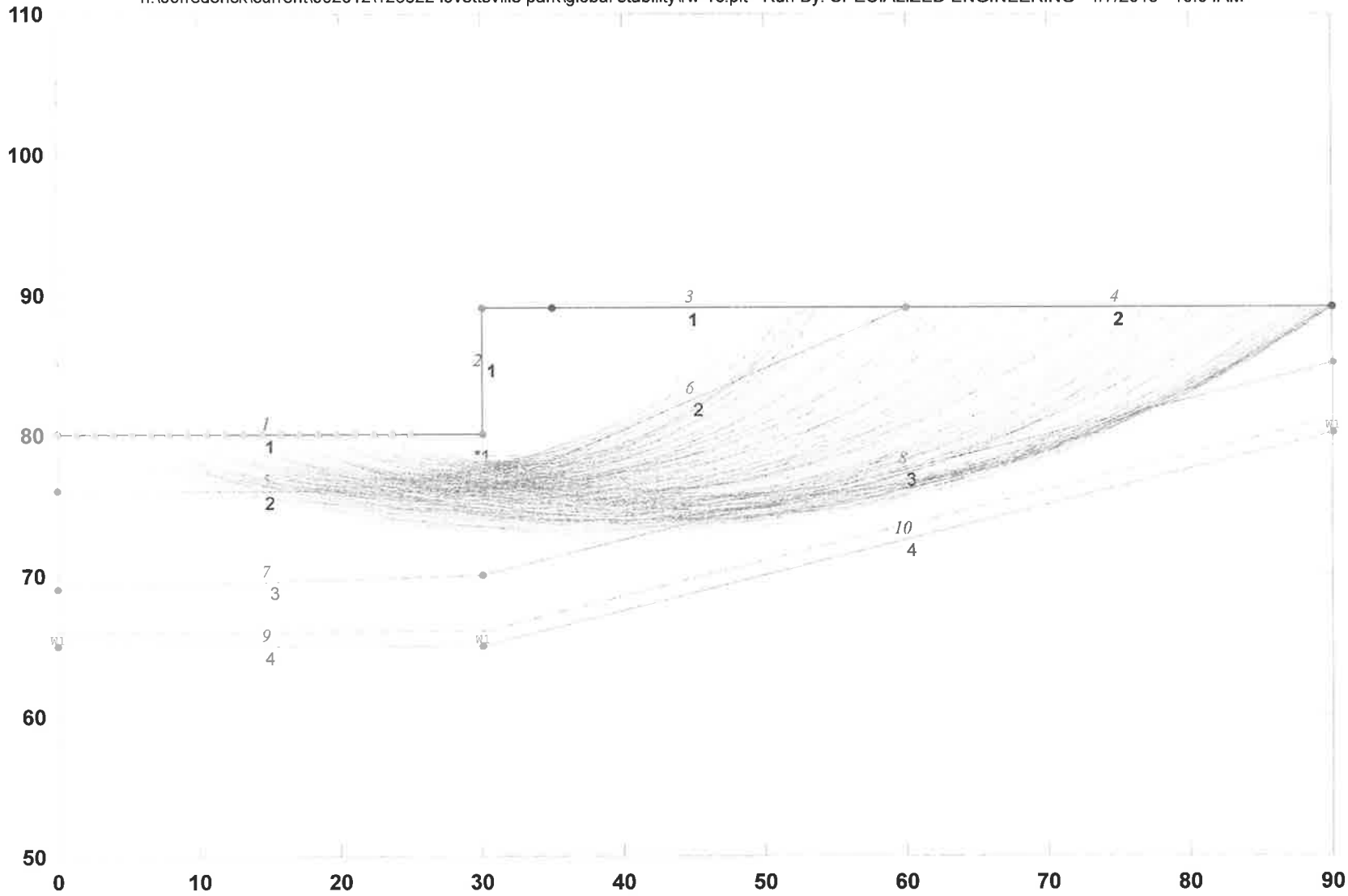


GSTABL7 v.2 FSmin=1.552

Safety Factors Are Calculated By The Modified Bishop Method

Lovettsville Park - Retaining Wall 1 RW-1c (Concrete Cantilever Retaining W.)

h:\00frederick\current\002012\125522 lovettsville park\global stability\rw-1c.plt Run By: SPECIALIZED ENGINEERING 1/7/2015 10:04AM



***** GSTABL7 *****

** GSTABL7 by Dr. Garry H. Gregory, Ph.D.,P.E.,D.GE **
** Original Version 1.0, January 1996; Current Ver. 2.005.3, Feb. 2013 **

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SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 1/7/2015
Time of Run: 10:04AM
Run By: SPECIALIZED ENGINEERING
Input Data Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-1c.in
Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-1c.OUT
Unit System: English
Plotted Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-1c.PLT
PROBLEM DESCRIPTION: Lovettsville Park - Retaining Wall 1
RW-1c (Concrete Cantilever Retaining W.)

BOUNDARY COORDINATES
4 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	80.00	30.00	80.01	1
2	30.00	80.01	30.01	89.00	1
3	30.01	89.00	60.00	89.00	1
4	60.00	89.00	90.00	89.00	2
5	0.00	76.00	30.00	76.00	2
6	30.00	76.00	60.00	89.00	2
7	0.00	69.00	30.00	70.00	3
8	30.00	70.00	90.00	85.00	3
9	0.00	65.00	30.00	65.00	4
10	30.00	65.00	90.00	80.00	4

User Specified Y-Origin = 50.00(ft)
User Specified X-Plus Value = 10.00(ft)
Default Y-Plus Value = 0.00(ft)

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	120.0	125.0	0.0	28.0	0.00	0.0	0
2	120.0	125.0	0.0	30.0	0.00	0.0	0
3	125.0	130.0	0.0	38.0	0.00	0.0	1
4	130.0	135.0	0.0	45.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 3 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	66.00
2	30.00	66.00
3	90.00	81.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 2 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	30.00	78.50	30.01	80.00
2	30.00	78.50	33.00	78.51

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 0.00(ft)
and X = 25.00(ft)
Each Surface Terminates Between X = 35.00(ft)
and X = 90.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 50.00(ft)
2.00(ft) Line Segments Define Each Trial Failure Surface.
Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -25.0
And -20.0 deg.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 8.800 FS Min = 1.552 FS Ave = 4.108
Standard Deviation = 1.754 Coefficient of Variation = 42.69 %
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	19.737	80.007
2	21.553	79.170
3	23.448	78.529
4	25.399	78.091
5	27.386	77.861
6	29.386	77.841
7	31.377	78.031
8	33.337	78.430
9	35.244	79.033
10	37.076	79.834
11	38.815	80.822
12	40.440	81.989
13	41.933	83.319
14	43.278	84.800
15	44.459	86.413
16	45.464	88.142
17	45.848	89.000

Circle Center At X = 28.575 ; Y = 96.804 ; and Radius = 18.981
Factor of Safety
*** 1.552 ***
Individual data on the 18 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.8	91.3	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.9	263.3	0.0	0.0	0.	0.	0.0	0.0	0.0
3	2.0	397.7	0.0	0.0	0.	0.	0.0	0.0	0.0
4	2.0	484.7	0.0	0.0	0.	0.	0.0	0.0	0.0
5	2.0	518.1	0.0	0.0	0.	0.	0.0	0.0	0.0
6	0.6	157.7	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.0	7.9	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.4	1809.9	0.0	0.0	0.	0.	0.0	0.0	0.0
9	2.0	2532.7	0.0	0.0	0.	0.	0.0	0.0	0.0
10	1.9	2349.7	0.0	0.0	0.	0.	0.0	0.0	0.0
11	1.8	2104.1	0.0	0.0	0.	0.	0.0	0.0	0.0
12	1.7	1809.1	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.6	1480.8	0.0	0.0	0.	0.	0.0	0.0	0.0
14	1.5	1137.0	0.0	0.0	0.	0.	0.0	0.0	0.0
15	1.3	797.3	0.0	0.0	0.	0.	0.0	0.0	0.0
16	1.2	481.1	0.0	0.0	0.	0.	0.0	0.0	0.0

17	1.0	207.7	0.0	0.0	0.	0.	0.0	0.0	0.0
18	0.4	19.8	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	80.007
2	24.182	79.165
3	26.086	78.552
4	28.051	78.178
5	30.047	78.049
6	32.043	78.166
7	34.010	78.528
8	35.917	79.130
9	37.736	79.962
10	39.439	81.012
11	40.999	82.263
12	42.393	83.696
13	43.601	85.291
14	44.603	87.022
15	45.384	88.863
16	45.423	89.000

Circle Center At X = 30.094 ; Y = 94.251 ; and Radius = 16.204

Factor of Safety

*** 1.590 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.789	80.005
2	17.604	79.164
3	19.482	78.476
4	21.410	77.946
5	23.376	77.578
6	25.366	77.374
7	27.365	77.335
8	29.361	77.462
9	31.340	77.754
10	33.288	78.209
11	35.191	78.824
12	37.036	79.594
13	38.812	80.515
14	40.505	81.580
15	42.104	82.781
16	43.598	84.110
17	44.977	85.559
18	46.231	87.117
19	47.352	88.774
20	47.479	89.000

Circle Center At X = 26.830 ; Y = 101.429 ; and Radius = 24.101

Factor of Safety

*** 1.655 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.105	80.006
2	18.971	79.286
3	20.887	78.712
4	22.842	78.287
5	24.823	78.014
6	26.819	77.893
7	28.819	77.926
8	30.810	78.113
9	32.781	78.453
10	34.720	78.943
11	36.616	79.580
12	38.457	80.361
13	40.233	81.281
14	41.932	82.336

15	43.546	83.517
16	45.064	84.819
17	46.478	86.234
18	47.778	87.754
19	48.689	89.000

Circle Center At X = 27.387 ; Y = 103.892 ; and Radius = 26.005

Factor of Safety

*** 1.664 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	19.737	80.007
2	21.597	79.271
3	23.514	78.702
4	25.474	78.304
5	27.461	78.079
6	29.461	78.030
7	31.457	78.157
8	33.434	78.459
9	35.377	78.933
10	37.271	79.576
11	39.101	80.383
12	40.853	81.348
13	42.513	82.463
14	44.069	83.719
15	45.509	85.107
16	46.821	86.617
17	47.995	88.236
18	48.453	89.000

Circle Center At X = 29.016 ; Y = 100.722 ; and Radius = 22.698

Factor of Safety

*** 1.681 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	80.007
2	24.213	79.234
3	26.129	78.663
4	28.096	78.298
5	30.090	78.146
6	32.089	78.208
7	34.070	78.483
8	36.011	78.967
9	37.888	79.656
10	39.682	80.541
11	41.371	81.613
12	42.935	82.858
13	44.358	84.264
14	45.623	85.813
15	46.715	87.489
16	47.484	89.000

Circle Center At X = 30.512 ; Y = 96.832 ; and Radius = 18.691

Factor of Safety

*** 1.706 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	11.842	80.004
2	13.662	79.175
3	15.536	78.475
4	17.454	77.908
5	19.407	77.477
6	21.385	77.183
7	23.379	77.028
8	25.379	77.013
9	27.375	77.139
10	29.357	77.403

11	31.316	77.806
12	33.242	78.345
13	35.126	79.017
14	36.958	79.819
15	38.730	80.747
16	40.432	81.797
17	42.056	82.964
18	43.595	84.241
19	45.041	85.623
20	46.387	87.103
21	47.625	88.673
22	47.848	89.000

Circle Center At X = 24.587 ; Y = 105.548 ; and Radius = 28.547

Factor of Safety

*** 1.732 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.053	80.007
2	22.921	79.293
3	24.845	78.749
4	26.811	78.380
5	28.802	78.190
6	30.802	78.179
7	32.795	78.347
8	34.765	78.694
9	36.695	79.216
10	38.571	79.909
11	40.377	80.768
12	42.099	81.786
13	43.722	82.954
14	45.234	84.264
15	46.623	85.703
16	47.876	87.262
17	48.984	88.927
18	49.024	89.000

Circle Center At X = 29.926 ; Y = 100.406 ; and Radius = 22.245

Factor of Safety

*** 1.745 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	80.007
2	24.241	79.306
3	26.173	78.788
4	28.146	78.458
5	30.141	78.319
6	32.140	78.372
7	34.125	78.617
8	36.077	79.051
9	37.979	79.671
10	39.812	80.471
11	41.560	81.443
12	43.206	82.579
13	44.736	83.867
14	46.135	85.297
15	47.390	86.854
16	48.489	88.525
17	48.740	89.000

Circle Center At X = 30.588 ; Y = 99.111 ; and Radius = 20.797

Factor of Safety

*** 1.760 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.526	80.004
2	12.385	79.266

3	14.285	78.640
4	16.218	78.128
5	18.178	77.731
6	20.159	77.451
7	22.152	77.288
8	24.152	77.244
9	26.150	77.319
10	28.141	77.511
11	30.117	77.821
12	32.071	78.248
13	33.996	78.790
14	35.886	79.444
15	37.734	80.210
16	39.533	81.083
17	41.277	82.061
18	42.960	83.141
19	44.577	84.319
20	46.121	85.591
21	47.587	86.951
22	48.969	88.396
23	49.482	89.000

Circle Center At X = 23.896 ; Y = 111.003 ; and Radius = 33.760

Factor of Safety

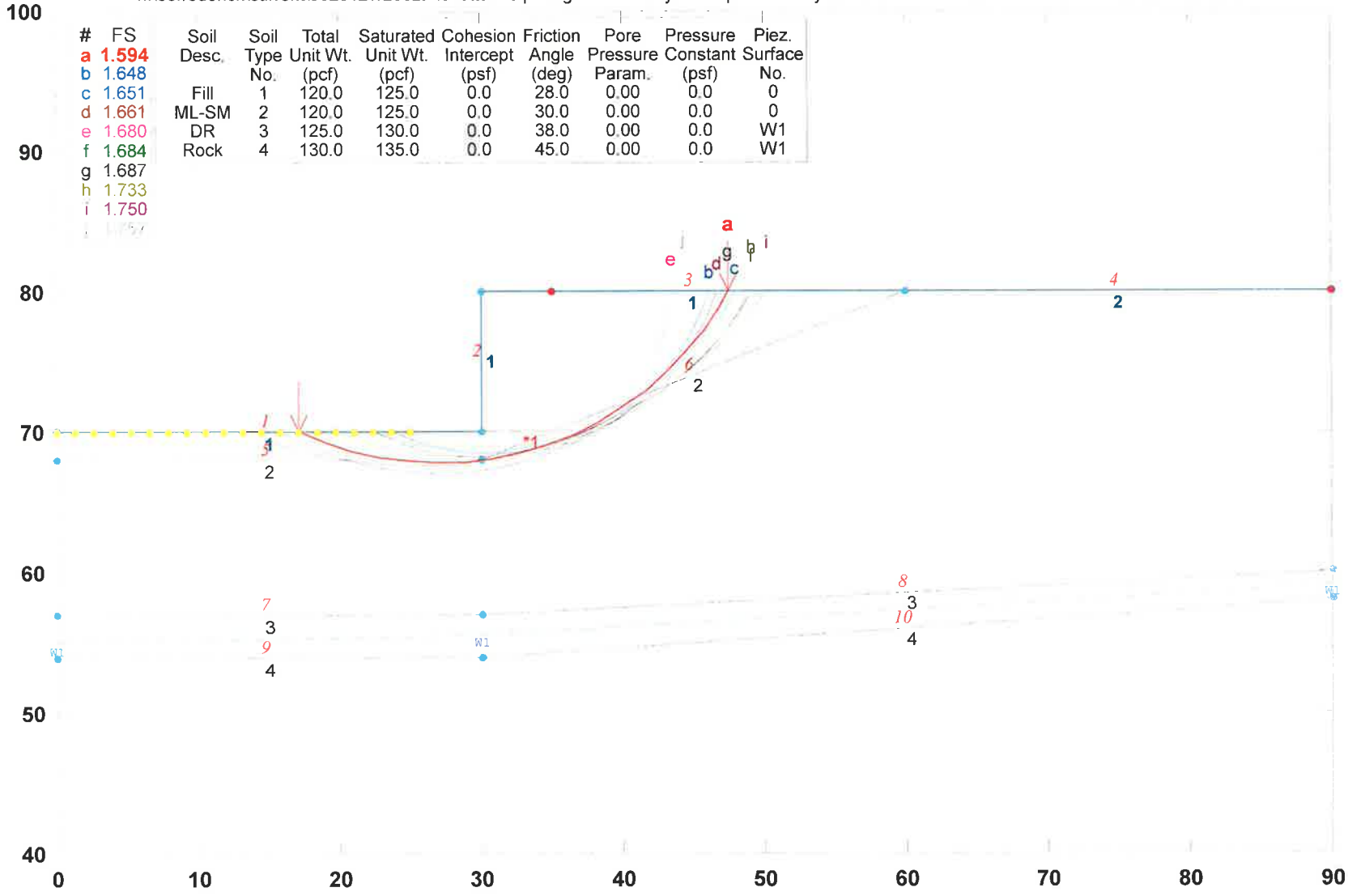
*** 1.796 ***

**** END OF GSTABL7 OUTPUT ****

Lovettsville Park - Retaining Wall 2 RW-2S (Segmental Retiaining Wall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\rw-2s.pl2 Run By: SPECIALIZED ENGINEERING 1/5/2015 01:04PM

#	FS	Soil Desc.	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.
a	1.594									
b	1.648									
c	1.651	Fill	1	120.0	125.0	0.0	28.0	0.00	0.0	0
d	1.661	ML-SM	2	120.0	125.0	0.0	30.0	0.00	0.0	0
e	1.680	DR	3	125.0	130.0	0.0	38.0	0.00	0.0	W1
f	1.684	Rock	4	130.0	135.0	0.0	45.0	0.00	0.0	W1
g	1.687									
h	1.733									
i	1.750									

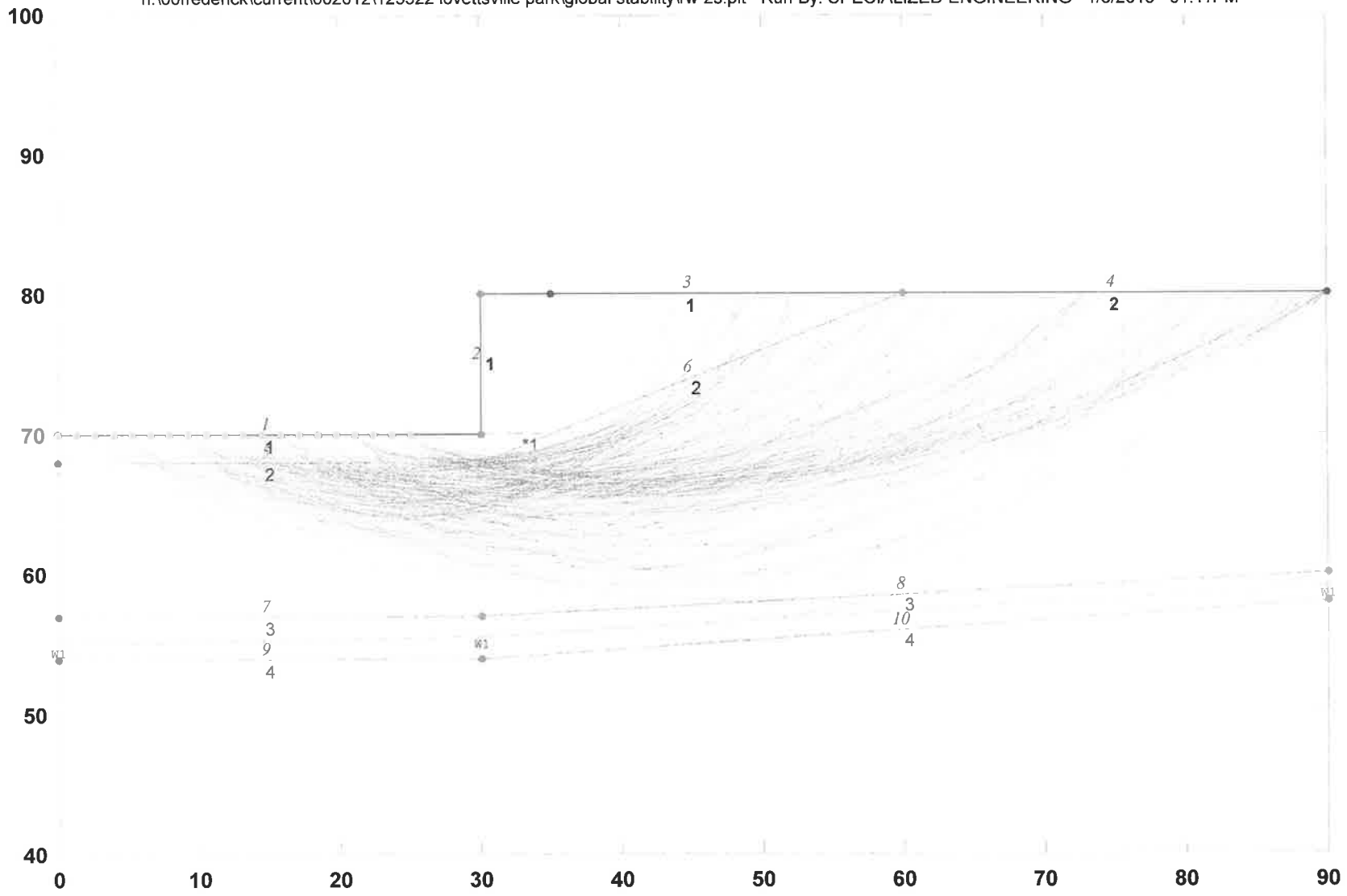


GSTABL7 v.2 FSmin=1.594

Safety Factors Are Calculated By The Modified Bishop Method

Lovettsville Park - Retaining Wall 2 RW-2S (Segmental Retiaining Wall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\rw-2s.plt Run By: SPECIALIZED ENGINEERING 1/5/2015 01:11PM



*** GSTABL7 ***

** GSTABL7 by Dr. Garry H. Gregory, Ph.D.,P.E.,D.GE **
** Original Version 1.0, January 1996; Current Ver. 2.005.3, Feb. 2013 **

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SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 1/5/2015
Time of Run: 01:04PM
Run By: SPECIALIZED ENGINEERING
Input Data Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-2S.in
Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-2S.OUT
Unit System: English
Plotted Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-2S.PLT

PROBLEM DESCRIPTION: Lovettsville Park - Retaining Wall 2
RW-2S (Segmental Retiaining Wall)

BOUNDARY COORDINATES
4 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	70.00	30.00	70.01	1
2	30.00	70.01	30.01	80.00	1
3	30.01	80.00	60.00	80.00	1
4	60.00	80.00	90.00	80.00	2
5	0.00	68.00	30.00	68.00	2
6	30.00	68.00	60.00	80.00	2
7	0.00	57.00	30.00	57.00	3
8	30.00	57.00	90.00	60.00	3
9	0.00	54.00	30.00	54.00	4
10	30.00	54.00	90.00	58.00	4

User Specified Y-Origin = 40.00(ft)
User Specified X-Plus Value = 10.00(ft)
Default Y-Plus Value = 0.00(ft)

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	120.0	125.0	0.0	28.0	0.00	0.0	0
2	120.0	125.0	0.0	30.0	0.00	0.0	0
3	125.0	130.0	0.0	38.0	0.00	0.0	1
4	130.0	135.0	0.0	45.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 3 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	55.00
2	30.00	55.50
3	90.00	59.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	30.00	70.00	37.00	70.01

A Critical Failure Surface Searching Method, Using A Random

Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 0.00(ft)
and X = 25.00(ft)
Each Surface Terminates Between X = 35.00(ft)
and X = 90.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 40.00(ft)
2.00(ft) Line Segments Define Each Trial Failure Surface.
Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -45.0
And -15.0 deg.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 9.912 FS Min = 1.594 FS Ave = 3.605
Standard Deviation = 1.387 Coefficient of Variation = 38.47 %
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.105	70.006
2	18.945	69.222
3	20.846	68.601
4	22.794	68.145
5	24.773	67.860
6	26.770	67.746
7	28.769	67.805
8	30.756	68.037
9	32.715	68.439
10	34.632	69.009
11	36.493	69.742
12	38.284	70.633
13	39.991	71.675
14	41.601	72.860
15	43.104	74.180
16	44.487	75.625
17	45.740	77.184
18	46.853	78.845
19	47.491	80.000

Circle Center At X = 27.085 ; Y = 90.895 ; and Radius = 23.151
Factor of Safety
*** 1.594 ***
Individual data on the 22 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.8	86.6	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.9	249.8	0.0	0.0	0.	0.	0.0	0.0	0.0
3	1.9	381.9	0.0	0.0	0.	0.	0.0	0.0	0.0
4	1.0	234.0	0.0	0.0	0.	0.	0.0	0.0	0.0
5	1.0	242.4	0.0	0.0	0.	0.	0.0	0.0	0.0
6	2.0	528.5	0.0	0.0	0.	0.	0.0	0.0	0.0
7	2.0	535.8	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.2	315.0	0.0	0.0	0.	0.	0.0	0.0	0.0
9	0.0	8.5	0.0	0.0	0.	0.	0.0	0.0	0.0
10	0.7	1074.6	0.0	0.0	0.	0.	0.0	0.0	0.0
11	2.0	2765.3	0.0	0.0	0.	0.	0.0	0.0	0.0
12	1.9	2594.2	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.9	2372.5	0.0	0.0	0.	0.	0.0	0.0	0.0
14	1.8	2108.5	0.0	0.0	0.	0.	0.0	0.0	0.0
15	1.7	1812.1	0.0	0.0	0.	0.	0.0	0.0	0.0

16	1.0	915.7	0.0	0.0	0.	0.	0.0	0.0	0.0
17	0.7	578.9	0.0	0.0	0.	0.	0.0	0.0	0.0
18	1.5	1168.2	0.0	0.0	0.	0.	0.0	0.0	0.0
19	1.4	845.8	0.0	0.0	0.	0.	0.0	0.0	0.0
20	1.3	540.6	0.0	0.0	0.	0.	0.0	0.0	0.0
21	1.1	265.3	0.0	0.0	0.	0.	0.0	0.0	0.0
22	0.6	44.1	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.684	70.008
2	25.544	69.271
3	27.479	68.769
4	29.462	68.507
5	31.462	68.492
6	33.449	68.722
7	35.392	69.194
8	37.263	69.902
9	39.033	70.834
10	40.674	71.976
11	42.163	73.311
12	43.477	74.820
13	44.595	76.478
14	45.502	78.260
15	46.131	80.000

Circle Center At X = 30.589 ; Y = 84.720 ; and Radius = 16.252

Factor of Safety

*** 1.648 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	70.007
2	24.256	69.347
3	26.201	68.879
4	28.182	68.608
5	30.181	68.536
6	32.177	68.664
7	34.150	68.990
8	36.081	69.512
9	37.949	70.225
10	39.738	71.120
11	41.428	72.190
12	43.002	73.424
13	44.445	74.808
14	45.743	76.330
15	46.883	77.973
16	47.852	79.723
17	47.971	80.000

Circle Center At X = 29.902 ; Y = 88.526 ; and Radius = 19.992

Factor of Safety

*** 1.651 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	70.007
2	24.203	69.211
3	26.117	68.631
4	28.085	68.273
5	30.081	68.143
6	32.078	68.243
7	34.051	68.570
8	35.974	69.122
9	37.820	69.890
10	39.567	70.864
11	41.190	72.032
12	42.669	73.379
13	43.984	74.885

14	45.118	76.533
15	46.056	78.300
16	46.721	80.000

Circle Center At X = 30.212 ; Y = 85.563 ; and Radius = 17.421

Factor of Safety

*** 1.661 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.000	70.008
2	26.808	69.154
3	28.731	68.602
4	30.717	68.369
5	32.715	68.459
6	34.672	68.871
7	36.537	69.593
8	38.261	70.607
9	39.798	71.887
10	41.109	73.398
11	42.158	75.100
12	42.918	76.950
13	43.370	78.898
14	43.443	80.000

Circle Center At X = 31.159 ; Y = 80.656 ; and Radius = 12.301

Factor of Safety

*** 1.680 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	19.737	70.007
2	21.613	69.313
3	23.541	68.781
4	25.507	68.416
5	27.497	68.219
6	29.497	68.192
7	31.492	68.336
8	33.467	68.649
9	35.409	69.129
10	37.303	69.773
11	39.135	70.575
12	40.892	71.530
13	42.561	72.632
14	44.130	73.872
15	45.589	75.240
16	46.925	76.728
17	48.130	78.325
18	49.183	80.000

Circle Center At X = 28.810 ; Y = 91.653 ; and Radius = 23.471

Factor of Safety

*** 1.684 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.789	70.005
2	17.570	69.094
3	19.423	68.343
4	21.336	67.758
5	23.293	67.344
6	25.278	67.104
7	27.277	67.040
8	29.274	67.152
9	31.253	67.440
10	33.199	67.901
11	35.097	68.532
12	36.932	69.328
13	38.690	70.282
14	40.356	71.388

15	41.919	72.636
16	43.366	74.017
17	44.685	75.520
18	45.867	77.133
19	46.902	78.845
20	47.468	80.000

Circle Center At X = 26.999 ; Y = 89.678 ; and Radius = 22.642

Factor of Safety

*** 1.687 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.684	70.008
2	25.609	69.463
3	27.575	69.101
4	29.568	68.924
5	31.568	68.935
6	33.558	69.133
7	35.521	69.516
8	37.439	70.082
9	39.296	70.824
10	41.075	71.737
11	42.762	72.813
12	44.339	74.042
13	45.795	75.413
14	47.116	76.915
15	48.291	78.533
16	49.158	80.000

Circle Center At X = 30.454 ; Y = 90.218 ; and Radius = 21.314

Factor of Safety

*** 1.733 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	13.158	70.004
2	15.022	69.280
3	16.929	68.678
4	18.872	68.201
5	20.840	67.849
6	22.828	67.625
7	24.826	67.530
8	26.825	67.564
9	28.819	67.727
10	30.797	68.018
11	32.753	68.436
12	34.678	68.979
13	36.564	69.646
14	38.402	70.433
15	40.187	71.336
16	41.909	72.353
17	43.562	73.479
18	45.139	74.710
19	46.633	76.039
20	48.038	77.462
21	49.349	78.973
22	50.130	80.000

Circle Center At X = 25.297 ; Y = 98.478 ; and Radius = 30.953

Factor of Safety

*** 1.750 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.000	70.008
2	26.806	69.149
3	28.723	68.577
4	30.704	68.308
5	32.704	68.346

6	34.674	68.691
7	36.567	69.335
8	38.339	70.263
9	39.947	71.452
10	41.353	72.875
11	42.523	74.497
12	43.430	76.279
13	44.053	78.180
14	44.350	80.000

Circle Center At X = 31.457 ; Y = 81.237 ; and Radius = 12.952

Factor of Safety

*** 1.757 ***

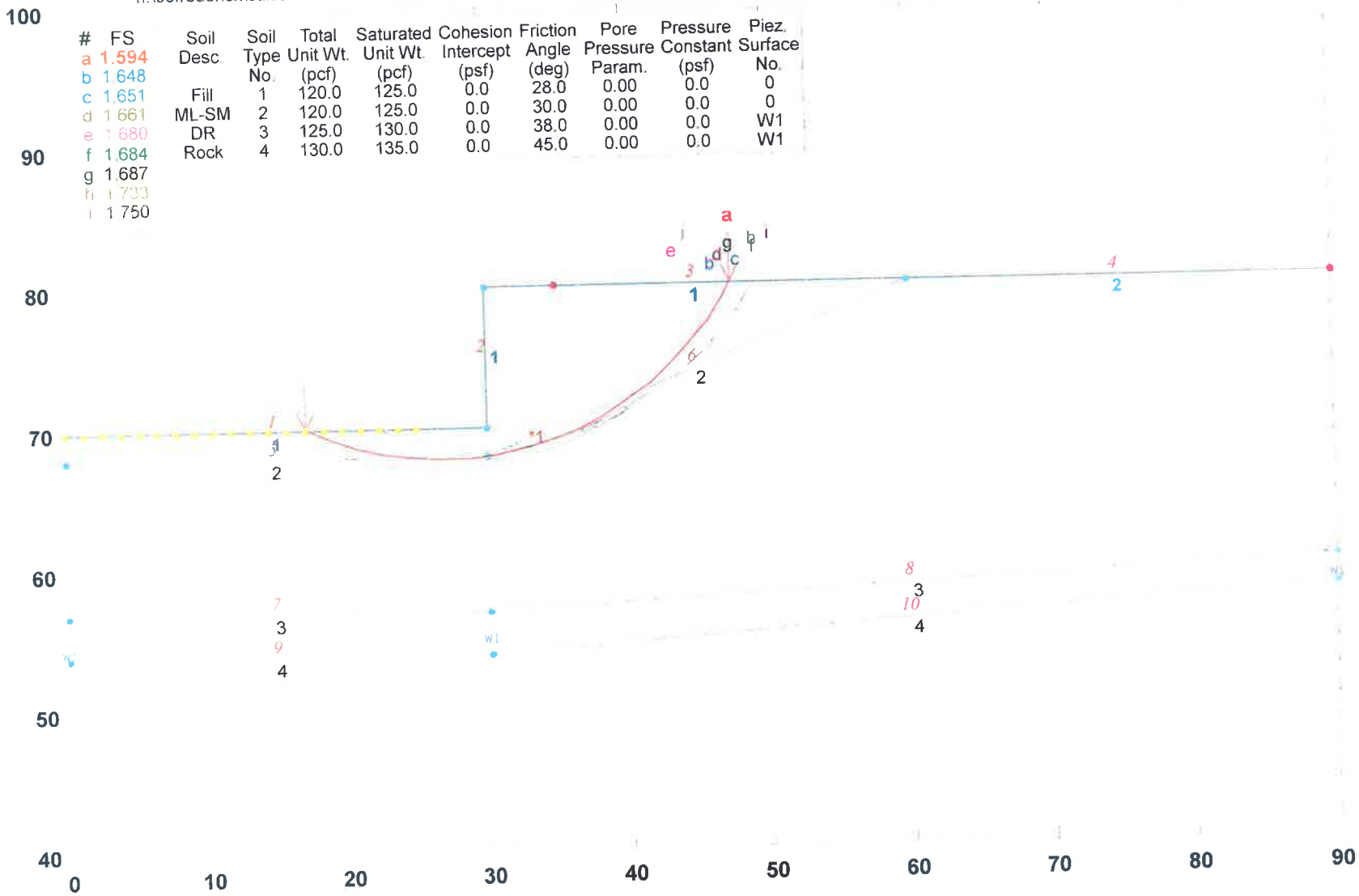
**** END OF GSTABL7 OUTPUT ****

Lovettsville Park - Retaining Wall 2 RW-2S (Segmental Retiaining Wall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\rw-2s.pl2 Run By: SPECIALIZED ENGINEERING 1/5/2015 01:04PM

#	FS
a	1.594
b	1.648
c	1.651
d	1.661
e	1.680
f	1.684
g	1.687
h	1.733
i	1.750

Soil Desc	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.
Fill	1	120.0	125.0	0.0	28.0	0.00	0.0	0
ML-SM	2	120.0	125.0	0.0	30.0	0.00	0.0	0
DR	3	125.0	130.0	0.0	38.0	0.00	0.0	W1
Rock	4	130.0	135.0	0.0	45.0	0.00	0.0	W1

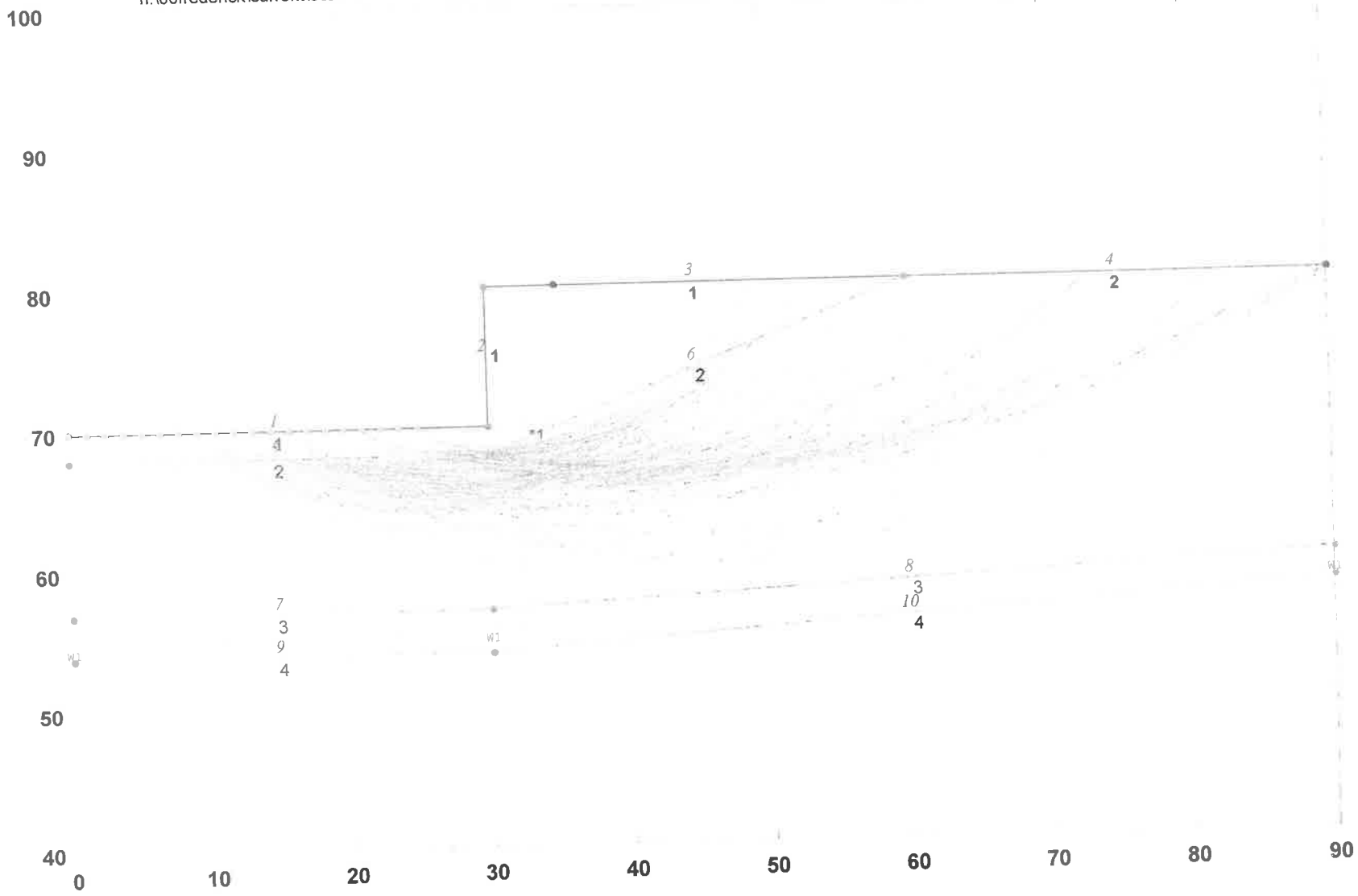


GSTABL7 v.2 FSmin=1.594

Safety Factors Are Calculated By The Modified Bishop Method

Lovettsville Park - Retaining Wall 2 RW-2S (Segmental Retiaining Wall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\rw-2s.plt Run By: SPECIALIZED ENGINEERING 1/5/2015 01:11PM



*** GSTABL7 ***

** GSTABL7 by Dr. Garry H. Gregory, Ph.D.,P.E.,D.GE **
** Original Version 1.0, January 1996; Current Ver. 2.005.3, Feb. 2013 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

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Analysis Run Date: 1/5/2015
Time of Run: 01:04PM
Run By: SPECIALIZED ENGINEERING
Input Data Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Globa
l Stability\rw-2S.in
Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Globa
l Stability\rw-2S.OUT
Unit System: English
Plotted Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Globa
l Stability\rw-2S.PLT
PROBLEM DESCRIPTION: Lovettsville Park - Retaining Wall 2
RW-2S (Segmental Retiaining Wall)

BOUNDARY COORDINATES
4 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	70.00	30.00	70.01	1
2	30.00	70.01	30.01	80.00	1
3	30.01	80.00	60.00	80.00	1
4	60.00	80.00	90.00	80.00	2
5	0.00	68.00	30.00	68.00	2
6	30.00	68.00	60.00	80.00	2
7	0.00	57.00	30.00	57.00	3
8	30.00	57.00	90.00	60.00	3
9	0.00	54.00	30.00	54.00	4
10	30.00	54.00	90.00	58.00	4

User Specified Y-Origin = 40.00(ft)
User Specified X-Plus Value = 10.00(ft)
Default Y-Plus Value = 0.00(ft)

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	120.0	125.0	0.0	28.0	0.00	0.0	0
2	120.0	125.0	0.0	30.0	0.00	0.0	0
3	125.0	130.0	0.0	38.0	0.00	0.0	1
4	130.0	135.0	0.0	45.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 3 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	55.00
2	30.00	55.50
3	90.00	59.00

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	30.00	70.00	37.00	70.01

A Critical Failure Surface Searching Method, Using A Random

Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 0.00(ft)
and X = 25.00(ft)
Each Surface Terminates Between X = 35.00(ft)
and X = 90.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 40.00(ft)
2.00(ft) Line Segments Define Each Trial Failure Surface.
Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -45.0
And -15.0 deg.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 9.912 FS Min = 1.594 FS Ave = 3.605
Standard Deviation = 1.387 Coefficient of Variation = 38.47 %
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.105	70.006
2	18.945	69.222
3	20.846	68.601
4	22.794	68.145
5	24.773	67.860
6	26.770	67.746
7	28.769	67.805
8	30.756	68.037
9	32.715	68.439
10	34.632	69.009
11	36.493	69.742
12	38.284	70.633
13	39.991	71.675
14	41.601	72.860
15	43.104	74.180
16	44.487	75.625
17	45.740	77.184
18	46.853	78.845
19	47.491	80.000

Circle Center At X = 27.085 ; Y = 90.895 ; and Radius = 23.151
Factor of Safety
*** 1.594 ***
Individual data on the 22 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.8	86.6	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.9	249.8	0.0	0.0	0.	0.	0.0	0.0	0.0
3	1.9	381.9	0.0	0.0	0.	0.	0.0	0.0	0.0
4	1.0	234.0	0.0	0.0	0.	0.	0.0	0.0	0.0
5	1.0	242.4	0.0	0.0	0.	0.	0.0	0.0	0.0
6	2.0	528.5	0.0	0.0	0.	0.	0.0	0.0	0.0
7	2.0	535.8	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.2	315.0	0.0	0.0	0.	0.	0.0	0.0	0.0
9	0.0	8.5	0.0	0.0	0.	0.	0.0	0.0	0.0
10	0.7	1074.6	0.0	0.0	0.	0.	0.0	0.0	0.0
11	2.0	2765.3	0.0	0.0	0.	0.	0.0	0.0	0.0
12	1.9	2594.2	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.9	2372.5	0.0	0.0	0.	0.	0.0	0.0	0.0
14	1.8	2108.5	0.0	0.0	0.	0.	0.0	0.0	0.0
15	1.7	1812.1	0.0	0.0	0.	0.	0.0	0.0	0.0

16	1.0	915.7	0.0	0.0	0.	0.	0.0	0.0	0.0
17	0.7	578.9	0.0	0.0	0.	0.	0.0	0.0	0.0
18	1.5	1168.2	0.0	0.0	0.	0.	0.0	0.0	0.0
19	1.4	845.8	0.0	0.0	0.	0.	0.0	0.0	0.0
20	1.3	540.6	0.0	0.0	0.	0.	0.0	0.0	0.0
21	1.1	265.3	0.0	0.0	0.	0.	0.0	0.0	0.0
22	0.6	44.1	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.684	70.008
2	25.544	69.271
3	27.479	68.769
4	29.462	68.507
5	31.462	68.492
6	33.449	68.722
7	35.392	69.194
8	37.263	69.902
9	39.033	70.834
10	40.674	71.976
11	42.163	73.311
12	43.477	74.820
13	44.595	76.478
14	45.502	78.260
15	46.131	80.000

Circle Center At X = 30.589 ; Y = 84.720 ; and Radius = 16.252

Factor of Safety

*** 1.648 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	70.007
2	24.256	69.347
3	26.201	68.879
4	28.182	68.608
5	30.181	68.536
6	32.177	68.664
7	34.150	68.990
8	36.081	69.512
9	37.949	70.225
10	39.738	71.120
11	41.428	72.190
12	43.002	73.424
13	44.445	74.808
14	45.743	76.330
15	46.883	77.973
16	47.852	79.723
17	47.971	80.000

Circle Center At X = 29.902 ; Y = 88.526 ; and Radius = 19.992

Factor of Safety

*** 1.651 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	70.007
2	24.203	69.211
3	26.117	68.631
4	28.085	68.273
5	30.081	68.143
6	32.078	68.243
7	34.051	68.570
8	35.974	69.122
9	37.820	69.890
10	39.567	70.864
11	41.190	72.032
12	42.669	73.379
13	43.984	74.885

14	45.118	76.533
15	46.056	78.300
16	46.721	80.000

Circle Center At X = 30.212 ; Y = 85.563 ; and Radius = 17.421

Factor of Safety
*** 1.661 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.000	70.008
2	26.808	69.154
3	28.731	68.602
4	30.717	68.369
5	32.715	68.459
6	34.672	68.871
7	36.537	69.593
8	38.261	70.607
9	39.798	71.887
10	41.109	73.398
11	42.158	75.100
12	42.918	76.950
13	43.370	78.898
14	43.443	80.000

Circle Center At X = 31.159 ; Y = 80.656 ; and Radius = 12.301

Factor of Safety
*** 1.680 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	19.737	70.007
2	21.613	69.313
3	23.541	68.781
4	25.507	68.416
5	27.497	68.219
6	29.497	68.192
7	31.492	68.336
8	33.467	68.649
9	35.409	69.129
10	37.303	69.773
11	39.135	70.575
12	40.892	71.530
13	42.561	72.632
14	44.130	73.872
15	45.589	75.240
16	46.925	76.728
17	48.130	78.325
18	49.183	80.000

Circle Center At X = 28.810 ; Y = 91.653 ; and Radius = 23.471

Factor of Safety
*** 1.684 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	15.789	70.005
2	17.570	69.094
3	19.423	68.343
4	21.336	67.758
5	23.293	67.344
6	25.278	67.104
7	27.277	67.040
8	29.274	67.152
9	31.253	67.440
10	33.199	67.901
11	35.097	68.532
12	36.932	69.328
13	38.690	70.282
14	40.356	71.388

15	41.919	72.636
16	43.366	74.017
17	44.685	75.520
18	45.867	77.133
19	46.902	78.845
20	47.468	80.000

Circle Center At X = 26.999 ; Y = 89.678 ; and Radius = 22.642

Factor of Safety

*** 1.687 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.684	70.008
2	25.609	69.463
3	27.575	69.101
4	29.568	68.924
5	31.568	68.935
6	33.558	69.133
7	35.521	69.516
8	37.439	70.082
9	39.296	70.824
10	41.075	71.737
11	42.762	72.813
12	44.339	74.042
13	45.795	75.413
14	47.116	76.915
15	48.291	78.533
16	49.158	80.000

Circle Center At X = 30.454 ; Y = 90.218 ; and Radius = 21.314

Factor of Safety

*** 1.733 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	13.158	70.004
2	15.022	69.280
3	16.929	68.678
4	18.872	68.201
5	20.840	67.849
6	22.828	67.625
7	24.826	67.530
8	26.825	67.564
9	28.819	67.727
10	30.797	68.018
11	32.753	68.436
12	34.678	68.979
13	36.564	69.646
14	38.402	70.433
15	40.187	71.336
16	41.909	72.353
17	43.562	73.479
18	45.139	74.710
19	46.633	76.039
20	48.038	77.462
21	49.349	78.973
22	50.130	80.000

Circle Center At X = 25.297 ; Y = 98.478 ; and Radius = 30.953

Factor of Safety

*** 1.750 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.000	70.008
2	26.806	69.149
3	28.723	68.577
4	30.704	68.308
5	32.704	68.346

6	34.674	68.691
7	36.567	69.335
8	38.339	70.263
9	39.947	71.452
10	41.353	72.875
11	42.523	74.497
12	43.430	76.279
13	44.053	78.180
14	44.350	80.000

Circle Center At X = 31.457 ; Y = 81.237 ; and Radius = 12.952

Factor of Safety

*** 1.757 ***

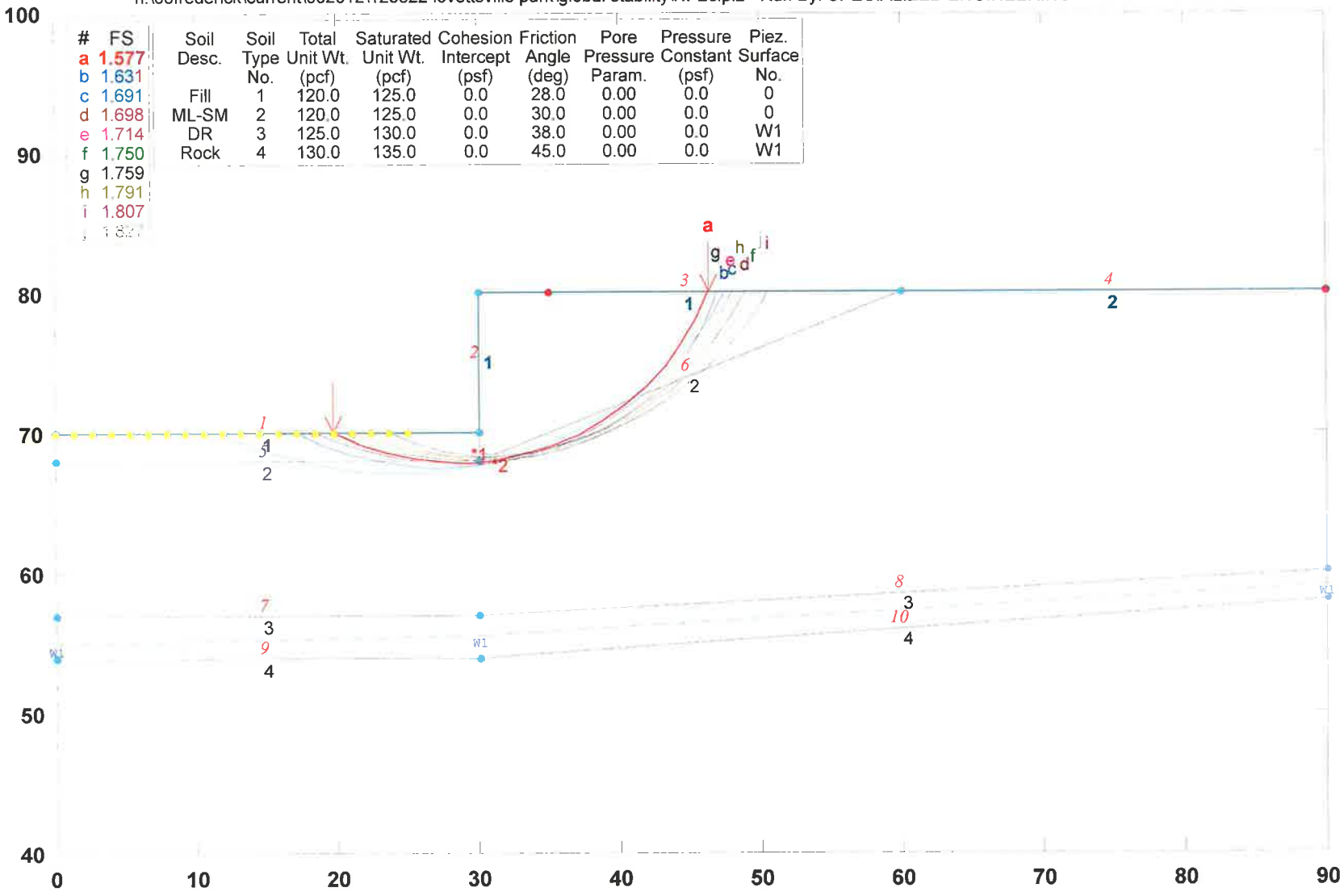
**** END OF GSTABL7 OUTPUT ****

Lovettsville Park - Retaining Wall 2 RW-2C (Concrete Cantilever retaininWall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\rw-2c.pl2 Run By: SPECIALIZED ENGINEERING 1/7/2015 10:13AM

#	FS
a	1.577
b	1.631
c	1.691
d	1.698
e	1.714
f	1.750
g	1.759
h	1.791
i	1.807

Soil Desc.	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.
Fill	1	120.0	125.0	0.0	28.0	0.00	0.0	0
ML-SM	2	120.0	125.0	0.0	30.0	0.00	0.0	0
DR	3	125.0	130.0	0.0	38.0	0.00	0.0	W1
Rock	4	130.0	135.0	0.0	45.0	0.00	0.0	W1

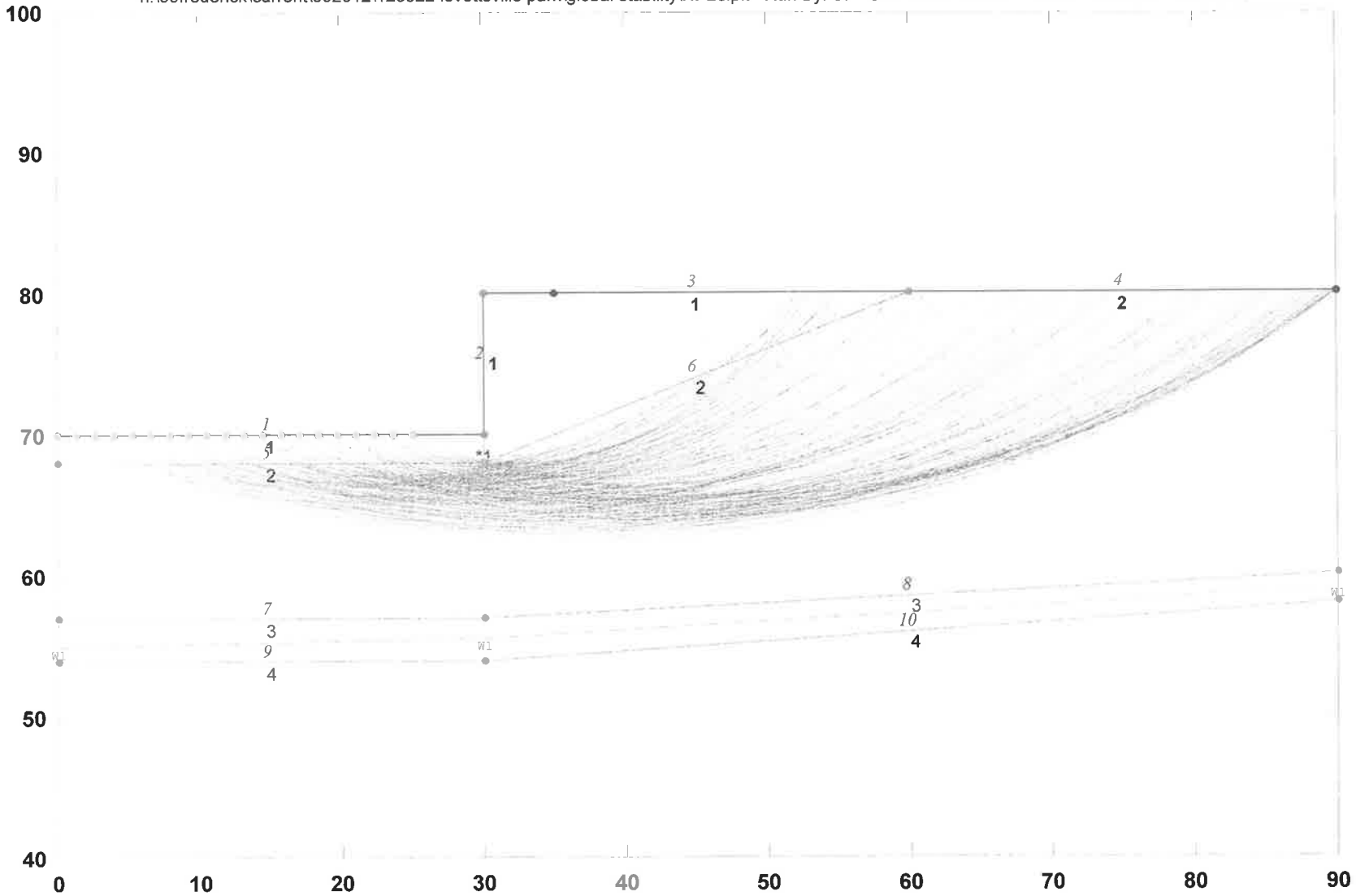


GSTABL7 v.2 FSmin=1.577

Safety Factors Are Calculated By The Modified Bishop Method

Lovettsville Park - Retaining Wall 2 RW-2C (Concrete Cantilever retainingWall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\rw-2c.plt Run By: SPECIALIZED ENGINEERING 1/7/2015 10:13AM



*** GSTABL7 ***

** GSTABL7 by Dr. Garry H. Gregory, Ph.D.,P.E.,D.GE **
** Original Version 1.0, January 1996; Current Ver. 2.005.3, Feb. 2013 **

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SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

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Analysis Run Date: 1/7/2015
Time of Run: 10:13AM
Run By: SPECIALIZED ENGINEERING
Input Data Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-2c.in
Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-2c.OUT
Unit System: English
Plotted Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-2c.PLT
PROBLEM DESCRIPTION: Lovettsville Park - Retaining Wall 2
RW-2C (Concrete Cantilever retaininWall)

BOUNDARY COORDINATES
4 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	70.00	30.00	70.01	1
2	30.00	70.01	30.01	80.00	1
3	30.01	80.00	60.00	80.00	1
4	60.00	80.00	90.00	80.00	2
5	0.00	68.00	30.00	68.00	2
6	30.00	68.00	60.00	80.00	2
7	0.00	57.00	30.00	57.00	3
8	30.00	57.00	90.00	60.00	3
9	0.00	54.00	30.00	54.00	4
10	30.00	54.00	90.00	58.00	4

User Specified Y-Origin = 40.00(ft)
User Specified X-Plus Value = 10.00(ft)
Default Y-Plus Value = 0.00(ft)

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	120.0	125.0	0.0	28.0	0.00	0.0	0
2	120.0	125.0	0.0	30.0	0.00	0.0	0
3	125.0	130.0	0.0	38.0	0.00	0.0	1
4	130.0	135.0	0.0	45.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 3 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	55.00
2	30.00	55.50
3	90.00	59.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 2 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	30.00	68.50	30.01	70.00
2	30.00	68.50	33.00	68.51

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 0.00(ft)
and X = 25.00(ft)
Each Surface Terminates Between X = 35.00(ft)
and X = 90.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 40.00(ft)
2.00(ft) Line Segments Define Each Trial Failure Surface.
Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -25.0
And -20.0 deg.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 6.523 FS Min = 1.577 FS Ave = 3.583
Standard Deviation = 1.227 Coefficient of Variation = 34.23 %
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	19.737	70.007
2	21.553	69.170
3	23.448	68.529
4	25.399	68.090
5	27.386	67.860
6	29.386	67.839
7	31.377	68.029
8	33.337	68.427
9	35.244	69.029
10	37.077	69.828
11	38.817	70.816
12	40.442	71.980
13	41.937	73.310
14	43.283	74.789
15	44.466	76.401
16	45.473	78.129
17	46.293	79.953
18	46.308	80.000

Circle Center At X = 28.581 ; Y = 86.813 ; and Radius = 18.992
Factor of Safety
*** 1.577 ***
Individual data on the 21 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.8	91.3	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.9	263.3	0.0	0.0	0.	0.	0.0	0.0	0.0
3	2.0	397.7	0.0	0.0	0.	0.	0.0	0.0	0.0
4	0.8	183.4	0.0	0.0	0.	0.	0.0	0.0	0.0
5	1.2	301.5	0.0	0.0	0.	0.	0.0	0.0	0.0
6	2.0	518.4	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.6	157.9	0.0	0.0	0.	0.	0.0	0.0	0.0
8	0.0	8.5	0.0	0.0	0.	0.	0.0	0.0	0.0
9	1.4	1974.1	0.0	0.0	0.	0.	0.0	0.0	0.0
10	2.0	2768.8	0.0	0.0	0.	0.	0.0	0.0	0.0
11	1.9	2579.9	0.0	0.0	0.	0.	0.0	0.0	0.0
12	1.8	2325.8	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.7	2019.9	0.0	0.0	0.	0.	0.0	0.0	0.0
14	1.6	1678.2	0.0	0.0	0.	0.	0.0	0.0	0.0
15	0.4	377.6	0.0	0.0	0.	0.	0.0	0.0	0.0

16	1.1	941.2	0.0	0.0	0.	0.	0.0	0.0	0.0
17	1.3	961.3	0.0	0.0	0.	0.	0.0	0.0	0.0
18	1.2	625.4	0.0	0.0	0.	0.	0.0	0.0	0.0
19	1.0	330.5	0.0	0.0	0.	0.	0.0	0.0	0.0
20	0.8	94.3	0.0	0.0	0.	0.	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.105	70.006
2	18.920	69.165
3	20.802	68.489
4	22.738	67.985
5	24.710	67.656
6	26.705	67.505
7	28.705	67.533
8	30.694	67.740
9	32.657	68.124
10	34.577	68.683
11	36.440	69.411
12	38.230	70.303
13	39.933	71.351
14	41.536	72.548
15	43.025	73.883
16	44.388	75.346
17	45.615	76.926
18	46.696	78.609
19	47.422	80.000

Circle Center At X = 27.391 ; Y = 89.817 ; and Radius = 22.322

Factor of Safety

*** 1.631 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	11.842	70.004
2	13.669	69.189
3	15.548	68.506
4	17.471	67.957
5	19.428	67.545
6	21.410	67.272
7	23.405	67.139
8	25.405	67.148
9	27.400	67.298
10	29.379	67.588
11	31.332	68.017
12	33.250	68.583
13	35.124	69.283
14	36.943	70.114
15	38.699	71.071
16	40.384	72.149
17	41.988	73.344
18	43.503	74.649
19	44.923	76.057
20	46.240	77.562
21	47.448	79.157
22	47.997	80.000

Circle Center At X = 24.278 ; Y = 95.408 ; and Radius = 28.285

Factor of Safety

*** 1.691 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	19.737	70.007
2	21.597	69.271
3	23.514	68.703
4	25.475	68.306
5	27.462	68.084

6	29.462	68.037
7	31.457	68.167
8	33.434	68.473
9	35.376	68.952
10	37.268	69.600
11	39.095	70.413
12	40.844	71.384
13	42.500	72.505
14	44.051	73.768
15	45.484	75.162
16	46.789	76.678
17	47.955	78.303
18	48.959	80.000

Circle Center At X = 28.986 ; Y = 90.682 ; and Radius = 22.650

Factor of Safety

*** 1.698 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	70.007
2	24.228	69.271
3	26.154	68.732
4	28.126	68.397
5	30.122	68.270
6	32.120	68.352
7	34.099	68.641
8	36.037	69.136
9	37.913	69.829
10	39.706	70.715
11	41.397	71.783
12	42.967	73.022
13	44.399	74.418
14	45.679	75.955
15	46.790	77.618
16	47.723	79.387
17	47.968	80.000

Circle Center At X = 30.341 ; Y = 87.415 ; and Radius = 19.146

Factor of Safety

*** 1.714 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	21.053	70.007
2	22.930	69.317
3	24.861	68.796
4	26.830	68.448
5	28.823	68.277
6	30.823	68.284
7	32.814	68.468
8	34.782	68.829
9	36.709	69.362
10	38.582	70.065
11	40.384	70.931
12	42.103	71.954
13	43.724	73.126
14	45.234	74.437
15	46.622	75.877
16	47.877	77.434
17	48.988	79.097
18	49.482	80.000

Circle Center At X = 29.747 ; Y = 90.709 ; and Radius = 22.453

Factor of Safety

*** 1.750 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.684	70.008

2	25.523	69.222
3	27.444	68.664
4	29.418	68.342
5	31.416	68.261
6	33.410	68.423
7	35.369	68.824
8	37.266	69.459
9	39.071	70.318
10	40.760	71.390
11	42.307	72.658
12	43.689	74.103
13	44.887	75.705
14	45.882	77.440
15	46.660	79.282
16	46.865	80.000

Circle Center At X = 31.081 ; Y = 84.732 ; and Radius = 16.478

Factor of Safety

*** 1.759 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.368	70.007
2	24.214	69.238
3	26.130	68.663
4	28.095	68.288
5	30.087	68.119
6	32.087	68.157
7	34.072	68.401
8	36.021	68.848
9	37.914	69.494
10	39.730	70.333
11	41.449	71.354
12	43.054	72.548
13	44.527	73.901
14	45.852	75.399
15	47.016	77.026
16	48.005	78.764
17	48.548	80.000

Circle Center At X = 30.725 ; Y = 87.448 ; and Radius = 19.340

Factor of Safety

*** 1.791 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	18.421	70.006
2	20.275	69.256
3	22.182	68.654
4	24.131	68.204
5	26.109	67.908
6	28.104	67.770
7	30.104	67.789
8	32.096	67.965
9	34.068	68.297
10	36.008	68.784
11	37.904	69.422
12	39.743	70.208
13	41.515	71.135
14	43.208	72.200
15	44.813	73.394
16	46.318	74.711
17	47.715	76.142
18	48.995	77.679
19	50.150	79.312
20	50.559	80.000

Circle Center At X = 28.862 ; Y = 93.103 ; and Radius = 25.347

Factor of Safety

*** 1.807 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	18.421	70.006
2	20.239	69.172
3	22.121	68.495
4	24.053	67.979
5	26.022	67.628
6	28.014	67.445
7	30.014	67.431
8	32.008	67.586
9	33.981	67.908
10	35.921	68.397
11	37.812	69.047
12	39.642	69.855
13	41.397	70.814
14	43.064	71.918
15	44.632	73.160
16	46.090	74.529
17	47.427	76.016
18	48.634	77.611
19	49.701	79.303
20	50.063	80.000

Circle Center At X = 29.179 ; Y = 91.033 ; and Radius = 23.619

Factor of Safety

*** 1.827 ***

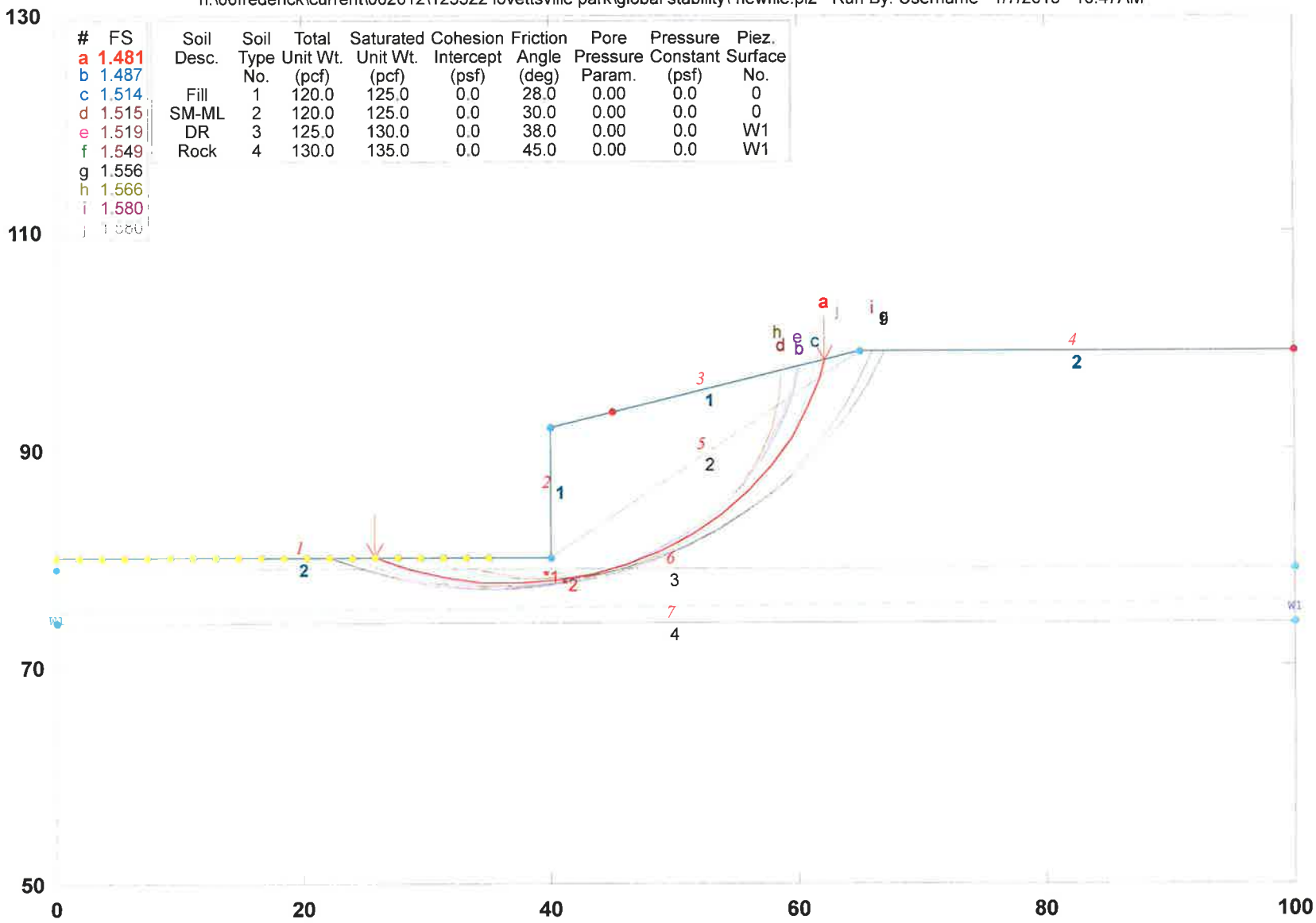
**** END OF GSTABL7 OUTPUT ****

Retaining Wall 3C RW 3 (Concrete Cantliver Wall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\-newfile.pl2 Run By: Username 1/7/2015 10:47AM

#	FS
a	1.481
b	1.487
c	1.514
d	1.515
e	1.519
f	1.549
g	1.556
h	1.566
i	1.580
j	1.580

Soil Desc.	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.
Fill	1	120.0	125.0	0.0	28.0	0.00	0.0	0
SM-ML	2	120.0	125.0	0.0	30.0	0.00	0.0	0
DR	3	125.0	130.0	0.0	38.0	0.00	0.0	W1
Rock	4	130.0	135.0	0.0	45.0	0.00	0.0	W1

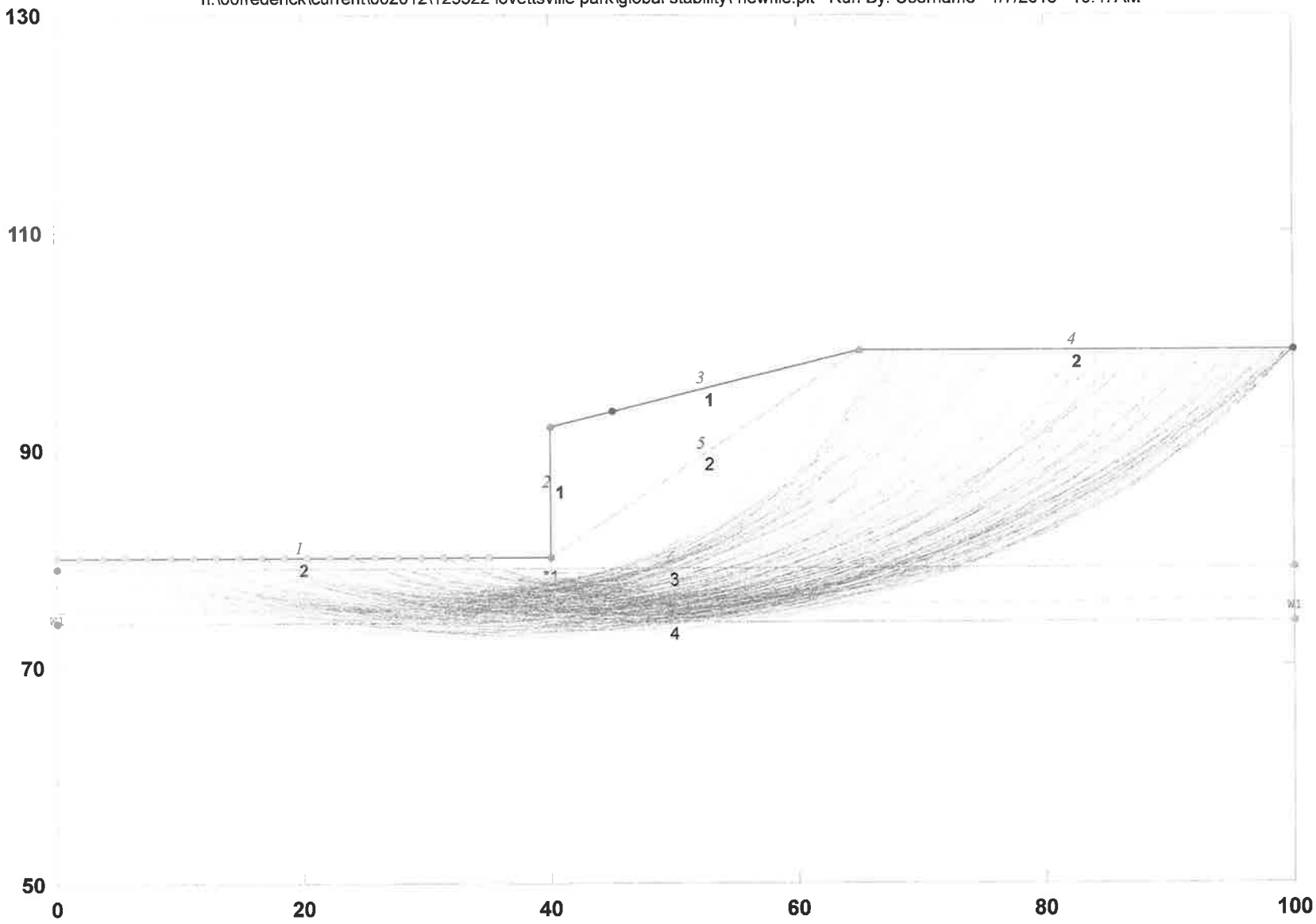


GSTABL7 v.2 FSmin=1.481

Safety Factors Are Calculated By The Modified Bishop Method

Retaining Wall 3C RW 3 (Concrete Cantliver Wall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\-newfile.plt Run By: Username 1/7/2015 10:47AM



***** GSTABL7 *****

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 1/7/2015
Time of Run: 10:47AM
Run By: Username
Input Data Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\-newfile.in
Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\-newfile.OUT
Unit System: English
Plotted Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\-newfile.PLT

PROBLEM DESCRIPTION: Retaining Wall 3C
RW 3 (Concrete Cantliver Wall)

BOUNDARY COORDINATES
4 Top Boundaries
7 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	80.00	40.00	80.01	2
2	40.00	80.01	40.01	92.00	1
3	40.01	92.00	65.00	99.00	1
4	65.00	99.00	100.00	99.00	2
5	40.00	80.01	65.00	99.00	2
6	0.00	79.00	100.00	79.00	3
7	0.00	74.00	100.00	74.00	4

User Specified Y-Origin = 50.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

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	120.0	125.0	0.0	28.0	0.00	0.0	0
2	120.0	125.0	0.0	30.0	0.00	0.0	0
3	125.0	130.0	0.0	38.0	0.00	0.0	1
4	130.0	135.0	0.0	45.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	75.00
2	100.00	76.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 2 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	40.00	78.50	40.01	80.01
2	40.00	78.50	43.00	78.51

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced

Along The Ground Surface Between X = 0.00(ft)
and X = 35.00(ft)
Each Surface Terminates Between X = 45.00(ft)
and X = 100.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 50.00(ft)
3.00(ft) Line Segments Define Each Trial Failure Surface.
Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -25.0
And -20.0 deg.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 3.936 FS Min = 1.481 FS Ave = 2.559
Standard Deviation = 0.591 Coefficient of Variation = 23.07 %
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.789	80.006
2	28.576	78.896
3	31.473	78.115
4	34.440	77.674
5	37.439	77.579
6	40.428	77.830
7	43.369	78.426
8	46.220	79.357
9	48.945	80.612
10	51.507	82.173
11	53.872	84.020
12	56.007	86.127
13	57.884	88.467
14	59.478	91.008
15	60.768	93.717
16	61.737	96.556
17	62.089	98.184

Circle Center At X = 36.761 ; Y = 103.490 ; and Radius = 25.920
Factor of Safety
*** 1.481 ***
Individual data on the 21 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.5	152.6	0.0	0.0	0.	0.	0.0	0.0	0.0
2	0.3	33.3	0.0	0.0	0.	0.	0.0	0.0	0.0
3	2.9	529.3	0.0	0.0	0.	0.	0.0	0.0	0.0
4	3.0	769.1	0.0	0.0	0.	0.	0.0	0.0	0.0
5	3.0	878.0	0.0	0.0	0.	0.	0.0	0.0	0.0
6	2.6	730.8	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.0	9.9	0.0	0.0	0.	0.	0.0	0.0	0.0
8	0.4	717.4	0.0	0.0	0.	0.	0.0	0.0	0.0
9	2.9	5093.9	0.0	0.0	0.	0.	0.0	0.0	0.0
10	1.8	3055.4	0.0	0.0	0.	0.	0.0	0.0	0.0
11	1.1	1891.6	0.0	0.0	0.	0.	0.0	0.0	0.0
12	2.7	4622.8	0.0	0.0	0.	0.	0.0	0.0	0.0
13	2.6	4140.7	0.0	0.0	0.	0.	0.0	0.0	0.0
14	2.4	3533.8	0.0	0.0	0.	0.	0.0	0.0	0.0
15	2.1	2846.1	0.0	0.0	0.	0.	0.0	0.0	0.0
16	1.9	2128.1	0.0	0.0	0.	0.	0.0	0.0	0.0
17	1.6	1433.4	0.0	0.0	0.	0.	0.0	0.0	0.0
18	1.3	816.0	0.0	0.0	0.	0.	0.0	0.0	0.0
19	1.0	324.0	0.0	0.0	0.	0.	0.0	0.0	0.0
20	0.0	3.0	0.0	0.0	0.	0.	0.0	0.0	0.0

21 0.4 32.3 0.0 0.0 0. 0. 0.0 0.0 0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.789	80.006
2	28.538	78.805
3	31.417	77.960
4	34.379	77.486
5	37.378	77.389
6	40.364	77.673
7	43.291	78.331
8	46.111	79.354
9	48.780	80.725
10	51.254	82.422
11	53.493	84.418
12	55.463	86.681
13	57.130	89.175
14	58.470	91.859
15	59.459	94.691
16	60.083	97.623

Circle Center At X = 36.637 ; Y = 101.076 ; and Radius = 23.698

Factor of Safety

*** 1.487 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	29.474	80.007
2	32.281	78.949
3	35.203	78.271
4	38.190	77.985
5	41.188	78.097
6	44.144	78.603
7	47.008	79.496
8	49.729	80.760
9	52.259	82.372
10	54.554	84.304
11	56.574	86.523
12	58.282	88.989
13	59.650	91.659
14	60.652	94.487
15	61.272	97.422
16	61.314	97.967

Circle Center At X = 38.851 ; Y = 100.586 ; and Radius = 22.615

Factor of Safety

*** 1.514 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	31.316	80.008
2	34.111	78.919
3	37.043	78.284
4	40.039	78.117
5	43.023	78.424
6	45.922	79.197
7	48.663	80.416
8	51.178	82.051
9	53.404	84.062
10	55.287	86.398
11	56.779	89.001
12	57.842	91.806
13	58.451	94.743
14	58.565	97.197

Circle Center At X = 39.592 ; Y = 97.081 ; and Radius = 18.973

Factor of Safety

*** 1.515 ***

Failure Surface Specified By 17 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	23.947	80.006
2	26.669	78.744
3	29.524	77.822
4	32.470	77.254
5	35.462	77.047
6	38.458	77.205
7	41.413	77.725
8	44.282	78.601
9	47.024	79.818
10	49.598	81.359
11	51.966	83.201
12	54.093	85.317
13	55.947	87.675
14	57.501	90.241
15	58.732	92.977
16	59.622	95.842
17	59.938	97.582

Circle Center At X = 35.664 ; Y = 101.714 ; and Radius = 24.668

Factor of Safety

*** 1.519 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.105	80.006
2	24.916	78.956
3	27.808	78.159
4	30.759	77.622
5	33.747	77.348
6	36.747	77.340
7	39.736	77.599
8	42.690	78.121
9	45.586	78.902
10	48.402	79.938
11	51.115	81.219
12	53.704	82.735
13	56.148	84.474
14	58.428	86.424
15	60.527	88.567
16	62.427	90.889
17	64.114	93.369
18	65.575	95.990
19	66.798	98.729
20	66.891	99.000

Circle Center At X = 35.334 ; Y = 111.110 ; and Radius = 33.801

Factor of Safety

*** 1.549 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.105	80.006
2	24.913	78.949
3	27.803	78.146
4	30.754	77.602
5	33.741	77.322
6	36.741	77.308
7	39.730	77.560
8	42.685	78.077
9	45.583	78.853
10	48.400	79.884
11	51.115	81.160
12	53.706	82.673
13	56.153	84.409
14	58.436	86.355
15	60.537	88.497
16	62.440	90.816
17	64.130	93.295

18	65.593	95.914
19	66.818	98.652
20	66.938	99.000

Circle Center At X = 35.397 ; Y = 111.040 ; and Radius = 33.761

Factor of Safety

*** 1.556 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	31.316	80.008
2	34.088	78.861
3	37.008	78.174
4	40.001	77.965
5	42.988	78.239
6	45.893	78.990
7	48.639	80.197
8	51.156	81.829
9	53.379	83.844
10	55.248	86.191
11	56.717	88.806
12	57.747	91.624
13	58.311	94.571
14	58.382	97.146

Circle Center At X = 39.798 ; Y = 96.554 ; and Radius = 18.593

Factor of Safety

*** 1.566 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.105	80.006
2	24.886	78.879
3	27.760	78.018
4	30.701	77.429
5	33.685	77.117
6	36.685	77.085
7	39.674	77.334
8	42.628	77.861
9	45.519	78.661
10	48.323	79.728
11	51.015	81.052
12	53.571	82.622
13	55.970	84.424
14	58.190	86.442
15	60.211	88.658
16	62.017	91.054
17	63.591	93.608
18	64.919	96.298
19	65.953	99.000

Circle Center At X = 35.524 ; Y = 109.144 ; and Radius = 32.080

Factor of Safety

*** 1.580 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.632	80.007
2	30.412	78.880
3	33.306	78.091
4	36.274	77.652
5	39.273	77.568
6	42.260	77.840
7	45.194	78.466
8	48.034	79.435
9	50.737	80.735
10	53.268	82.346
11	55.589	84.247
12	57.668	86.409
13	59.476	88.804

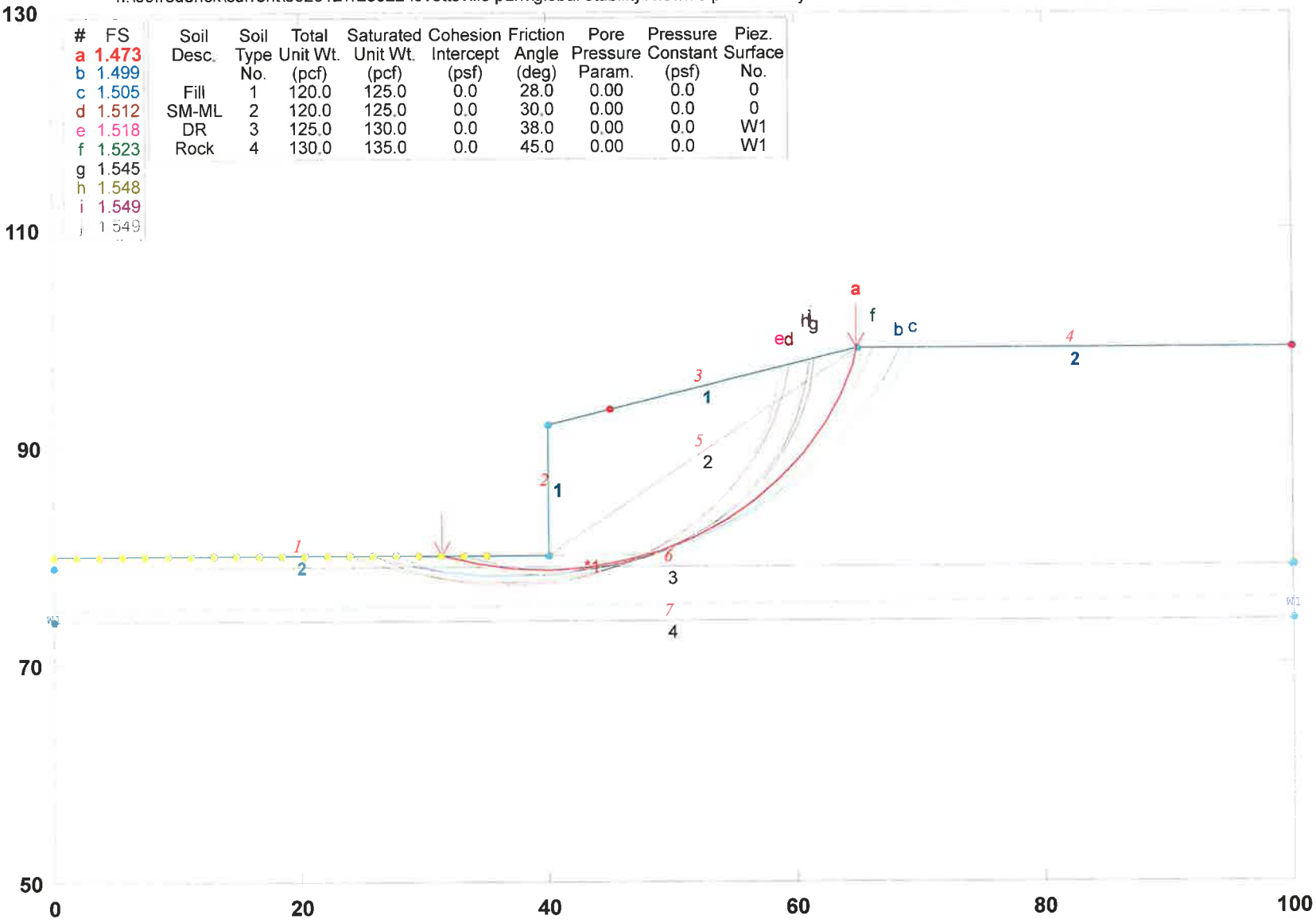
```
   14          60.987        91.396
   15          62.179        94.148
   16          63.036        97.023
   17          63.294        98.522
Circle Center At X =    38.479 ; Y =   102.777 ; and Radius =    25.222
      Factor of Safety
     ***    1.580   ***
         **** END OF GSTABL7 OUTPUT ****
```

Lovettsville Park - Retaining Wall 3 RW-3S (Segmental Retaining wall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\-newfile.pl2 Run By: SPECIALIZED ENGINEERING 1/7/2015 03:58PM

#	FS
a	1.473
b	1.499
c	1.505
d	1.512
e	1.518
f	1.523
g	1.545
h	1.548
i	1.549
j	1.549

Soil Desc.	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.
Fill	1	120.0	125.0	0.0	28.0	0.00	0.0	0
SM-ML	2	120.0	125.0	0.0	30.0	0.00	0.0	0
DR	3	125.0	130.0	0.0	38.0	0.00	0.0	W1
Rock	4	130.0	135.0	0.0	45.0	0.00	0.0	W1

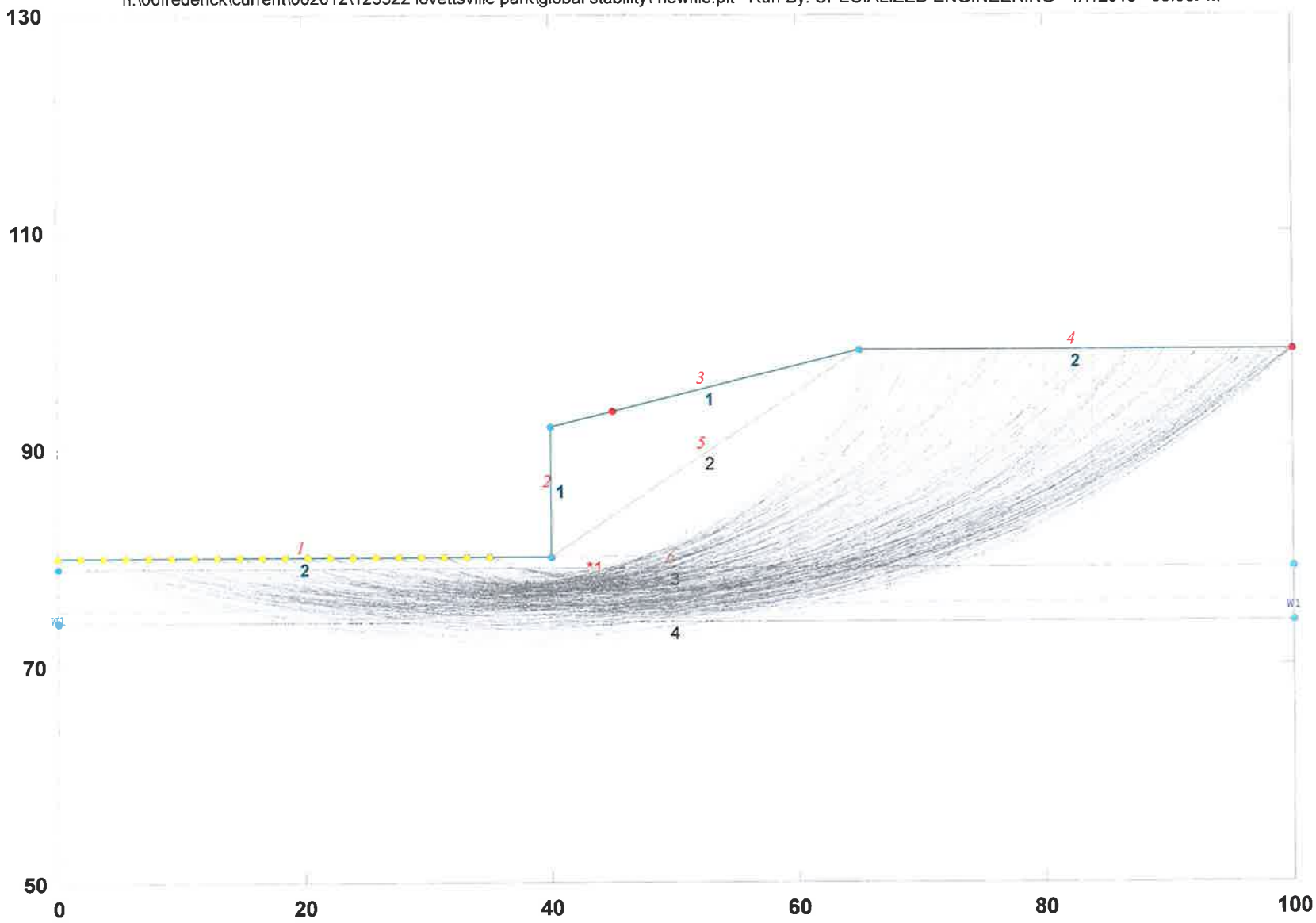


GSTABL7 v.2 FSmin=1.473

Safety Factors Are Calculated By The Modified Bishop Method

Lovettsville Park - Retaining Wall 3 RW-3S (Segmental Retaining wall)

h:\00frederick\current\002012\125522 lovettsville park\global stability\-newfile.plt Run By: SPECIALIZED ENGINEERING 1/7/2015 03:58PM



*** GSTABL7 ***

** GSTABL7 by Dr. Garry H. Gregory, Ph.D.,P.E.,D.GE **
** Original Version 1.0, January 1996; Current Ver. 2.005.3, Feb. 2013 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 1/7/2015
Time of Run: 10:59AM
Run By: Username
Input Data Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-3S.in
Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-3S.OUT
Unit System: English
Plotted Output Filename: H:\00Frederick\Current\002012\125522 Lovettsville Park\Global Stability\rw-3S.PLT

PROBLEM DESCRIPTION: Lovettsville Park - Retaining Wall 3
RW -3S (Segmental Retaining Wall)

BOUNDARY COORDINATES
4 Top Boundaries
7 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	80.00	40.00	80.01	2
2	40.00	80.01	40.01	92.00	1
3	40.01	92.00	65.00	99.00	1
4	65.00	99.00	100.00	99.00	2
5	40.00	80.01	65.00	99.00	2
6	0.00	79.00	100.00	79.00	3
7	0.00	74.00	100.00	74.00	4

User Specified Y-Origin = 50.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

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	120.0	125.0	0.0	28.0	0.00	0.0	0
2	120.0	125.0	0.0	30.0	0.00	0.0	0
3	125.0	130.0	0.0	38.0	0.00	0.0	1
4	130.0	135.0	0.0	45.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	75.00
2	100.00	76.00

Searching Routine Will Be Limited To An Area Defined By 2 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	40.00	80.00	47.00	80.01
2	0.00	0.00	0.00	0.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced

Along The Ground Surface Between X = 0.00(ft)
and X = 35.00(ft)
Each Surface Terminates Between X = 45.00(ft)
and X = 100.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 50.00(ft)
3.00(ft) Line Segments Define Each Trial Failure Surface.
Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -25.0
And -20.0 deg.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 4.138 FS Min = 1.438 FS Ave = 2.486
Standard Deviation = 0.557 Coefficient of Variation = 22.42 %
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.789	80.006
2	28.589	78.927
3	31.494	78.180
4	34.467	77.775
5	37.466	77.718
6	40.452	78.010
7	43.384	78.646
8	46.222	79.618
9	48.928	80.912
10	51.466	82.513
11	53.801	84.396
12	55.901	86.538
13	57.739	88.910
14	59.289	91.478
15	60.530	94.209
16	61.446	97.066
17	61.641	98.059

Circle Center At X = 36.457 ; Y = 103.504 ; and Radius = 25.805
Factor of Safety
*** 1.438 ***
Individual data on the 21 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.6	157.7	0.0	0.0	0.	0.	0.0	0.0	0.0
2	0.2	23.7	0.0	0.0	0.	0.	0.0	0.0	0.0
3	2.9	513.4	0.0	0.0	0.	0.	0.0	0.0	0.0
4	3.0	739.5	0.0	0.0	0.	0.	0.0	0.0	0.0
5	3.0	833.0	0.0	0.0	0.	0.	0.0	0.0	0.0
6	2.5	673.8	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.0	9.7	0.0	0.0	0.	0.	0.0	0.0	0.0
8	0.4	748.6	0.0	0.0	0.	0.	0.0	0.0	0.0
9	2.9	5008.0	0.0	0.0	0.	0.	0.0	0.0	0.0
10	1.0	1772.3	0.0	0.0	0.	0.	0.0	0.0	0.0
11	1.8	3068.6	0.0	0.0	0.	0.	0.0	0.0	0.0
12	2.7	4499.0	0.0	0.0	0.	0.	0.0	0.0	0.0
13	2.5	4001.7	0.0	0.0	0.	0.	0.0	0.0	0.0
14	2.3	3384.9	0.0	0.0	0.	0.	0.0	0.0	0.0
15	2.1	2694.3	0.0	0.0	0.	0.	0.0	0.0	0.0
16	1.8	1981.2	0.0	0.0	0.	0.	0.0	0.0	0.0
17	1.5	1299.9	0.0	0.0	0.	0.	0.0	0.0	0.0
18	1.2	704.6	0.0	0.0	0.	0.	0.0	0.0	0.0
19	0.6	191.5	0.0	0.0	0.	0.	0.0	0.0	0.0
20	0.3	54.5	0.0	0.0	0.	0.	0.0	0.0	0.0

21 0.2 11.0 0.0 0.0 0. 0. 0.0 0.0 0.0

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.789	80.006
2	28.581	78.908
3	31.481	78.139
4	34.450	77.709
5	37.449	77.623
6	40.437	77.884
7	43.376	78.487
8	46.226	79.424
9	48.949	80.683
10	51.509	82.248
11	53.871	84.097
12	56.005	86.205
13	57.882	88.546
14	59.477	91.087
15	60.768	93.795
16	61.739	96.633
17	62.076	98.181

Circle Center At X = 36.689 ; Y = 103.618 ; and Radius = 26.006

Factor of Safety

*** 1.470 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.105	80.006
2	24.915	78.953
3	27.810	78.169
4	30.767	77.661
5	33.758	77.433
6	36.758	77.486
7	39.739	77.822
8	42.675	78.436
9	45.541	79.324
10	48.311	80.477
11	50.960	81.885
12	53.465	83.536
13	55.803	85.414
14	57.955	87.505
15	59.901	89.788
16	61.624	92.244
17	63.108	94.851
18	64.341	97.586
19	64.805	98.945

Circle Center At X = 34.685 ; Y = 109.306 ; and Radius = 31.887

Factor of Safety

*** 1.479 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.632	80.007
2	30.441	78.954
3	33.356	78.246
4	36.335	77.893
5	39.335	77.900
6	42.313	78.266
7	45.225	78.988
8	48.029	80.054
9	50.685	81.448
10	53.155	83.151
11	55.402	85.139
12	57.395	87.381
13	59.104	89.847
14	60.505	92.499
15	61.577	95.301

16	62.306	98.211
17	62.310	98.247

Circle Center At X = 37.778 ; Y = 102.805 ; and Radius = 24.954

Factor of Safety

*** 1.484 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.105	80.006
2	24.915	78.955
3	27.810	78.166
4	30.764	77.647
5	33.754	77.402
6	36.754	77.432
7	39.739	77.737
8	42.682	78.316
9	45.560	79.162
10	48.349	80.270
11	51.023	81.629
12	53.562	83.227
13	55.943	85.053
14	58.146	87.089
15	60.153	89.319
16	61.946	91.724
17	63.511	94.283
18	64.834	96.976
19	65.607	99.000

Circle Center At X = 34.926 ; Y = 110.002 ; and Radius = 32.622

Factor of Safety

*** 1.504 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.105	80.006
2	24.919	78.964
3	27.815	78.182
4	30.770	77.666
5	33.760	77.421
6	36.760	77.449
7	39.745	77.749
8	42.690	78.319
9	45.572	79.155
10	48.365	80.248
11	51.048	81.591
12	53.597	83.173
13	55.993	84.979
14	58.214	86.995
15	60.243	89.205
16	62.063	91.590
17	63.658	94.131
18	65.016	96.806
19	65.890	99.000

Circle Center At X = 34.955 ; Y = 110.385 ; and Radius = 32.986

Factor of Safety

*** 1.507 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.789	80.006
2	28.511	78.745
3	31.375	77.850
4	34.331	77.337
5	37.328	77.216
6	40.316	77.488
7	43.242	78.148
8	46.057	79.186
9	48.712	80.582

10	51.162	82.314
11	53.363	84.352
12	55.280	86.660
13	56.878	89.199
14	58.129	91.926
15	59.014	94.792
16	59.465	97.450

Circle Center At X = 36.753 ; Y = 100.070 ; and Radius = 22.863

Factor of Safety

*** 1.518 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	22.105	80.006
2	24.920	78.966
3	27.814	78.178
4	30.766	77.646
5	33.754	77.374
6	36.754	77.365
7	39.743	77.618
8	42.699	78.133
9	45.598	78.904
10	48.419	79.926
11	51.139	81.191
12	53.738	82.689
13	56.196	84.409
14	58.494	86.338
15	60.614	88.461
16	62.540	90.760
17	64.257	93.220
18	65.753	95.821
19	67.015	98.543
20	67.180	99.000

Circle Center At X = 35.358 ; Y = 111.537 ; and Radius = 34.203

Factor of Safety

*** 1.551 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	29.474	80.007
2	32.237	78.840
3	35.139	78.078
4	38.119	77.737
5	41.118	77.825
6	44.074	78.339
7	46.926	79.270
8	49.616	80.597
9	52.090	82.294
10	54.296	84.327
11	56.190	86.653
12	57.733	89.226
13	58.894	91.992
14	59.649	94.896
15	59.949	97.585

Circle Center At X = 39.006 ; Y = 98.711 ; and Radius = 20.992

Factor of Safety

*** 1.562 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.947	80.006
2	26.749	78.933
3	29.641	78.134
4	32.596	77.616
5	35.586	77.383
6	38.586	77.438
7	41.566	77.780

8	44.500	78.406
9	47.361	79.310
10	50.121	80.485
11	52.757	81.918
12	55.243	83.598
13	57.556	85.508
14	59.676	87.630
15	61.582	89.947
16	63.258	92.435
17	64.688	95.072
18	65.858	97.835
19	66.225	99.000

Circle Center At X = 36.515 ; Y = 108.638 ; and Radius = 31.269

Factor of Safety

*** 1.564 ***

**** END OF GSTABL7 OUTPUT ****

APPENDIX E

ASFE BULLETIN

Important Information About Your

Geotechnical Engineering Report

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

The following information is provided to help you manage your risks.

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

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

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

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

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