



**GEOTECHNICAL INVESTIGATION
VA MEDICAL CENTER - SECONDARY ACCESS ROAD
HUNTINGTON, WEST VIRGINIA**

NGE PROJECT No. W16011

SUBMITTED TO:

**RANDOLPH ENGINEERING
SCOTT DEPOT, WEST VIRGINIA**

SUBMITTED BY:

**NGE, LLC
ST. ALBANS, WEST VIRGINIA**

MARCH 2016



March 29, 2016

Mr. Jacob C. White, P.E.
Randolph Engineering
6767 Teays Valley Road
Scott Depot, WV 25560

Subject: Geotechnical Investigation
VA Medical Center – Secondary Access Road
Huntington, West Virginia
NGE Project No. W16011

Dear Mr. White:

In accordance with your request, we have performed a geotechnical investigation for the proposed new access road at the VA Medical Center in Huntington, West Virginia. Our services were performed in accordance with the scope of work outlined in our Proposal No. PW16531, dated February 22, 2016.

This report presents the results of the field investigation performed to evaluate subsurface conditions and provides our conclusions and recommendations pertaining to design and construction of the roadway earthwork.

We appreciate the opportunity to assist you with this project. Please contact us if you have any questions concerning this report, or if we can provide any further assistance with this project.

Respectfully submitted,
NGE, LLC

A handwritten signature in blue ink, appearing to read 'Jesse A. Scarborough'.

Jessee A. Scarborough, P.E., D.GE
Senior Geotechnical Engineer



A handwritten signature in black ink, appearing to read 'John E. Nottingham'.

John E. Nottingham, P.E.
Principal Engineer

TABLE OF CONTENTS

1.0	SCOPE OF SERVICES	1
2.0	SITE & PROJECT DESCRIPTION	1
3.0	DRILLING & SAMPLING PROCEDURES	1
4.0	SUBSURFACE CONDITIONS	2
4.1	Soil Conditions	2
4.2	Results of Laboratory Testing	3
4.3	Bedrock Conditions	3
4.4	Groundwater	4
5.0	CONCLUSIONS AND RECOMMENDATIONS	4
5.1	Site Preparation	4
5.2	Cut Slope Recommendations.....	4
5.2.1	Cut Slopes Extending From Station 30+00 to 39+00	5
5.2.2	Cut Slopes Extending From Station 45+00 to 54+50	6
5.3	Fill and Backfill Recommendations	6
5.3.1	Fill Material Placement & Compaction	7
5.3.2	Sidehill Fill Slope Construction.....	8
5.4	Slope Stability Analyses	8
6.0	CONSTRUCTION TESTING.....	9
7.0	REPORT LIMITATIONS.....	9

FIGURES

Figure 1 – Boring Location Plan, eastern side

Figure 2 – Boring Location Plan, western side

Figures 3 to 15 – Test Boring Logs for R-1 through R-11

APPENDICES

APPENDIX A - Results of Laboratory Testing

APPENDIX B – Results of Slope Stability Analyses with Fill Slope Toe Detail

1.0 SCOPE OF SERVICES

The purpose of our investigation was to evaluate subsurface conditions and develop recommendations for the earthwork for a new access road. The results of our field exploration and geotechnical engineering evaluation are presented in the following report. Our actual scope of services consisted of the following items:

- Field coordination including site reconnaissance, drilling supervision and sample logging.
- Drilling of eleven test borings with standard penetration testing and sampling.
- Laboratory testing of selected soil samples.
- Preparation of a geotechnical engineering report to address the following items:
 - A description of the subsurface conditions encountered at the test boring locations;
 - Results of our laboratory testing;
 - Recommendations for site preparation;
 - Recommendations for cut slope design;
 - Fill placement and compaction recommendations.

2.0 SITE & PROJECT DESCRIPTION

The existing VA Medical Center is located off of Spring Valley Drive (WV Route 7) in Huntington, Wayne County, West Virginia. A new access road is proposed to connect the southern end of the VA Medical Center to Spring Valley Drive. The road is proposed to be about 2950 feet long, with about 325 feet of elevation change. Preliminary grading plans show cut and fill slopes inclined at a 2H:1V ratio. The planned roadway alignment along with preliminary grading contours is shown on Figure Nos. 1 and 2 of this report.

The area of the planned roadway is wooded, steeply sloping terrain. During our reconnaissance of the site, we observed evidence of several old and recent landslides in the area of the proposed road. We have indicated the approximate locations of the existing slides on Figures No. 1 & 2. In addition to the landslides, we observed a couple groundwater seeps in areas which are shown on Figure No. 2.

3.0 DRILLING & SAMPLING PROCEDURES

A total of 11 test borings (R-1 to R-11) were drilled to evaluate subsurface conditions along the proposed roadway alignment. The boring locations were chosen by our engineer and staked in the field by Randolph Engineering. The approximate boring locations are shown on Figures No. 1 & 2 in the back of this report.

The test borings were drilled to depths ranging from 3 to 60 feet using a track-mounted rotary drilling rig equipped with 3-1/4 inch I.D. hollow stem augers. Standard penetration testing and sampling was generally performed at 2.5 ft. intervals from the ground surface to the boring termination depth (or beginning of rock coring). The standard penetration testing and sampling was performed in accordance with ASTM D-1586.

Standard penetration testing is performed by driving a 2.0 inch O.D. split-barrel sampler into the soil with a 140-lb. hammer dropping a distance of 30 inches. The drill used for this project was equipped with a hydraulic powered auto-hammer. The sampler is driven a distance of 18 inches in three 6-inch increments, and the number of hammer blows required to produce the last two 6-inch increments of penetration is termed the Standard Penetration Number or "N" value. These values provide an indication of the consistency or relative density of the soil. A 1-3/8 inch diameter soil/rock sample was retrieved from the split-barrel sampler in conjunction with each penetration test. A representative portion of each split-barrel sample was placed in an air-tight glass jar.

Rock coring was performed using wireline methods within Borings R-2, R-4, R-7, and R-8. The rock coring was performed in five foot long runs using a NQ sized double tube core barrel equipped with a diamond impregnated cutting bit. Continuous 2-inch diameter bedrock samples were recovered from each core run and placed in a partitioned wooden box. The core recovery and rock quality designation (RQD) were measured for each core run.

Upon completion of drilling, all soil and rock samples were delivered to our laboratory where they were examined by a geologist and geotechnical engineer. Soil and rock descriptions, standard penetration numbers, and other pertinent subsurface information are provided on the boring logs included in the back of this report.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered by the soil test borings are shown on the boring logs. The boring logs represent our interpretation of the subsurface conditions based on examination of the split-spoon samples. The stratification lines indicated on the boring logs represent approximate boundaries between soil and rock types; however, the actual transition may be gradual.

Conditions represented by the test borings should be considered applicable only at the boring locations. It should be assumed that the reported conditions might be different at other locations. The general subsurface conditions encountered and their pertinent characteristics are described in the following paragraphs.

4.1 Soil Conditions

Colluvial soil deposits were encountered within 6 of the test borings (in Borings R-1, 2, 3, 5, 6, and 9). Colluvial soils are deposited into place by gravity, and are typically indicative of old landslide and/or erosion activity. Colluvial deposits are generally weaker and more landslide prone than natural residual type soils. The colluvial soils generally consisted of a brown to red silty to sandy clay with varying amounts of rock fragments. N-values from the Standard Penetration Test within the colluvial soils varied between 4 and 23 blows per foot. The colluvial

soils were up to 15.5 feet thick at the test boring locations and extended to the bedrock surface in Borings R-2 and R-6.

Residual clay soils were encountered beneath the colluvium in Borings R-1, 3, 5, and 9 and as the upper soil layer in Borings R-4, 7, 8, 10, and 11. Residual soils are formed in-place, weathered from the parent rock. The standard penetration N-values obtained in the residual soils varied between 4 and 55 blows per foot. The thickness of the residual soils varied between 2.5 and 15 feet at the test boring locations.

Based on our observations and laboratory test results, the site soils are predominantly moderate plasticity clays (i.e., CL type soil). Some of the clay zones encountered were classified as high plasticity clay (CH type soil). Section 4.2 describes the results of laboratory soil classification testing.

4.2 Results of Laboratory Testing

Laboratory testing of recovered soil specimens included natural moisture content and Atterberg liquid and plastic limits. The results of the Atterberg limit testing are shown on the boring logs and summarized in Table 4.2 below. The results of all the individual laboratory tests are provided in Appendix A.

Table 4.1 – Summary of Laboratory Classification Testing

Boring & Depth	Atterberg Limits		Soil Description
	LL	PI	
R-1 / S-2 2.5 – 4 ft.	62	37	Brown silty CLAY (CH)
R-3 / S-2 2.5 – 4 ft.	43	21	Red silty CLAY (CL) with rock fragments
R-5 / S-3 5 – 6.5 ft.	55	20	Brown silty CLAY (CH)
R-6 / S-3 5 – 6.5 ft.	34	15	Brown silty CLAY (CL) with rock fragments
R-9 / S-2 2.5 – 4 ft.	46	25	Brown silty CLAY (CL) with rock fragments
R-9 / S-6 12.5 – 14.0 ft.	46	25	Red silty CLAY (CL)
R-11 / S-3 5 – 6.5 ft.	38	17	Brown silty CLAY (CL)
R-11 / S-4 7.5 – 9 ft.	39	19	Brown silty CLAY (CL)

4.3 Bedrock Conditions

All of the test borings were extended into bedrock. Rock coring was performed within four of the borings. The depth to bedrock varied between 2.5 and 17.5 feet at the test boring locations. Bedrock strata encountered in the borings consisted of interbedded layers of

claystone, shale, siltstone, limestone, and sandstone. In general, most of the claystone and shale strata were noted to be very soft to soft. The limestone layers varied from extremely soft to medium hard. The siltstone layers varied from soft to medium hard. The sandstone strata were generally found to be medium hard to hard. A massive (approximately 38 ft. thick) zone of sandstone with a few thin interbedded layers of shale was encountered in Boring R-7 from an elevation interval of about 757 to 795 feet.

4.4 Groundwater

All of the test borings were dry during soil drilling and standard penetration sampling. Water was used as the drilling fluid during rock coring. Consequently, water was present in some of the open boreholes after drilling completion within the rock core borings. The water level measured in these borings does not reflect the groundwater table due to introduction of water during coring. The presence or absence of groundwater in the boreholes at the time of drilling does not necessarily mean that groundwater will or will not be present at other times or locations. Seasonal variations in rainfall will cause fluctuations in groundwater levels and influence the presence of water in upper soils. As previously noted, our engineer noted groundwater seepage along the ground surface in a couple locations as shown on Figure No. 2.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Site Preparation

All existing topsoil, vegetation, and tree stumps located within planned earthwork areas should be stripped prior to beginning site grading. Any underground utility lines located within the planned roadway may need to be removed and/or relocated. All voids created by removal of underground items should be properly backfilled in accordance with Section 5.3 of this report.

The development of the site should address surface drainage. Appropriate drainage should be provided both during and after site grading is complete such that surface water does not become ponded or entrapped around the roadway or along cut and fill slopes. Any groundwater seeps which are encountered during site grading operations should be reported to **NGE** for evaluation.

Proof-rolling of soil subgrades using suitable construction equipment should be performed prior to placing fill. The proof-rolling will cause rutting and deformations of softer soils, and densify firmer soils. Undercutting and replacement of soft and/or wet soils should be performed. The proof-rolling operations should be inspected and documented by a qualified soils technician or engineer.

5.2 Cut Slope Recommendations

Cut slopes up to 70 feet high are planned for the new access road. As previously discussed, our engineer observed numerous landslides and indications of past instability throughout the project area. It is believed that the depth to bedrock will be variable in some areas and that subsurface rock ledges will be present. The cut slope recommendations provided herein are based on a few widely spaced borings. We recommend that the contract

plans and specifications clearly state that variable subsurface conditions are expected and that field adjustment to the proposed grading plans may be necessary in some areas of the project. Any cut slopes which are designed steeper than 2H:1V are intended to be in bedrock only. Soil cuts should be sloped not steeper than 2H:1V. Also, any cuts which are in known landslide areas or areas of colluvial deposits should be sloped not steeper than 3H:1V. Cut slopes in soil should be seeded and mulched as soon as possible after final grading to reduce the occurrence of erosion and minor surficial slips.

NGE should be promptly consulted if groundwater seepage is evident in any of the cut slope areas. Small, isolated groundwater seeps or springs encountered within the cut slope areas must be collected with a permanent underdrain or the soil cut slope could become unstable. Any soil cut slope areas exhibiting significant groundwater seepage may have to be reconfigured at a flatter slope and/or the clay soil over-excavated and replaced with free draining crushed or shot rock to maintain adequate stability.

Based on our review of the project cross-sections and test boring data, we anticipate the cut slopes for the project will be predominantly within bedrock with minimal thickness of soil overburden at the top of the cuts. The cut slope area borings included R-1, R-2, R-4, R-7 and R-8. The soil overburden thickness in Boring R-1 was 9.0 feet, and the soil thickness in the other cut slope borings was 3.5 feet or less. We recommend the cut slope design for this project generally follow the WVDOT-DOH Design Directive DD-403 (Guide for Design of Cut Sections Through Bedrock). This design guide has been developed and is based on many years of experience with cut slopes within the West Virginia geology.

5.2.1 Cut Slopes Extending From Station 30+00 to 39+00

In the area of Boring R-1, we encountered residual clay soil underlain by extremely soft limestone bedrock to a depth of 18 feet. We recommend the initial left side portion of this cut section from 30+00 to 32+00 be configured no steeper than a 2H:1V ratio. A 3H:1V cut slope ratio should be maintained for the entire length of the cut along the right side of the roadway (relatively low cut slope). For the remainder of the left side cut section between Station 32+00 and 39+00, we recommend the following slope configuration:

- Consider the bedrock as Type 4 in accordance with the WVDOT-DOH Design Guide.
- All benches should be a minimum 10 ft. wide and should slope at 15:1 (H:V) toward the roadway.
- Above the ditch, use a 1.5H:1V slope for a height of 5 ft. above the ditch bottom, then use a 10 ft. wide bench (Bench A).
- Above Bench A, utilize a 1H:1V slope for a maximum height of 40 feet, then show another 10 ft. wide bench.
- Utilize 10 ft. wide benches on a maximum vertical interval of 40 feet for the entire cut slope height.
- When the cut slope is within approximately 5 feet of the existing ground surface, transition to a 2H:1V slope ratio until it daylight.

5.2.2 Cut Slopes Extending From Station 45+00 to 54+50

For cut slopes between roadway Stations 45+00 to 54+50, two predominant rock types were encountered. Above an approximate elevation of 795 feet, we recommend the bedrock be considered as Type 4 Bedrock in accordance with the WVDOT-DOH Design Guide. At an approximate elevation interval of 795 to 757 feet, the bedrock was predominantly medium hard to hard sandstone with some interbedded layers of medium hard shale which we recommended be considered as Type 2 Bedrock. Below an elevation of 757 feet, we recommend the bedrock be considered as Type 4 Bedrock. We recommend the following slope configuration for this cut section:

- All benches should be a minimum 10 ft. wide and should slope at 15:1 (H:V) toward the roadway.
- Above the ditch, use a 1.5H:1V slope for a height of 5 ft. above the ditch bottom, then use a 10 ft. wide bench (Bench A).
- For Type 2 sandstone bedrock within an approximate elevation range of 795 to 757 feet, utilize a 0.5H:1V slope ratio for a maximum height of 40 feet between benches.
- For all other bedrock strata below elevation 757 ft. or above elevation 795 feet, utilize a 1H:1V slope for a maximum height of 40 feet between benches.
- When the cut slope is within approximately 5 feet of the existing ground surface, transition to a 2H:1V slope ratio until it daylights.

5.3 Fill and Backfill Recommendations

Fill slopes up to about 120 feet high are required for the roadway. The proposed fill slopes for the roadway are proposed to be inclined at 2H:1V. Based on results of our stability analyses and our experience with fill embankment construction, we believe that the proposed fill slopes will have adequate long-term stability provided the conditions outlined below are met. A typical detail for the recommended slope toe-key and rock bonding benches is provided in Appendix B.

1. The fill is properly founded with a toe-key bench excavated into bedrock. The recommended toe-key design is illustrated on the Typical Section provided in Appendix B.
2. Bonding benches into bedrock are installed uphill of the toe-key bench as illustrated on the Typical Section provided in Appendix B.
3. The fill does not contain organic material and/or an excessive amount of high plasticity clays/silts (CH/MH Type Soil).
4. The fill is properly compacted to at least 95 percent of the standard Proctor maximum dry density with the soil moisture content within three percent of its optimum value.
5. The fill does not become saturated after it is placed. Underdrains should be placed below the fill embankment as illustrated on the Typical Section provided in Appendix B. Additional underdrains should also be placed to intercept any

groundwater seeps which are evident during construction. We also recommend a core drain be placed in the base of natural ravine areas.

6. Benches are provided on the face of the fill slope for every 50 feet increase in elevation. Benches should be at least 10 feet wide, and inclined along the slope so water does not pond on the bench.

5.3.1 Fill Material Placement & Compaction

Soil fill material placed for the project can consist of onsite non-organic soil and broken rock material with a maximum particle size of 6 inches. Soil fill should be placed in maximum 9-inch thick loose lifts. Each lift of fill should be compacted to at least 95 percent of the maximum dry density as determined by the standard Proctor laboratory test (ASTM D698). All fill should be moisture conditioned to within three percentage points of the material's optimum moisture content as determined by the standard Proctor test. A sufficient number of field moisture/density tests should be performed on each lift of soil fill to verify and document that the required fill density is achieved. We recommend high plasticity clay/silt soil (CH or MH type soil) not be used as engineered fill unless it is blended with low plasticity material such that the overall mixture is not high plasticity and/or treated by mixing with hydrated lime or quicklime.

When using soft shale and claystone as engineered fill, it is important that the material be properly broken down prior to compaction. If the material is not adequately broken down, the fill will have excessive void space between rock pieces which slowly degrade causing excessive fill settlement and possible instability. Processing of soft shale and claystone will require extra effort by the contractor to thoroughly break down the rock pieces. This may require the application of water to the material while turning and breaking down the rock by tracking with large dozers.

Due to the cohesive, moderately plastic nature of the clayey soils present at this site, pumping conditions could develop during fill placement if the soil fill is subjected to excessive construction traffic and/or if the fill material is excessively moist. If pumping conditions should develop during fill placement, measures such as over-excavation and placement of stabilization fabric and/or a thick layer of rock fill may be necessary to facilitate proper fill compaction.

Hard Rock Fill:

Rock fill may consist of medium-hard to hard sandstone and siltstone rock excavated from onsite or imported from an offsite borrow source. We recommend rock fill be defined as rock mixtures which contain 35 percent or less (by visual inspection) of soil material. Mixtures which contain in excess of 35 percent of soil material should be designated as soil fill. Rock fill should be placed in maximum 18-inch compacted lifts. Each lift of rock fill should be thoroughly compacted using a minimum 20-ton applied force vibratory roller. The compaction of each lift of rock fill should be verified and documented by the proof-roll method. We recommend suitable rock fill materials generated from cut areas be stockpiled for use in the lowermost portion of the fill slopes, particularly the highest fill embankment.

5.3.2 Sidehill Fill Slope Construction

Achieving an acceptable level of fill slope stability will require excavation of a toe key bench on bedrock. The toe-key bench should be at least 15 feet wide and inclined back into the slope. A collector drain should be installed at the back of the toe-key bench. This collector drain should consist of a perforated pipe covered with at least two feet of free-draining crushed limestone rock (AASHTO No. 57 stone). This rock blanket should be covered by an appropriate geotextile filter fabric manufactured to retain soil particles while allowing water to pass freely, such as Mirafi 160N. The perforated pipes should be connected to solid outlet pipes at regular intervals (recommended approximate maximum 100 ft. spacing for outlets) and routed to appropriate outlet points below the toe of the fill slope. A detail illustrating the recommended fill foundation bench is provided in Appendix B.

Following excavation of the toe key bench and placement of the underdrain system, fill placement can begin. Fill placement should be initiated at the toe of the slope and proceed upward in uniform, level lifts. Each lift of fill should be keyed (benched) into the hillside as the fill progresses as described below. All finished fill slopes should be seeded and mulched as soon as practical to reduce the occurrence of slope erosion and minor slips.

In addition to the toe-key bench, the fill embankments will require bonding benches excavated into bedrock for the full extent of the fill slope (i.e., zone extending from the back of the toe-key bench to the crest of the fill slope should be keyed into bedrock – see the Typical Section for illustration). A collector drain should be installed on the bonding benches at least every 20 ft. rise in elevation above the toe key bench as shown on the typical detail in Appendix B. The collector drains should be routed to an appropriate outlet(s) away from the fill slope.

Underdrains:

Permanent underdrains should be construction to collect and drain any groundwater seep locations which are evident during construction. Underdrains should consist of a minimum 3 ft. deep by 2 ft. wide trench excavated below the base of the fill. A minimum 6-inch perforated pipe should be placed in the base of the trench and surrounded by No. 57 crushed limestone. The crushed stone should be wrapped with a non-woven filter fabric such as Mirafi 160N. Each underdrain should be routed to drain to an appropriate outlet away from the fill or should be tied into a bonding bench or toe-key drain. We also recommend a dumped rock underdrain be utilized in the bottom of natural ravine areas which will be covered with fill. We recommend underdrains placed in ravine areas consist of free draining durable crushed rock wrapped in filter fabric (Mirafi 160N) with a minimum cross-sectional area of 3 ft. by 3 ft.

5.4 Slope Stability Analyses

Slope stability was evaluated at four cross-sections (A-A', B-B', C-C', and D-D') as shown on Figures No. 1 & 2. The stability analyses were performed on the proposed 2H:1V fill slope configuration and the toe-key excavation and bonding benches as recommended herein. Stability analyses of proposed fill embankments were performed using the STABL computer program. Our analyses were conducted using circular failure arcs with factors of safety calculated using Modified Bishop's Method. Soil parameters used in the analyses were selected based upon results of the test borings, laboratory testing, anticipated fill types and placement procedures, and our experience with similar materials.

Results of the stability analyses indicate the proposed fill embankments will have an acceptable slope stability factor of safety equal to or greater than 1.5 provided the recommendations outlined in Section 5.3 of this report are followed and the fill does not become saturated after placement. Stability calculations and analyses output sheets are provided in Appendix B of this report.

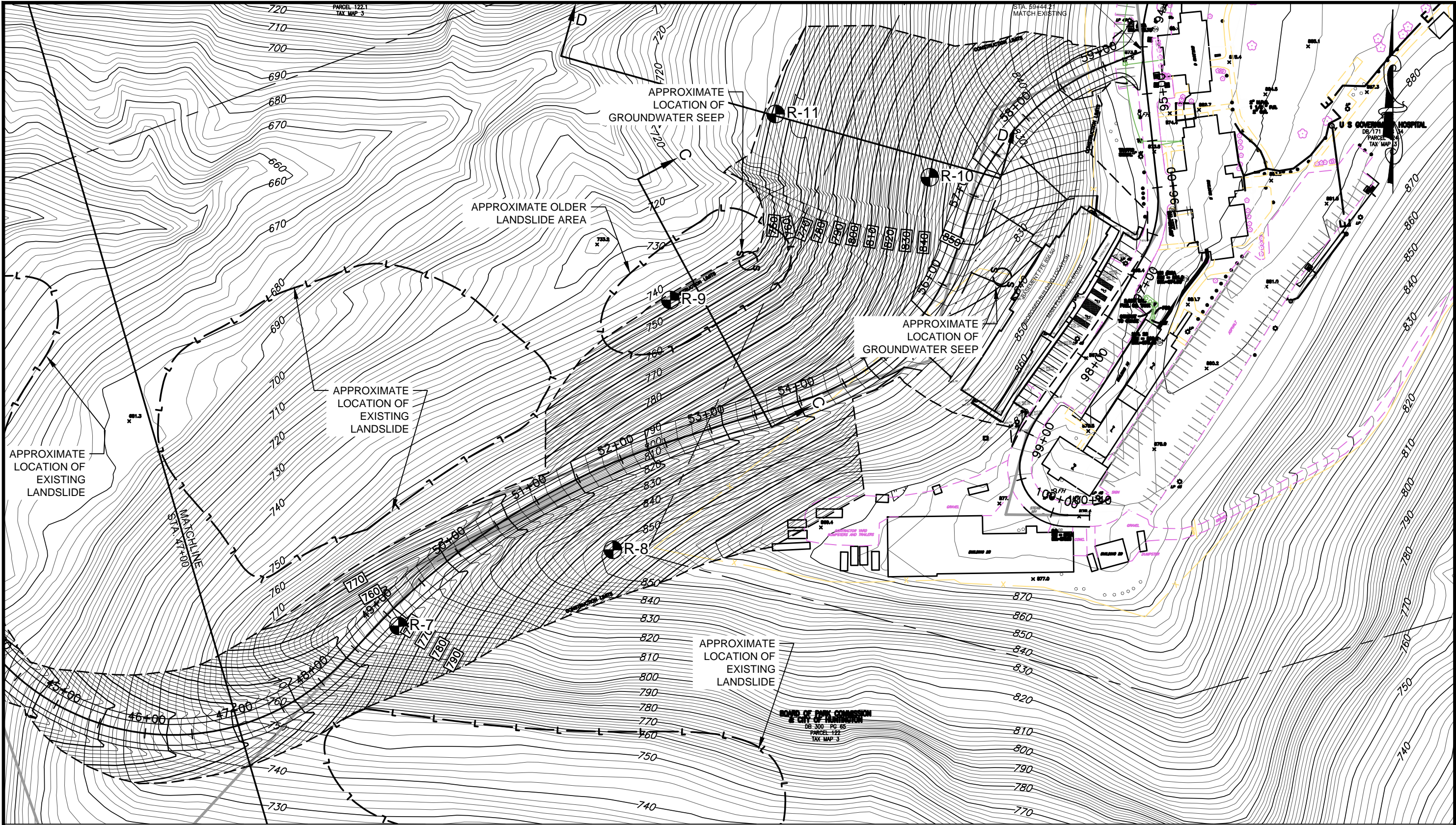
6.0 CONSTRUCTION TESTING

We recommend that a qualified geotechnical firm be retained by the owner to provide a comprehensive construction-testing program to assist the owner in determining that certain aspects of construction are being carried out in conformance with the applicable plans and specifications. This construction testing primarily includes foundation preparation for fill areas, testing of fill materials during placement, and verification of construction materials.

7.0 REPORT LIMITATIONS

- This report has been prepared for the exclusive use of **Randolph Engineering**. All recommendations contained in this report have been made in accordance with generally accepted soil and foundation engineering practices in the area and at the time where the services were performed. No other warranties are implied or expressed.
- The scope of this investigation did not include an investigation or study to assess the potential for damage due to possible mine subsidence. The scope of services represented by this report does not include an environmental assessment, or exploration for the presence or absence of wetlands, hazardous, or toxic material at the site.
- The analyses and recommendations submitted in this report are based, in part, upon the data obtained from a limited number of soil test borings. The nature and extent of variations in soil conditions between the borings may not become evident until construction. If variations then appear evident, it may be necessary to re-evaluate the recommendations of this report and provide additional recommendations.
- It is emphasized that the data and recommendations contained in this report are for design information purposes only and may not be sufficient to prepare accurate bids. Any conclusions drawn by contractors regarding subsurface conditions, quantities of unsuitable soils, presence and condition of rock, groundwater or methods and means of construction are at their sole risk.
- It is important that the geotechnical engineer be provided the opportunity to review the final construction plans and specifications to verify that the recommendations in this report are properly interpreted and incorporated in the design.



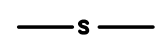

Figures

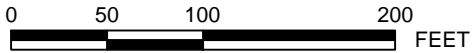


NOTES

1. BORING LOCATION PLAN IS FOR ILLUSTRATIVE PURPOSES ONLY; BORING LOCATIONS ARE APPROXIMATE.
2. SITE PLAN IS BASED ON DRAWING PROVIDED BY RANDOLPH ENGINEERING.

LEGEND

-  B-# APPROXIMATE LOCATION OF BORING
-  APPROXIMATE LOCATION OF SECTION
-  APPROXIMATE LOCATION OF SEEP/SPRING
-  APPROXIMATE LOCATION OF LANDSLIDE



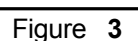
REVISION	NO.	DATE

NGE
Environmental & Geotechnical Engineering Services
650 MacCorkle Avenue West
Saint Albans, West Virginia 25177
(304) 201-5180 FAX 201-5182
www.ngiconsulting.com

PROJECT: VA MEDICAL CENTER ROAD
CLIENT: RANDOLPH ENGINEERING
SHEET: BORING PLAN

Project No.	W16011
Drawn:	NLS
Checked:	JAS
Approved:	JAS
Scale:	1"=100'
Date:	3-17-16
CAD File #	NA

FIGURE NO. 2





Project Name: **V.A. Medical Center Road
Huntington, West Virginia**

BORING NO.

Project Number: **W16011**

R- 2

Elevation	Depth, feet	Sample Type	Symbol / USCS	Location: See Figure 1 Offset: Surface El.: 622.0 ft.	Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index
				<div> <div>⊠</div> Split Spoon <div>⊠</div> Shelby Tube </div> <div> <div>■</div> Rock Core <div>⊠</div> Bag Sample </div>									
				MATERIAL DESCRIPTION									
620				Red SILTY CLAY with rock fragments, moist, stiff			2-3-3		22				
				- Colluvium -	2.5								
				Brown SANDSTONE , soft, weathered			50/6"						
5					5.2								
				Brown SANDY SILTSTONE , soft to medium hard, weathered	6.3		14-50/2"						
615				Brown SANDSTONE with frequent horizontal partings, medium hard, weathered	52	17							
				- gray (8.6 - 9.2 ft.)									
					9.7								
610				Brown and gray SILTY to SANDY SHALE , soft	98	28							
				- very sandy, w/interbedded sandstone (10.6 - 12.0 ft.)									
				- gray, very soft from 13.1 ft.									
15					16.0	54							
605				Gray CLAYSTONE , extremely soft and weathered									
20					90	60							
600				- highly weathered from 23.0 ft.									
					24.7								
25				Gray SANDY SILTSTONE , medium hard	100	70							
				- soft (24.7 - 25.2 ft.)									
595				- diagonal fracture @ 26.4 ft.									
30													

Completion Depth: **55.0 ft.**

Date Boring Started: **3/11/16**

Date Boring Completed: **3/11/16**

Engineer/Geologist: **CEM**

Driller: **NGE**

Remarks: **Boring was noted to be dry during drilling operations and at boring completion.**

Depth to Water @ 24 hrs.: ---

WV DOT LOG W16011 BORING LOGS.GPJ NGE LOG.GDT 3/29/16

Novel Geo-Environmental

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

Figure **4**








Project Name: **V.A. Medical Center Road
Huntington, West Virginia**

Project Number: **W16011**

BORING NO.

R- 2

Elevation	Depth, feet	Sample Type	Symbol / USCS	Location: See Figure 1 Offset:	Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index						
				Surface El.: 622.0 ft.															
				<div><div> Split Spoon</div><div> Shelby Tube</div><div> Rock Core</div><div> Bag Sample</div></div>															
MATERIAL DESCRIPTION																			
590				Gray SANDY SILTSTONE , medium hard	98	82													
				31.1															
			Gray SHALE , soft																
			34.0																
35			Gray SANDSTONE , fine to medium grained, medium hard to hard, calcareous	98	54														
			37.7																
585			Gray LIMESTONE , medium hard	38.5															
			Gray SILTY SHALE , very soft to soft, weathered	98	78														
40																			
580																			
					92	66													
45																			
575																			
				- extremely soft, clayey (51.8 - 52.0 ft.)	82	44													
50																			
570				- vertical fracture w/clay lining (52.3 - 52.9 ft.)															
					100	54													
55				55.0															
565				Bottom of Test Boring @ 55.0 ft.															

Completion Depth: **55.0 ft.**

Date Boring Started: **3/11/16**

Date Boring Completed: **3/11/16**

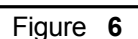
Engineer/Geologist: **CEM**

Driller: **NGE**

Remarks: **Boring was noted to be dry during drilling operations and at boring completion.**

Depth to Water @ 24 hrs.: ---

WV DOT LOG W16011 BORING LOGS.GPJ NGELOG.GDT 3/29/16









Project Name: **V.A. Medical Center Road
Huntington, West Virginia**

Project Number: **W16011**

BORING NO.

R- 4

Elevation	Depth, feet	Sample Type	Symbol / USCS	Location: See Figure 1 Offset:		Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index
				Surface El.: 629.0 ft.										
				 Split Spoon	 Shelby Tube									
				 Rock Core	 Bag Sample									
MATERIAL DESCRIPTION														
625 <														

Completion Depth: **25.0 ft.**

Date Boring Started: **3/11/16**

Date Boring Completed: **3/11/16**

Engineer/Geologist: **CEM**

Driller: **NGE**

Remarks: **Boring was noted to be dry during drilling operations. Water was noted at 3.5 ft. at boring completion.**

Depth to Water @ 24 hrs.: ---

WV DOT LOG W16011 BORING LOGS.GPJ NGELOG.GDT 3/29/16

Novel Geo-Environmental

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

Figure 7



Project Name: **V.A. Medical Center Road
Huntington, West Virginia**

Project Number: **W16011**

BORING NO.

R- 5

Elevation	Depth, feet	Sample Type	Symbol / USCS	Location: See Figure 1 Offset: Surface El.: 573.5 ft.	Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index
				<div> <div>⊠</div> Split Spoon <div>⊠</div> Shelby Tube </div> <div> <div>■</div> Rock Core <div>⊠</div> Bag Sample </div>									
				MATERIAL DESCRIPTION									
570	5			Reddish brown SILTY CLAY with rock fragments, moist, medium stiff to stiff - Colluvium -			1-2-3		23				
							4-6-9		14				
							8-6-8		16			55	30
565	10			Brown SILTY CLAY , moist, stiff to very stiff - w/residual shale from 7.5 ft.			7-8-17		15				
							13-27-50/6"						
560	15			Gray SHALE , very soft to soft, calcareous			50/6"						
							50/5"						
				Bottom of Test Boring @ 15.4 ft.									
555	20												
550	25												
545	30												

Completion Depth: **15.4 ft.**

Date Boring Started: **3/10/16**

Date Boring Completed: **3/10/16**

Engineer/Geologist: **CEM**

Driller: **NGE**

Remarks: **Boring was noted to be dry during drilling operations and at boring completion.**

Depth to Water @ 24 hrs.: ---

















Project Name: **V.A. Medical Center Road
Huntington, West Virginia**

Project Number: **W16011**

BORING NO.

R- 6

Location: See Figure 1 Offset:													
Elevation	Depth, feet	Sample Type	Symbol / USCS	Surface El.: 610.0 ft.									
				 Split Spoon	 Shelby Tube								
				 Rock Core	 Bag Sample								
MATERIAL DESCRIPTION				Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index	
605	5			Reddish brown SILTY CLAY with rock fragments, moist, soft to stiff									
600	10			- Colluvium -									
595	15												
590	20			Brown SHALE , very soft to soft, highly weathered									
				- silty to sandy from 17.5 ft.									
				- auger refusal @ 19.5 ft.									
585	25			Bottom of Test Boring @ 19.5 ft.									

Completion Depth: **19.5 ft.**

Date Boring Started: **3/10/16**

Date Boring Completed: **3/10/16**

Engineer/Geologist: **CEM**

Driller: **NGE**

Remarks: **Boring was noted to be dry during drilling operations and at boring completion.**

Depth to Water @ 24 hrs.: ---

WV DOT LOG W16011 BORING LOGS.GPJ NGELOG.GDT 3/29/16







Project Name: **V.A. Medical Center Road
Huntington, West Virginia**

BORING NO.

Project Number: **W16011**

R- 7

Location: See Figure 1 Offset:													
Elevation	Depth, feet	Sample Type	Symbol / USCS	Surface El.: 809.0 ft.	Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index
<div><div> Split Spoon</div><div> Shelby Tube</div><div> Rock Core</div><div> Bag Sample</div></div>													
MATERIAL DESCRIPTION													
805 													

WV DOT LOG W16011 BORING LOGS.GPJ NGELOG.GDT 3/29/16







Project Name: **V.A. Medical Center Road
Huntington, West Virginia**

BORING NO.

Project Number: **W16011**

R- 7

Elevation	Depth, feet	Sample Type	Symbol / USCS	Location: See Figure 1 Offset:	Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index
				Surface El.: 809.0 ft.									
				<div><div> Split Spoon</div><div> Shelby Tube</div><div> Rock Core</div><div> Bag Sample</div></div>									
MATERIAL DESCRIPTION													
				Brown SANDSTONE , medium hard to hard, medium to coarse grained	100	60							
775	35				100	96							
770	40				100	100							
765	45				100	94							
760	50			- fractured, w/calcite and iron staining (49.8 - 50.6 ft.)	96	80							
				52.5									
755	55			Gray SHALE , soft	80	80							
				55.0									
				Bottom of Test Boring @ 55.0 ft.									
750													

Completion Depth: **55.0 ft.**

Date Boring Started: **3/8/16**

Date Boring Completed: **3/8/16**

Engineer/Geologist: **CEM**

Driller: **NGE**





















































Remarks: **Boring was noted to be dry during drilling operations and at boring completion.**

Depth to Water @ 24 hrs.: ---

WV DOT LOG W16011 BORING LOGS.GPJ NGELOG.GDT 3/29/16

Project Number: **W16011**

R- 8

Elevation	Depth, feet	Sample Type	Symbol / USCS	Location: See Figure 1 Offset:		Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index	
				Surface El.: 851.0 ft.											
				 Split Spoon	 Shelby Tube										
				 Rock Core	 Bag Sample										
MATERIAL DESCRIPTION															
850				Brown SILTY CLAY with residual shale, moist, medium stiff	3.5			2-3-4		17					
							10-15-26								
5				Brown SANDY SHALE , very soft to soft, highly weathered											
845								80	27	50/6"					
															
				- clayey from 9.0 ft.											
840								96	44						
															
															
835								96	36						
															
															
830								100	94						
															
				- gray from 22.5 ft.											
825								98	84						
															
				Brown SANDSTONE with shale laminations, medium hard, fine grained	25.5										
					28.0										
				Gray CLAYSTONE , very soft, highly weathered											
820								100	66						
															
				- w/red mottling from 30.0 ft.											
				- red from 32.5 ft.											
															

Completion Depth: **60.0 ft.**

Date Boring Started: 3/2/16

Date Boring Completed: **3/2/16**

Engineer/Geologist: **CEM**

Driller: **NGE**

Remarks: **Boring was noted to be dry during drilling operations and at boring completion.**

Depth to Water @ 24 hrs.: ---

WV DOT LOG W16011 BORING LOGS.GPJ NGELOG.GDT 3/29/16



Project Name: **V.A. Medical Center Road
Huntington, West Virginia**









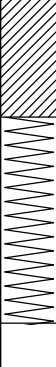



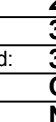

BORING NO.

Project Number: **W16011**

R- 8

Elevation	Depth, feet	Sample Type	Symbol / USCS	Location: See Figure 1 Offset:	Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index
				Surface El.: 851.0 ft.									
				<div>⊠</div> Split Spoon <div>⊠</div> Shelby Tube <div>■</div> Rock Core <div>⊠</div> Bag Sample									
MATERIAL DESCRIPTION													
815		<div></div>	<div></div>	Gray CLAYSTONE , very soft, highly weathered	52	17							
				37.8									
40				Gray SILTSTONE , medium hard									
810					100	100							
				45.0									
45				Gray CLAYSTONE , soft, weathered	96	96							
805				47.8									
				Red SILTSTONE with gray mottling, soft, weathered - brown, sandy from 49.0 ft.									
50				50.0									
800				Brown SANDSTONE , medium hard to hard, fine grained	98	96							
		- vertical fracture (53.5 - 54.8 ft.) and (55.2 - 55.7 ft.)											
55			98	64									
795													
			100	100									
60			60.0										
790			Bottom of Test Boring @ 60.0 ft.										
65													
785													
70													
Completion Depth: 60.0 ft.				Remarks: Boring was noted to be dry during drilling operations and at boring completion.									
Date Boring Started: 3/2/16													
Date Boring Completed: 3/2/16													
Engineer/Geologist: CEM													
Driller: NGE				Depth to Water @ 24 hrs.: ---									

WV DOT LOG W16011 BORING LOGS.GPJ NGELOG.GDT 3/29/16

Elevation		Depth, feet	Sample Type	Symbol / USCS	Location: See Figure 1 Offset:	Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index
Surface El.: 745.0 ft.														
<div><div> Split Spoon</div><div> Shelby Tube</div><div> Rock Core</div><div> Bag Sample</div></div>														
MATERIAL DESCRIPTION														
740	5			Brown SILTY CLAY with rock fragments, moist, medium stiff to stiff			2-3-5		20					
				4-5-12										
				9-8-7										
				8-10-12										
				9-12-18										
				14-16-25										
735	10			Red SILTY CLAY , moist, very stiff to hard					17					
730	15								13					
725	20			Brown SHALE , very soft, highly weathered			22-50/6"							
720	25			- auger refusal @ 21.8 ft.			27-32-50/4"							
715	30			Bottom of Test Boring @ 21.8 ft.										

Completion Depth:	21.8 ft.	Remarks: Boring was noted to be dry during drilling operations and at boring completion.
Date Boring Started:	3/10/16	
Date Boring Completed:	3/10/16	
Engineer/Geologist:	CEM	
Driller:	NGE	
Depth to Water @ 24 hrs.: ---		

WV DOT LOG W16011 BORING LOGS.GPJ NGELOG.GDT 3/29/16



Project Name: **V.A. Medical Center Road
Huntington, West Virginia**

Project Number: **W16011**

BORING NO.

R-10

Elevation	Depth, feet	Sample Type	Symbol / USCS	Location: See Figure 1 Offset: Surface El.: 802.0 ft.	Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index
				<div> <div>⊠</div> Split Spoon <div>⊠</div> Shelby Tube </div> <div> <div>■</div> Rock Core <div>⊠</div> Bag Sample </div>									
				MATERIAL DESCRIPTION									
800				Brown SANDY CLAY with rock fragments, moist, very stiff			WOH-4-14		25				
				<div> <div>2.5</div> <div>3.0</div> </div>			50/1"						
				Brown SANDSTONE , hard - auger refusal @ 3.0 ft.									
				Bottom of Test Boring @ 3.0 ft.									
5													
795													
10													
790													
15													
785													
20													
780													
25													
775													
30													

Completion Depth: **3.0 ft.**

Date Boring Started: **3/9/16**

Date Boring Completed: **3/9/16**

Engineer/Geologist: **CEM**

Driller: **NGE**

Remarks: **Boring was noted to be dry during drilling operations and at boring completion.**

Depth to Water @ 24 hrs.: ---

WV DOT LOG W16011 BORING LOGS.GPJ NGELOG.GDT 3/29/16

Novel Geo-Environmental

The stratification lines represent approximate strata boundaries.
In situations, the transition may be gradual.

Figure **15**



Project Name: **V.A. Medical Center Road
Huntington, West Virginia**

Project Number: **W16011**

BORING NO.

R-11

Elevation	Depth, feet	Sample Type	Symbol / USCS	Location: See Figure 1 Offset: Surface El.: 748.0 ft.	Recovery %	RQD	Penetration Blows / 6 inches	HCSI	Moisture %	Silt and Clay %	Sand %	Liquid Limit	Plasticity Index
				<div> <div>⊠</div> Split Spoon <div>⊠</div> Shelby Tube </div> <div> <div>■</div> Rock Core <div>⊠</div> Bag Sample </div>									
				MATERIAL DESCRIPTION									
745	5			Brown SILTY CLAY , moist, soft to hard - w/few rock fragments (0.0 - 1.5 ft.)			1-1-3 4-4-6 6-7-8		21 21 19			38	17
740	10			- brown and gray (7.5 - 9.0 ft.) - red, w/numerous rock fragments (10.0 - 11.5 ft.)			5-6-7 5-7-10 11-12-21		21 18			39	19
735	15			15.0			28-32-50/5"		13				
730	20			Red CLAYSTONE , very soft, highly weathered 21.0			13-45-50/5" 28-50/6"						
725	25			Bottom of Test Boring @ 21.0 ft.									
720	30												

WV DOT LOG W16011 BORING LOGS.GPJ NGELOG.GDT 3/29/16

Completion Depth: **21.0 ft.**
Date Boring Started: **3/9/16**
Date Boring Completed: **3/9/16**
Engineer/Geologist: **CEM**
Driller: **NGE**

Remarks: **Boring was noted to be dry during drilling operations and at boring completion.**

Depth to Water @ 24 hrs.: ---

Appendix A

LIQUID AND PLASTIC LIMITS TEST REPORT

The graph plots Plasticity Index (PI) on the Y-axis (0 to 60) against Liquid Limit (LL) on the X-axis (0 to 110). A dashed line indicates the approximate upper limit boundary for natural soils. The graph is divided into regions for soil classification: CL or OL, CH or OH, ML or OL, and MH or OH. A data point is plotted at LL = 62 and PI = 37, which falls within the CH or OH region.

MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
Brown SILTY CLAY	62	25	37			

Project No. W16011 **Client:** Randolph Engineering
Project: V.A. Medical Center Road

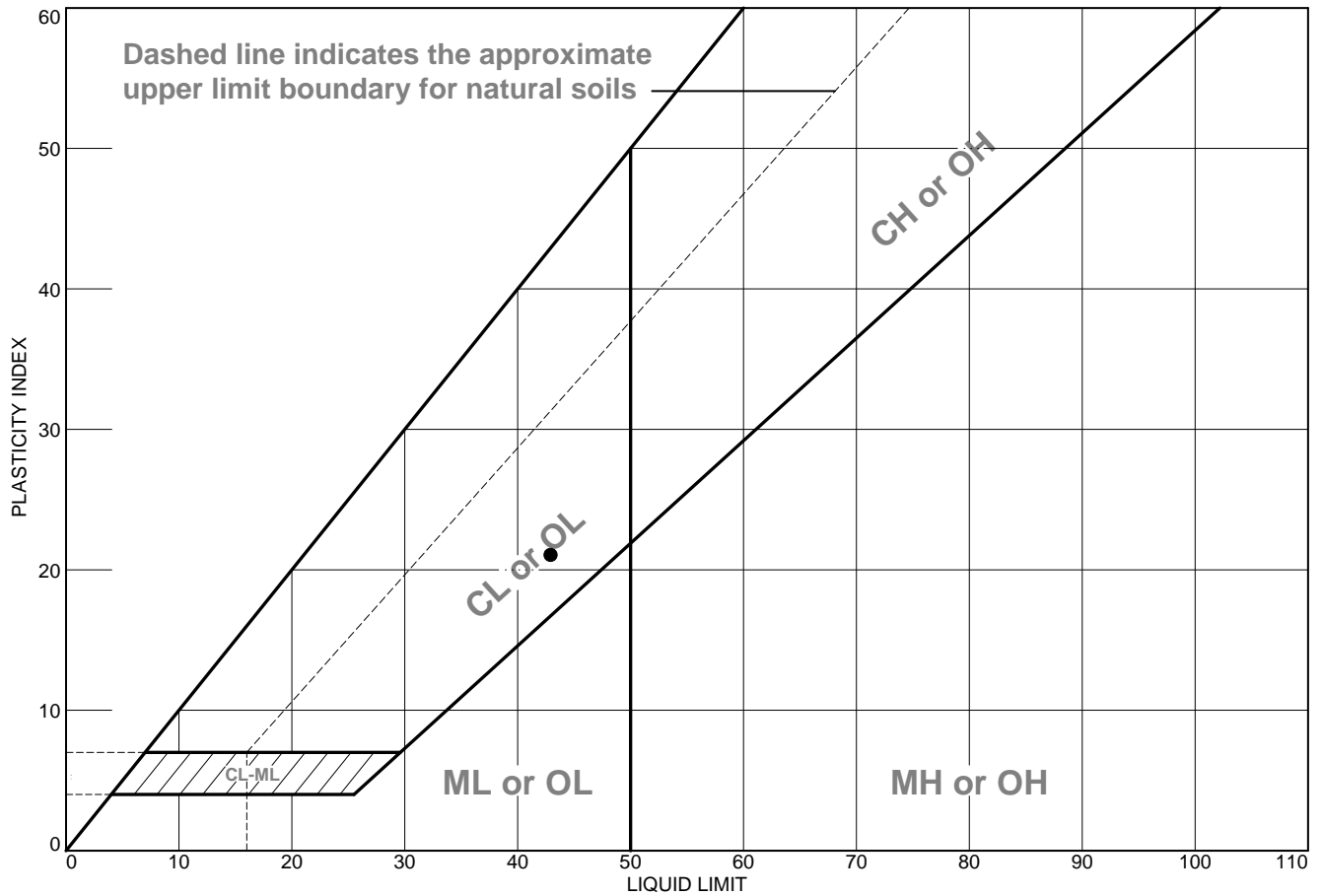
Source of Sample: R-1 **Depth:** 2.5 - 4.0 ft. **Sample Number:** 2

NGE, LLC
 St. Albans, West Virginia

Figure

Tested By: CTD **Checked By:** CEM

LIQUID AND PLASTIC LIMITS TEST REPORT



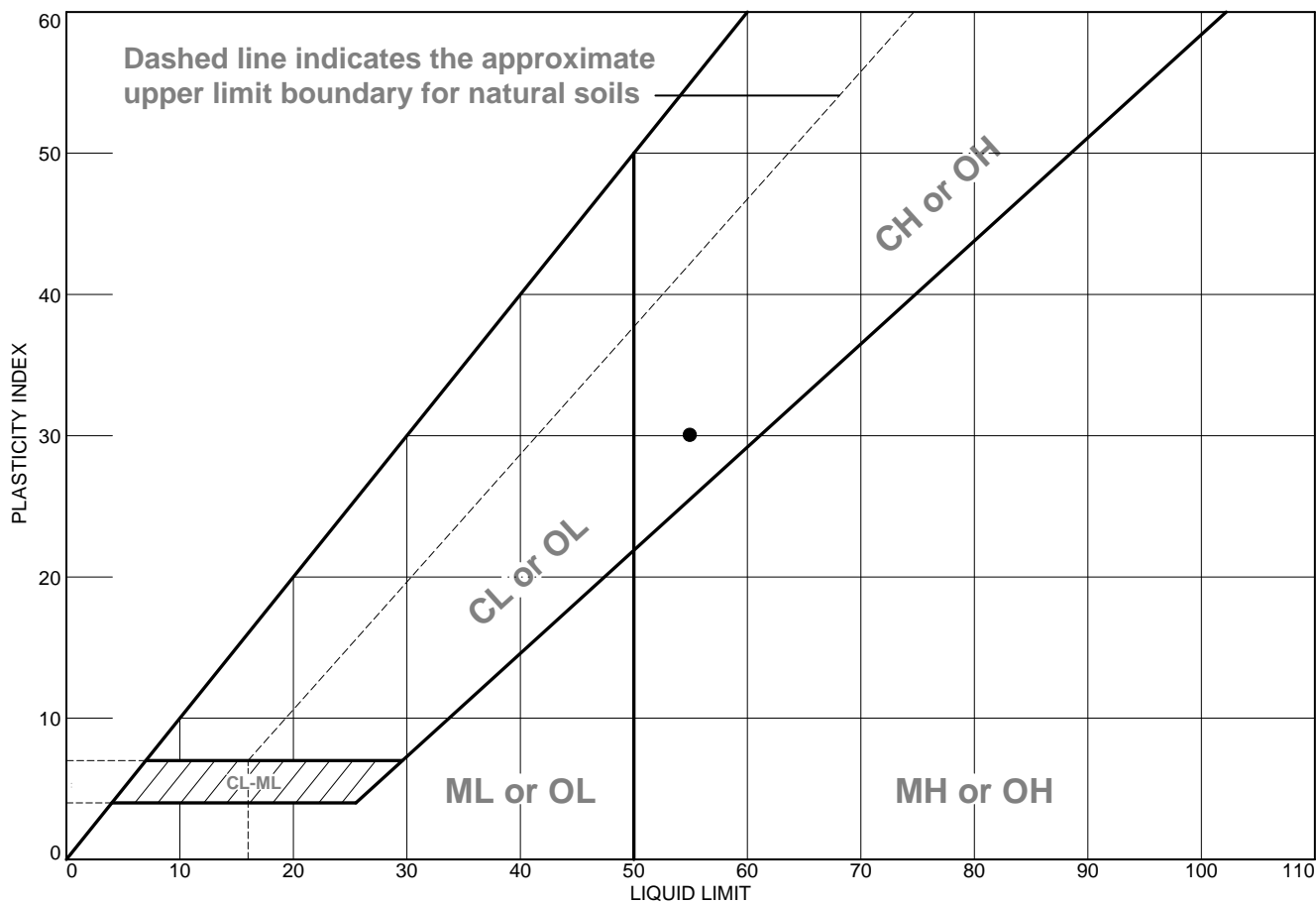
	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Red SILTY CLAY w/rock fragments	43	22	21			

Project No. W16011 Client: Randolph Engineering Project: V.A. Medical Center Road Source of Sample: R-3 Depth: 2.5 - 4.0 ft. Sample Number: 2	Remarks:
NGE, LLC St. Albans, West Virginia	

Figure

Tested By: CTD Checked By: CEM

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown SILTY CLAY	55	25	30			

Project No.	W16011	Client:	Randolph Engineering
--------------------	--------	----------------	----------------------

Project: V.A. Medical Center Road

● **Source of Sample:** R-5 **Depth:** 5.0 - 6.5 ft. **Sample Number:** 3

NGE, LLC

St. Albans, West Virginia

Remarks:

Figure

Tested By: CTD **Checked By:** CEM

LIQUID AND PLASTIC LIMITS TEST REPORT

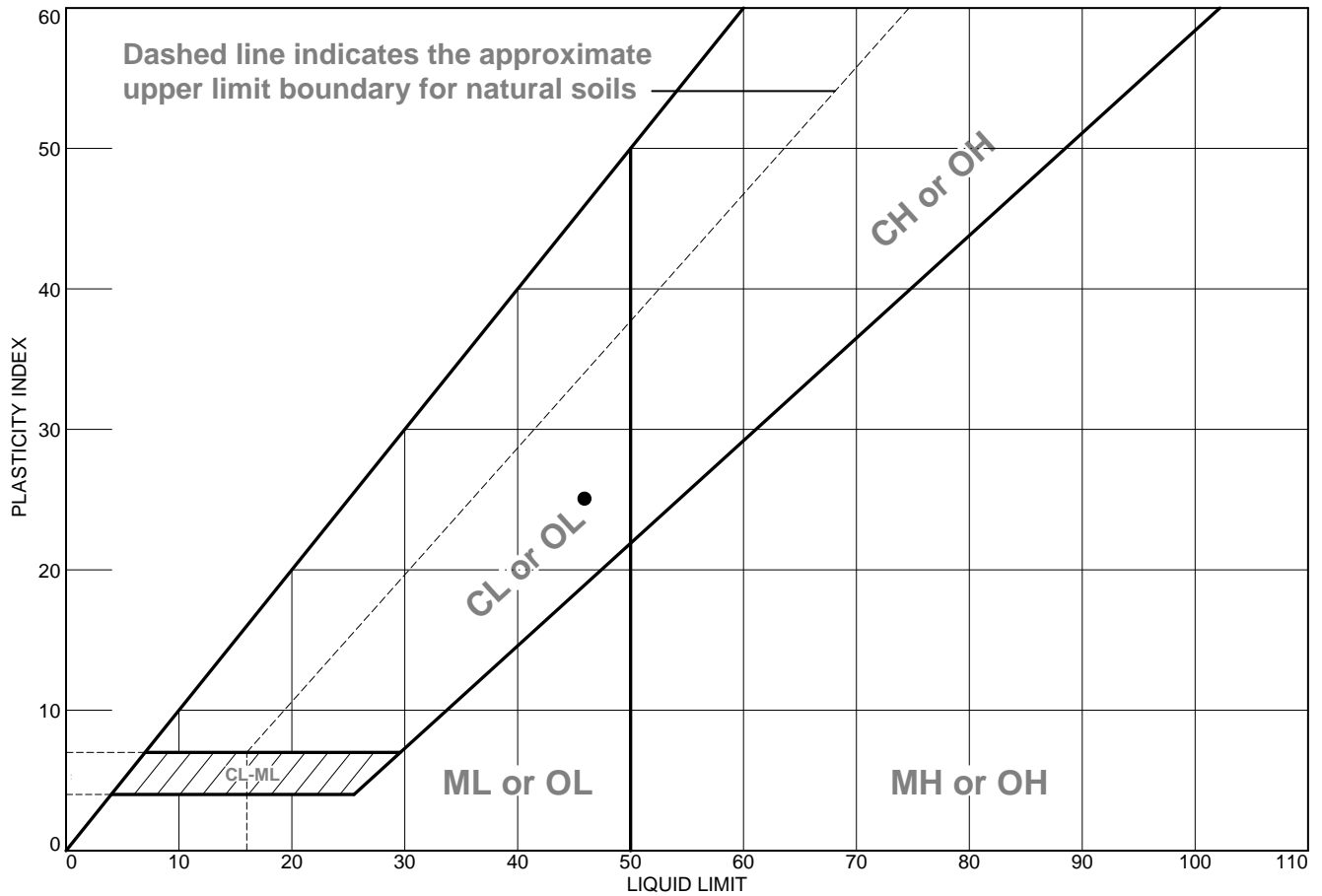
Dashed line indicates the approximate upper limit boundary for natural soils

MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
Brown SILTY CLAY w/rock fragments	34	19	15			

Project No.	W16011	Client:	Randolph Engineering	Remarks:
Project:	V.A. Medical Center Road			
Source of Sample:	R-6	Depth:	5.0 - 6.5 ft.	
		Sample Number:	3	
NGE, LLC				Figure
St. Albans, West Virginia				

Tested By: CTD **Checked By:** CEM

LIQUID AND PLASTIC LIMITS TEST REPORT



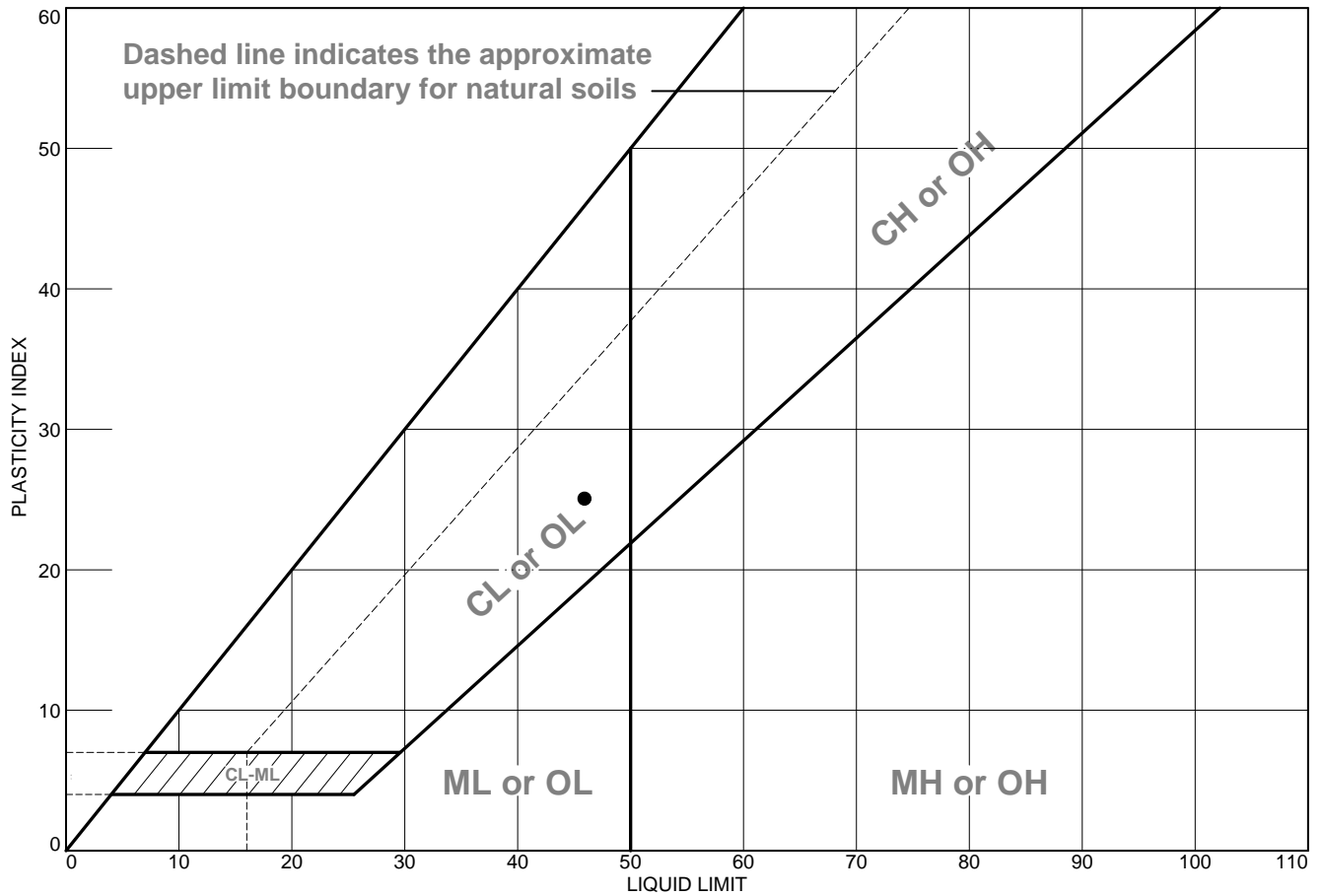
	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown SILTY CLAY w/rock fragments	46	21	25			

Project No. W16011 Client: Randolph Engineering Project: V.A. Medical Center Road Source of Sample: R-9 Depth: 2.5 - 4.0 ft. Sample Number: 2	Remarks:
NGE, LLC St. Albans, West Virginia	

Figure

Tested By: CTD Checked By: CEM

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Red SILTY CLAY	46	21	25			

Project No. W16011	Client: Randolph Engineering
---------------------------	-------------------------------------

Project: V.A. Medical Center Road

● **Source of Sample:** R-9 **Depth:** 12.5 - 14.0 ft. **Sample Number:** 6

NGE, LLC

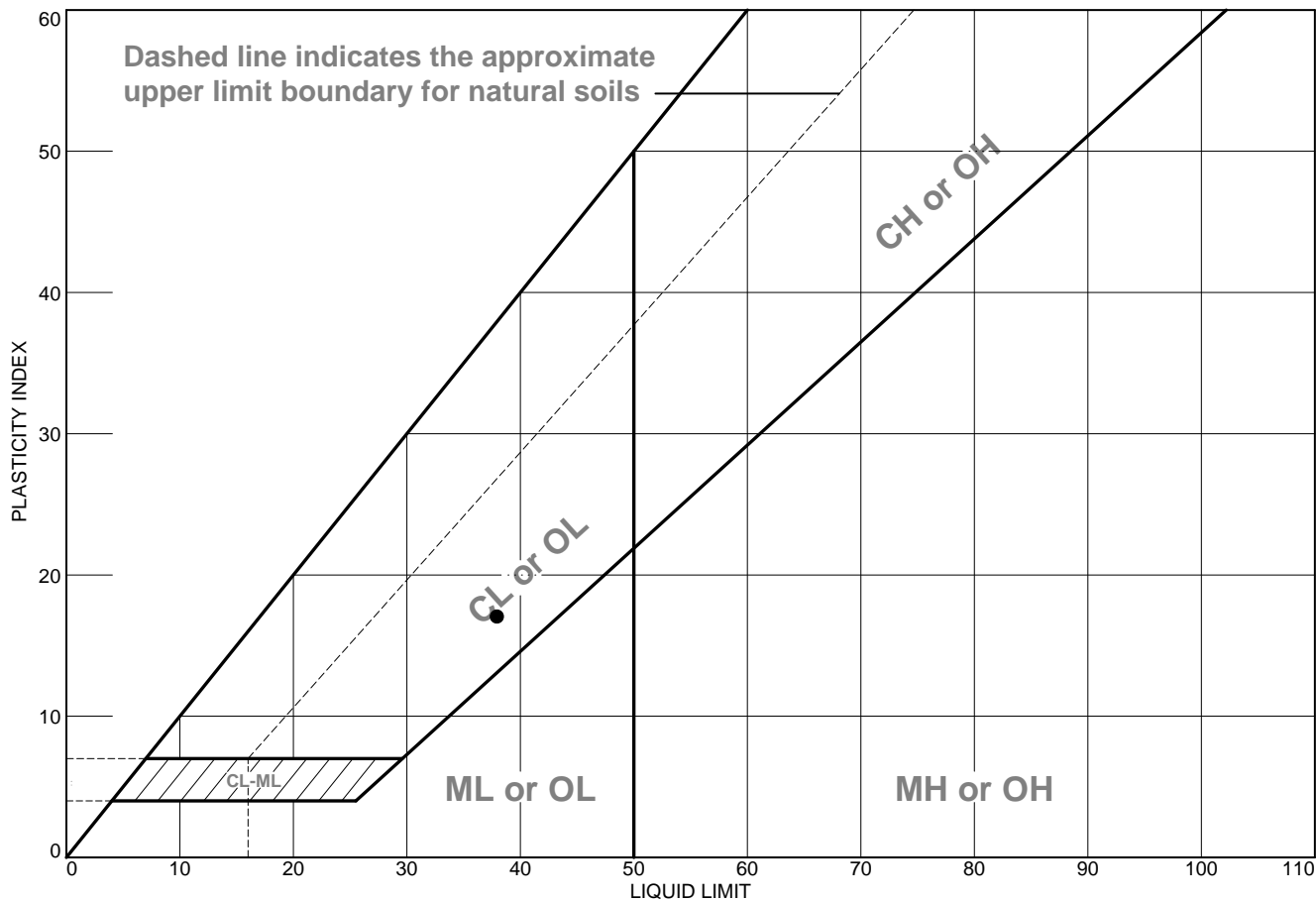
St. Albans, West Virginia

Remarks:

Figure

Tested By: CTD **Checked By:** CEM

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown SILTY CLAY w/rock fragments	38	21	17			

Project No.	W16011	Client:	Randolph Engineering
--------------------	--------	----------------	----------------------

Project: V.A. Medical Center Road

● **Source of Sample:** R-11 **Depth:** 5.0 - 6.5 ft. **Sample Number:** 3

NGE, LLC

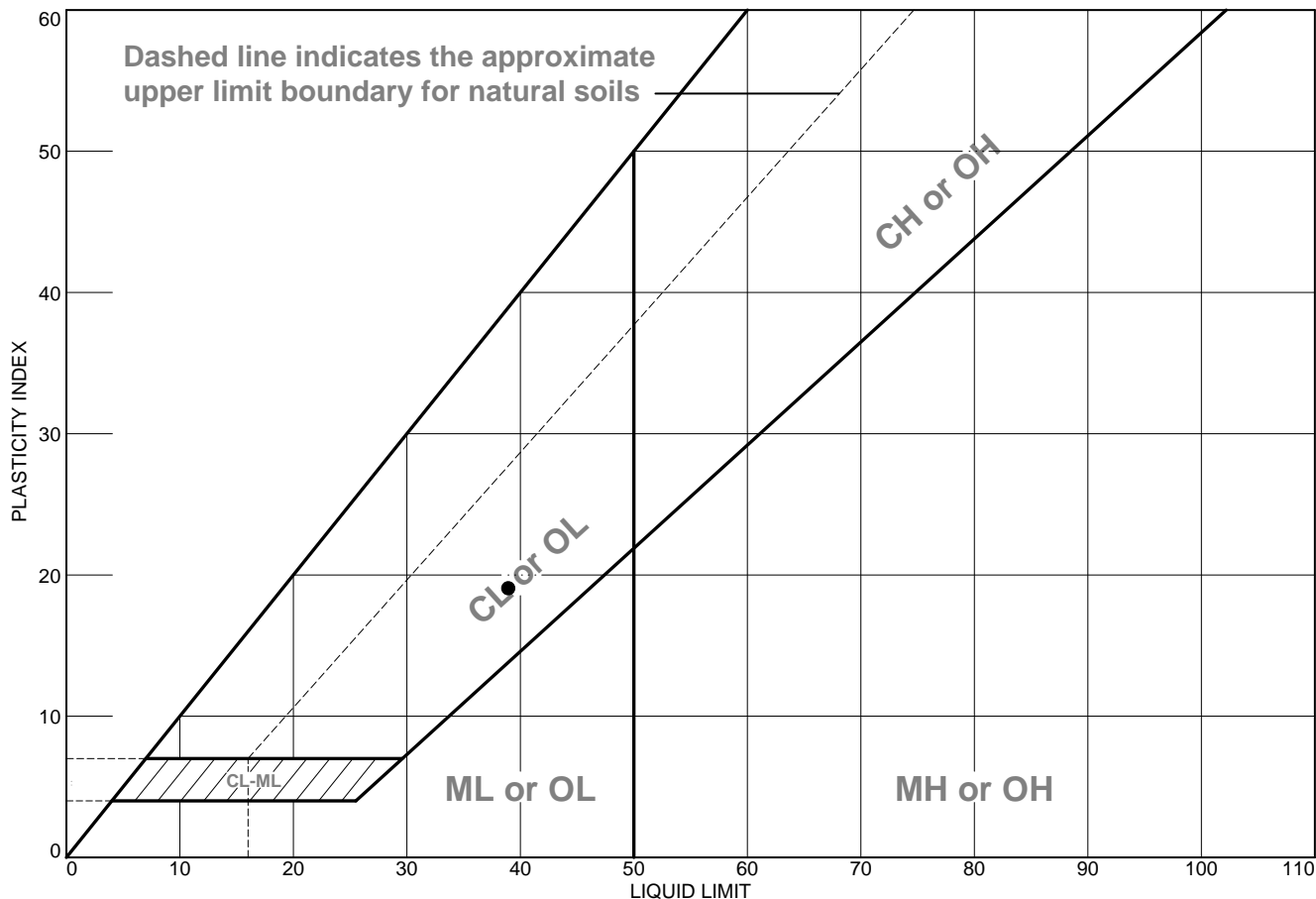
St. Albans, West Virginia

Remarks:

Figure

Tested By: CTD **Checked By:** CEM

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Red SLTY CLAY	39	20	19			

Project No.	W16011	Client:	Randolph Engineering
--------------------	--------	----------------	----------------------

Project: V.A. Medical Center Road

● **Source of Sample:** R-11 **Depth:** 7.5 - 9.0 ft. **Sample Number:** 4

NGE, LLC

St. Albans, West Virginia

Remarks:

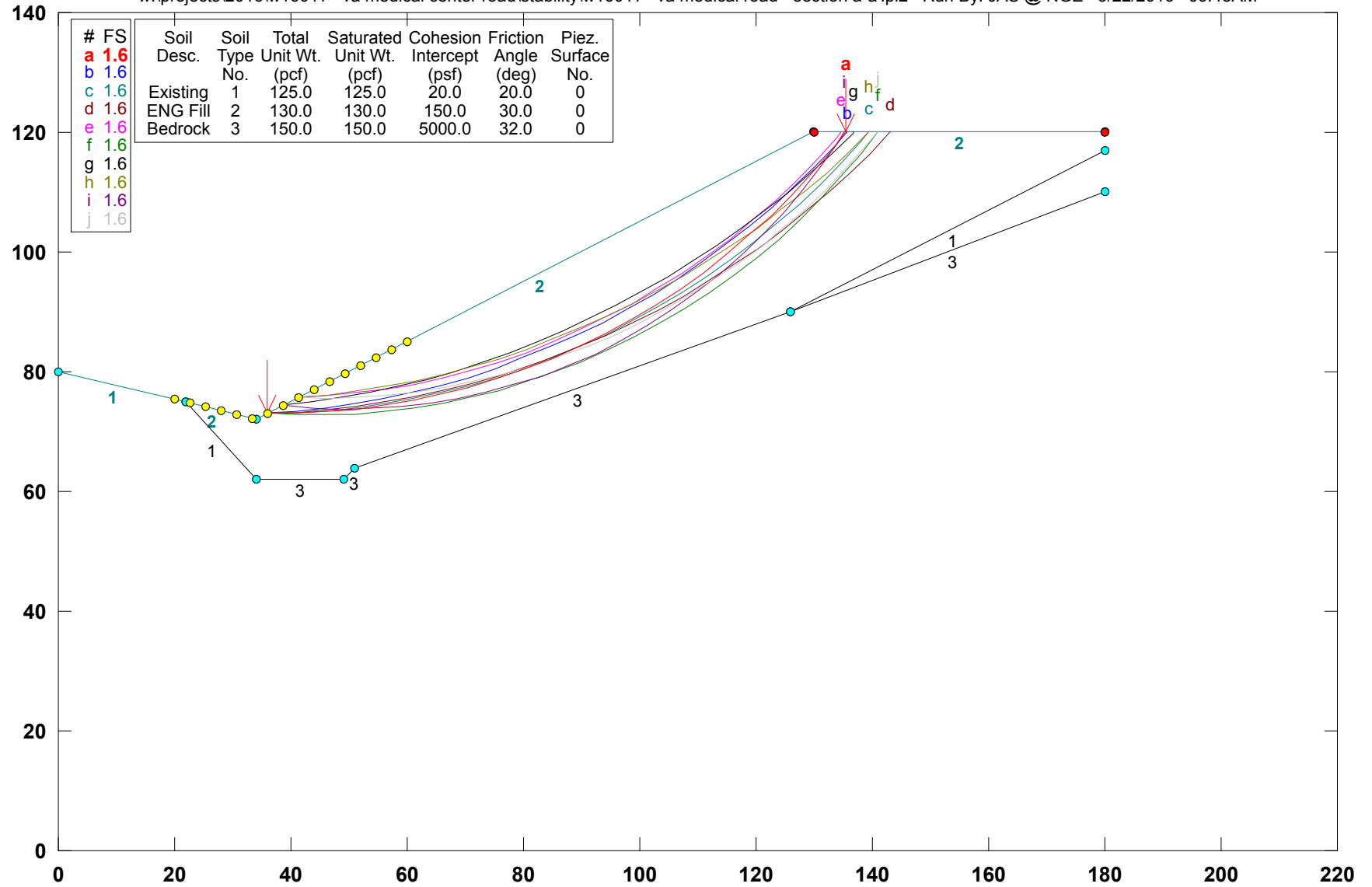
Figure

Tested By: CTD **Checked By:** CEM

Appendix B

W16011 - VA Medical Road - Section A-A' - Toe Key & Bonding Benches

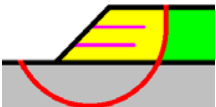
w:\projects\2016\w16011 - va medical center road\stability\w16011 - va medical road - section a-a'.pl2 Run By: JAS @ NGE 3/22/2016 09:48AM



STABL6H FSmin=1.6

Safety Factors Are Calculated By The Modified Bishop Method

STED



** STABL6H **

by

Purdue University

--Slope Stability Analysis--

Simplified Janbu, Simplified Bishop

or Spencer's Method of Slices

Run Date: 3/22/2016

Time of Run: 09:48AM

Run By: JAS @ NGE

Input Data Filename: W:w16011 - va medical road - section a-a'.in

Output Filename: W:w16011 - va medical road - section a-a'.OUT

Plotted Output Filename: W:w16011 - va medical road - section a-a'.PLT

PROBLEM DESCRIPTION W16011 - VA Medical Road - Section A-A'

- Toe Key & Bonding Benches

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	22.00	75.00	1
2	22.00	75.00	34.00	72.00	2
3	34.00	72.00	130.00	120.00	2
4	130.00	120.00	180.00	120.00	2
5	22.00	75.00	34.00	62.00	1
6	34.00	62.00	49.00	62.00	3
7	49.00	62.00	51.00	64.00	3
8	51.00	64.00	126.00	90.00	3
9	126.00	90.00	180.00	117.00	1
10	126.00	90.00	180.00	110.00	3

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param. (psf)	Pressure Constant (psf)	Piez. Surface No.
1	125.0	125.0	20.0	20.0	0.00	0.0	0
2	130.0	130.0	150.0	30.0	0.00	0.0	0
3	150.0	150.0	5000.0	32.0	0.00	0.0	0

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

3200 Trial Surfaces Have Been Generated.

200 Surfaces Initiate From Each Of 16 Points Equally Spaced

Along The Ground Surface Between X = 20.00 ft.

and X = 60.00 ft.

Each Surface Terminates Between X = 130.00 ft.

and X = 180.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial

Failure Surfaces Examined. They Are Ordered - Most Critical First.

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

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	36.00	73.00
2	41.00	73.04
3	45.99	73.27
4	50.98	73.71
5	55.94	74.34
6	60.87	75.17
7	65.76	76.19
8	70.61	77.41
9	75.41	78.82
10	80.14	80.42
11	84.81	82.21
12	89.41	84.18

13	93.92	86.33
14	98.35	88.66
15	102.67	91.17
16	106.90	93.84
17	111.01	96.68
18	115.01	99.68
19	118.89	102.84
20	122.63	106.15
21	126.25	109.61
22	129.72	113.21
23	133.05	116.94
24	135.56	120.00

Circle Center At X = 37.6 ; Y = 198.7 and Radius, 125.7

*** 1.602 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	36.00	73.00
2	40.99	73.36
3	45.96	73.89
4	50.91	74.59
5	55.83	75.46
6	60.73	76.50
7	65.58	77.70
8	70.39	79.06
9	75.15	80.59
10	79.86	82.28
11	84.50	84.12
12	89.08	86.13
13	93.59	88.29
14	98.03	90.60
15	102.38	93.06
16	106.65	95.66
17	110.82	98.41
18	114.91	101.30
19	118.88	104.33
20	122.76	107.49
21	126.52	110.78
22	130.17	114.20
23	133.71	117.73
24	135.82	120.00

Circle Center At X = 27.8 ; Y = 219.9 and Radius, 147.1

*** 1.604 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	36.00	73.00
2	41.00	73.13
3	45.99	73.44
4	50.97	73.93
5	55.92	74.60
6	60.85	75.44
7	65.74	76.46
8	70.60	77.65
9	75.41	79.02
10	80.17	80.55
11	84.87	82.26
12	89.50	84.13
13	94.07	86.17
14	98.56	88.37
15	102.97	90.73
16	107.29	93.25
17	111.52	95.92
18	115.65	98.73
19	119.67	101.70
20	123.59	104.80
21	127.40	108.05

22	131.08	111.42
23	134.65	114.93
24	138.08	118.56
25	139.35	120.00

Circle Center At X = 34.8 ; Y = 212.8 and Radius, 139.8

*** 1.605 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	36.00	73.00
2	41.00	73.23
3	45.98	73.61
4	50.95	74.16
5	55.90	74.86
6	60.83	75.73
7	65.72	76.75
8	70.58	77.92
9	75.40	79.25
10	80.17	80.74
11	84.90	82.37
12	89.57	84.16
13	94.18	86.09
14	98.73	88.17
15	103.20	90.40
16	107.61	92.77
17	111.93	95.27
18	116.18	97.92
19	120.33	100.70
20	124.40	103.61
21	128.37	106.65
22	132.24	109.81
23	136.01	113.10
24	139.67	116.50
25	143.20	120.00

Circle Center At X = 31.4 ; Y = 229.2 and Radius, 156.3

*** 1.621 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	41.33	75.67
2	46.33	75.96
3	51.30	76.45
4	56.26	77.12
5	61.18	77.98
6	66.07	79.03
7	70.92	80.26
8	75.71	81.68
9	80.45	83.27
10	85.13	85.04
11	89.73	86.99
12	94.26	89.11
13	98.70	91.40
14	103.06	93.86
15	107.31	96.48
16	111.47	99.27
17	115.52	102.20
18	119.45	105.29
19	123.26	108.52
20	126.95	111.90
21	130.51	115.41
22	133.93	119.06
23	134.75	120.00

Circle Center At X = 36.0 ; Y = 207.5 and Radius, 132.0

*** 1.622 ***

Failure Surface Specified By 25 Coordinate Points

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

1	36.00	73.00
2	41.00	72.78
3	46.00	72.77
4	50.99	72.96
5	55.98	73.35
6	60.94	73.94
7	65.88	74.73
8	70.78	75.72
9	75.64	76.91
10	80.44	78.30
11	85.19	79.88
12	89.86	81.64
13	94.46	83.60
14	98.98	85.74
15	103.41	88.06
16	107.74	90.56
17	111.97	93.23
18	116.08	96.07
19	120.08	99.08
20	123.95	102.24
21	127.69	105.56
22	131.29	109.03
23	134.75	112.64
24	138.06	116.38
25	141.01	120.00

Circle Center At X = 43.8 ; Y = 196.3 and Radius, 123.6

*** 1.624 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	38.67	74.33
2	43.63	74.93
3	48.58	75.67
4	53.50	76.57
5	58.39	77.61
6	63.24	78.79
7	68.06	80.12
8	72.84	81.60
9	77.57	83.22
10	82.25	84.98
11	86.88	86.87
12	91.44	88.91
13	95.95	91.08
14	100.38	93.39
15	104.75	95.83
16	109.04	98.40
17	113.25	101.10
18	117.37	103.92
19	121.41	106.86
20	125.37	109.93
21	129.22	113.11
22	132.98	116.41
23	136.64	119.81
24	136.83	120.00

Circle Center At X = 21.3 ; Y = 240.0 and Radius, 166.6

*** 1.628 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	41.33	75.67
2	46.31	76.13
3	51.27	76.74
4	56.21	77.52
5	61.13	78.45
6	66.01	79.54
7	70.85	80.78
8	75.65	82.17

9	80.41	83.72
10	85.11	85.41
11	89.76	87.26
12	94.35	89.25
13	98.87	91.38
14	103.32	93.66
15	107.69	96.08
16	111.99	98.63
17	116.21	101.32
18	120.33	104.15
19	124.37	107.10
20	128.31	110.18
21	132.15	113.38
22	135.88	116.70
23	139.36	120.00

Circle Center At X = 29.3 ; Y = 232.7 and Radius, 157.5

*** 1.632 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	38.67	74.33
2	43.65	73.91
3	48.65	73.73
4	53.65	73.79
5	58.64	74.10
6	63.60	74.66
7	68.54	75.46
8	73.43	76.50
9	78.26	77.78
10	83.03	79.30
11	87.71	81.05
12	92.31	83.02
13	96.80	85.22
14	101.17	87.64
15	105.42	90.27
16	109.54	93.11
17	113.52	96.14
18	117.34	99.37
19	120.99	102.78
20	124.48	106.36
21	127.78	110.12
22	130.90	114.03
23	133.82	118.09
24	135.06	120.00

Circle Center At X = 49.8 ; Y = 175.4 and Radius, 101.7

*** 1.634 ***

Failure Surface Specified By 24 Coordinate Points

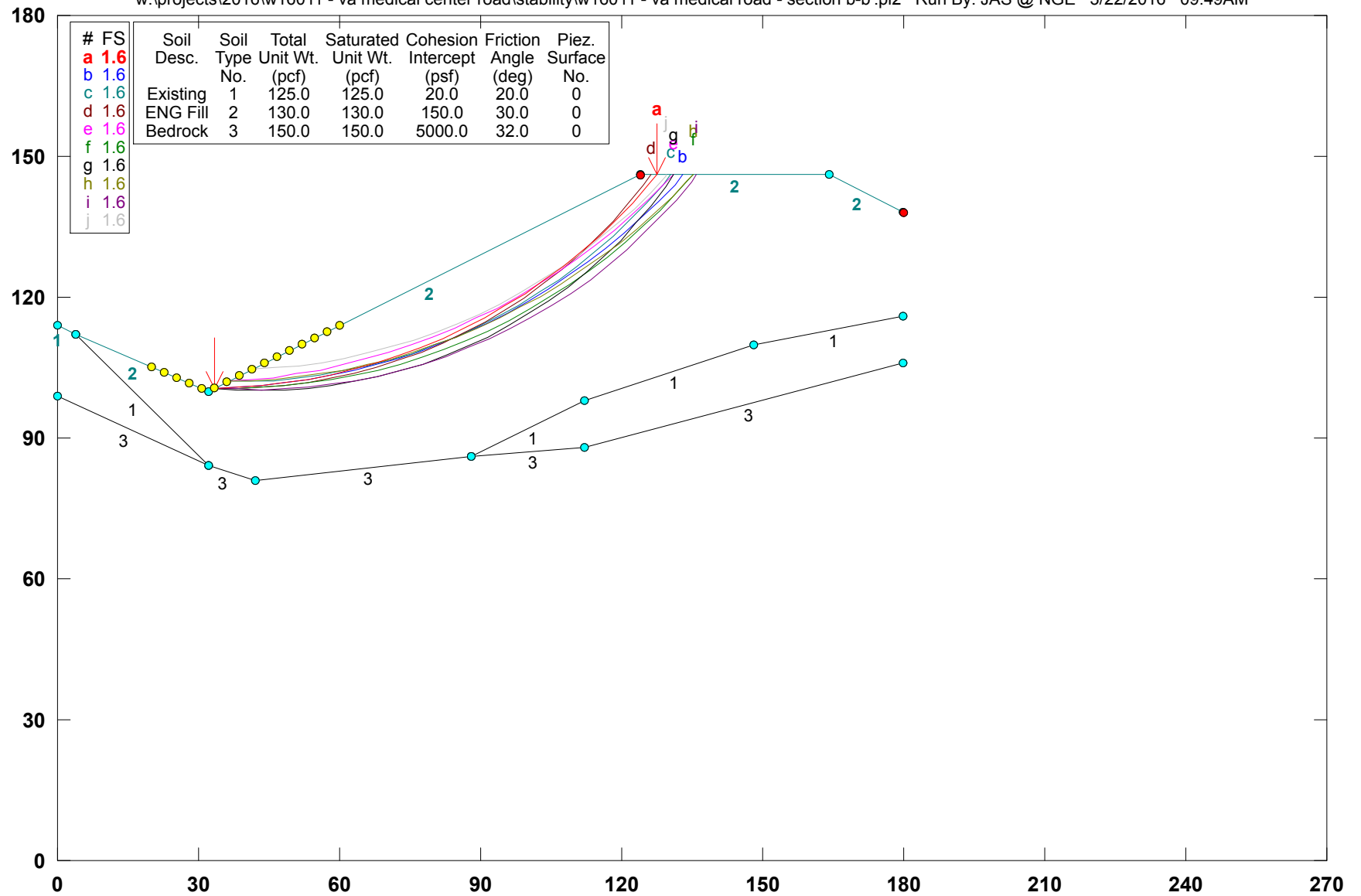
Point No.	X-Surf (ft)	Y-Surf (ft)
1	41.33	75.67
2	46.33	75.61
3	51.33	75.75
4	56.32	76.09
5	61.29	76.62
6	66.24	77.36
7	71.15	78.29
8	76.02	79.42
9	80.84	80.75
10	85.61	82.26
11	90.31	83.97
12	94.93	85.86
13	99.48	87.93
14	103.95	90.19
15	108.32	92.62
16	112.58	95.22
17	116.75	97.99
18	120.79	100.93

19	124.72	104.03
20	128.52	107.28
21	132.18	110.68
22	135.71	114.22
23	139.09	117.90
24	140.87	120.00

Circle Center At X = 45.3 ; Y = 200.6 and Radius, 125.0
 *** 1.635 ***

W16011 - VA Medical Road - Section B-B' - Toe Key & Bonding Benches

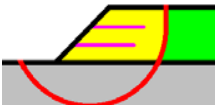
w:\projects\2016\w16011 - va medical center road\stability\w16011 - va medical road - section b-b'.pl2 Run By: JAS @ NGE 3/22/2016 09:49AM



STABL6H FSmin=1.6

Safety Factors Are Calculated By The Modified Bishop Method

STED



** STABL6H **

by

Purdue University

--Slope Stability Analysis--

Simplified Janbu, Simplified Bishop

or Spencer's Method of Slices

Run Date: 3/22/2016

Time of Run: 09:49AM

Run By: JAS @ NGE

Input Data Filename: W:w16011 - va medical road - section b-b'.in

Output Filename: W:w16011 - va medical road - section b-b'.OUT

Plotted Output Filename: W:w16011 - va medical road - section b-b'.PLT

PROBLEM DESCRIPTION W16011 - VA Medical Road - Section B-B'

- Toe Key & Bonding Benches

BOUNDARY COORDINATES

5 Top Boundaries

14 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	114.00	4.00	112.00	1
2	4.00	112.00	32.00	100.00	2
3	32.00	100.00	124.00	146.00	2
4	124.00	146.00	164.00	146.00	2
5	164.00	146.00	180.00	138.00	2
6	4.00	112.00	32.00	84.00	1
7	32.00	84.00	42.00	81.00	3
8	42.00	81.00	88.00	86.00	3
9	88.00	86.00	112.00	98.00	1
10	112.00	98.00	148.00	110.00	1
11	148.00	110.00	180.00	116.00	1
12	0.00	99.00	32.00	84.00	3
13	88.00	86.00	112.00	88.00	3
14	112.00	88.00	180.00	106.00	3

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	125.0	125.0	20.0	20.0	0.00	0.0	0
2	130.0	130.0	150.0	30.0	0.00	0.0	0
3	150.0	150.0	5000.0	32.0	0.00	0.0	0

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

3200 Trial Surfaces Have Been Generated.

200 Surfaces Initiate From Each Of 16 Points Equally Spaced

Along The Ground Surface Between X = 20.00 ft.

and X = 60.00 ft.

Each Surface Terminates Between X = 124.00 ft.

and X = 180.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial

Failure Surfaces Examined. They Are Ordered - Most Critical First.

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

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	100.67
2	38.33	100.83
3	43.32	101.20
4	48.28	101.77
5	53.23	102.54
6	58.13	103.51
7	62.99	104.68
8	67.80	106.04

9	72.56	107.59
10	77.24	109.33
11	81.85	111.26
12	86.38	113.38
13	90.83	115.68
14	95.17	118.15
15	99.41	120.80
16	103.54	123.62
17	107.56	126.60
18	111.45	129.74
19	115.21	133.03
20	118.83	136.48
21	122.32	140.06
22	125.65	143.79
23	127.48	146.00

Circle Center At X = 31.7 ; Y = 224.6 and Radius, 123.9

*** 1.615 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	100.67
2	38.33	100.83
3	43.32	101.18
4	48.29	101.71
5	53.24	102.42
6	58.16	103.31
7	63.04	104.38
8	67.89	105.63
9	72.68	107.06
10	77.42	108.65
11	82.09	110.43
12	86.70	112.37
13	91.23	114.48
14	95.69	116.75
15	100.05	119.18
16	104.33	121.77
17	108.51	124.52
18	112.58	127.42
19	116.55	130.46
20	120.40	133.65
21	124.13	136.98
22	127.74	140.44
23	131.22	144.03
24	133.00	146.00

Circle Center At X = 31.3 ; Y = 237.4 and Radius, 136.7

*** 1.616 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	36.00	102.00
2	41.00	102.04
3	45.99	102.28
4	50.97	102.74
5	55.93	103.40
6	60.85	104.26
7	65.74	105.33
8	70.57	106.60
9	75.35	108.07
10	80.07	109.74
11	84.71	111.61
12	89.26	113.66
13	93.73	115.91
14	98.10	118.34
15	102.37	120.94
16	106.52	123.73
17	110.56	126.68
18	114.47	129.80

19	118.24	133.08
20	121.88	136.51
21	125.37	140.09
22	128.70	143.81
23	130.51	146.00

Circle Center At X = 37.6 ; Y = 222.1 and Radius, 120.1

*** 1.622 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	100.67
2	38.33	100.61
3	43.33	100.78
4	48.31	101.18
5	53.28	101.80
6	58.20	102.65
7	63.09	103.72
8	67.92	105.01
9	72.68	106.52
10	77.38	108.25
11	81.99	110.18
12	86.51	112.33
13	90.92	114.67
14	95.23	117.22
15	99.41	119.95
16	103.47	122.88
17	107.39	125.98
18	111.16	129.26
19	114.78	132.71
20	118.24	136.32
21	121.54	140.08
22	124.66	143.98
23	126.12	146.00

Circle Center At X = 37.1 ; Y = 210.7 and Radius, 110.1

*** 1.622 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	36.00	102.00
2	40.99	102.36
3	45.96	102.90
4	50.91	103.61
5	55.83	104.50
6	60.71	105.56
7	65.56	106.80
8	70.36	108.20
9	75.10	109.78
10	79.79	111.52
11	84.41	113.42
12	88.97	115.49
13	93.44	117.72
14	97.84	120.10
15	102.14	122.64
16	106.36	125.33
17	110.48	128.17
18	114.49	131.15
19	118.40	134.27
20	122.19	137.53
21	125.87	140.91
22	129.42	144.43
23	130.90	146.00

Circle Center At X = 28.3 ; Y = 243.1 and Radius, 141.3

*** 1.626 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	100.67

2	38.33	100.64
3	43.33	100.80
4	48.32	101.16
5	53.29	101.71
6	58.23	102.45
7	63.15	103.38
8	68.02	104.50
9	72.84	105.81
10	77.62	107.30
11	82.33	108.97
12	86.97	110.83
13	91.54	112.86
14	96.03	115.07
15	100.42	117.45
16	104.73	120.00
17	108.93	122.71
18	113.02	125.58
19	117.00	128.60
20	120.86	131.78
21	124.60	135.11
22	128.20	138.57
23	131.67	142.17
24	135.00	145.91
25	135.07	146.00

Circle Center At X = 36.6 ; Y = 230.3 and Radius, 129.6

*** 1.627 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	100.67
2	38.32	100.30
3	43.32	100.17
4	48.32	100.27
5	53.31	100.61
6	58.27	101.18
7	63.21	101.98
8	68.10	103.01
9	72.94	104.28
10	77.71	105.76
11	82.41	107.47
12	87.03	109.40
13	91.54	111.54
14	95.96	113.89
15	100.25	116.45
16	104.43	119.20
17	108.47	122.15
18	112.36	125.28
19	116.11	128.60
20	119.69	132.08
21	123.11	135.73
22	126.36	139.53
23	129.42	143.49
24	131.18	146.00

Circle Center At X = 43.6 ; Y = 206.8 and Radius, 106.6

*** 1.634 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	36.00	102.00
2	41.00	102.13
3	45.99	102.45
4	50.96	102.95
5	55.92	103.63
6	60.84	104.49
7	65.73	105.53
8	70.58	106.75
9	75.38	108.15

10	80.13	109.72
11	84.81	111.47
12	89.43	113.39
13	93.97	115.47
14	98.44	117.72
15	102.82	120.14
16	107.10	122.71
17	111.29	125.44
18	115.38	128.32
19	119.36	131.35
20	123.22	134.52
21	126.97	137.83
22	130.59	141.28
23	134.08	144.86
24	135.12	146.00

Circle Center At X = 34.9 ; Y = 238.1 and Radius, 136.1

*** 1.634 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.33	100.67
2	38.33	100.39
3	43.33	100.32
4	48.32	100.47
5	53.31	100.82
6	58.28	101.39
7	63.22	102.16
8	68.12	103.15
9	72.98	104.33
10	77.78	105.72
11	82.52	107.32
12	87.19	109.11
13	91.78	111.09
14	96.28	113.27
15	100.68	115.64
16	104.98	118.19
17	109.17	120.92
18	113.24	123.82
19	117.19	126.89
20	121.00	130.13
21	124.67	133.52
22	128.20	137.07
23	131.57	140.76
24	134.78	144.59
25	135.87	146.00

Circle Center At X = 42.4 ; Y = 218.9 and Radius, 118.5

*** 1.644 ***

Failure Surface Specified By 22 Coordinate Points

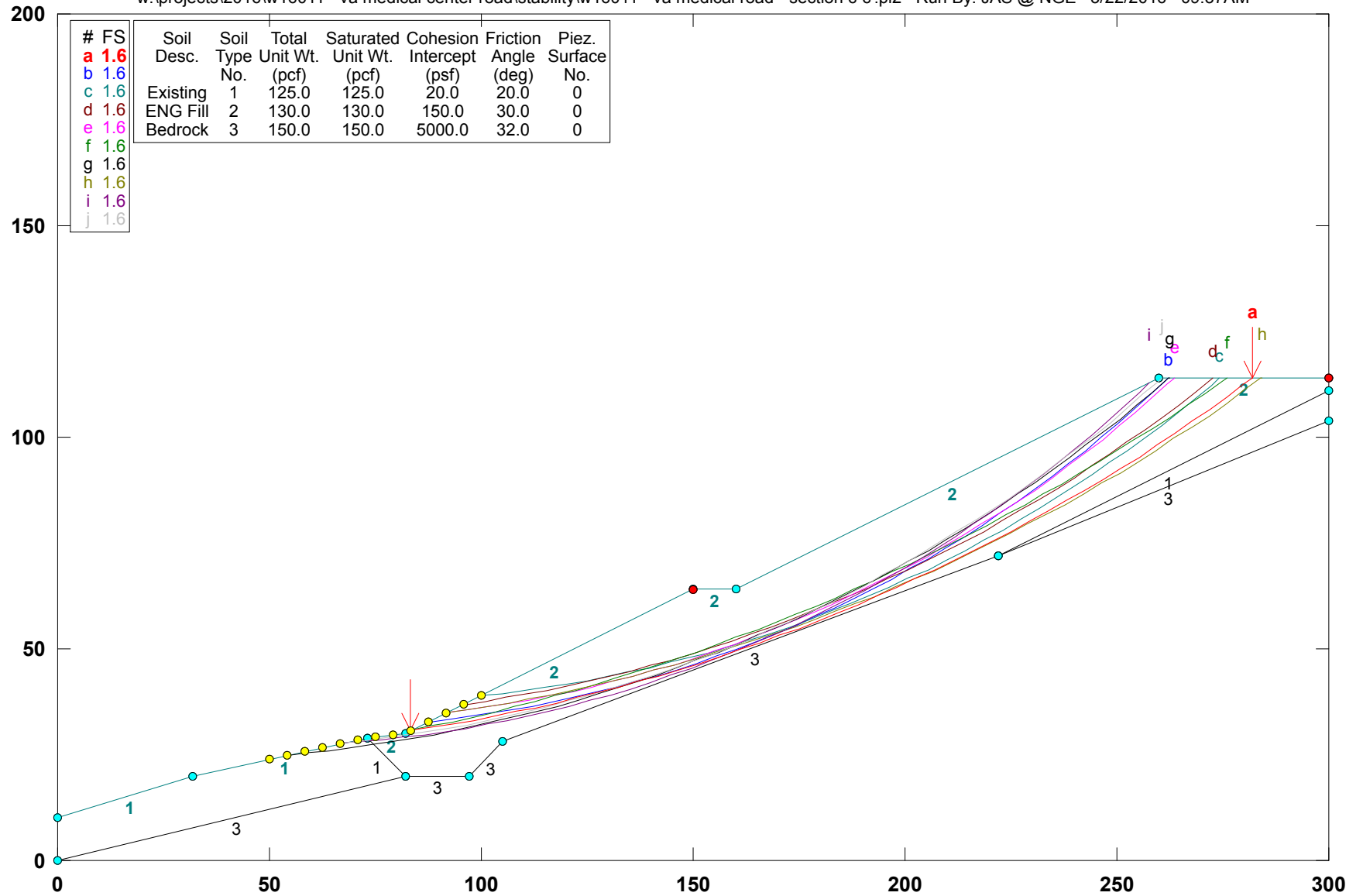
Point No.	X-Surf (ft)	Y-Surf (ft)
1	41.33	104.67
2	46.33	104.96
3	51.30	105.46
4	56.25	106.15
5	61.17	107.04
6	66.05	108.13
7	70.89	109.40
8	75.67	110.87
9	80.38	112.53
10	85.03	114.38
11	89.60	116.41
12	94.09	118.61
13	98.48	121.00
14	102.78	123.56
15	106.97	126.29
16	111.04	129.18
17	115.00	132.23

18	118.84	135.44
19	122.54	138.80
20	126.11	142.30
21	129.54	145.94
22	129.59	146.00

Circle Center At X = 36.4 ; Y = 230.1 and Radius, 125.6
*** 1.645 ***

W16011 - VA Medical Road - Section C-C' - Toe Key & Bonding Benches

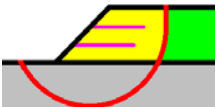
w:\projects\2016\w16011 - va medical center road\stability\w16011 - va medical road - section c-c'.pl2 Run By: JAS @ NGE 3/22/2016 09:37AM



STABL6H FSmin=1.6

Safety Factors Are Calculated By The Modified Bishop Method

STED



** STABL6H **

by

Purdue University

--Slope Stability Analysis--

Simplified Janbu, Simplified Bishop

or Spencer's Method of Slices

Run Date: 3/22/2016

Time of Run: 09:37AM

Run By: JAS @ NGE

Input Data Filename: W:w16011 - va medical road - section c-c'.in

Output Filename: W:w16011 - va medical road - section c-c'.OUT

Plotted Output Filename: W:w16011 - va medical road - section c-c'.PLT

PROBLEM DESCRIPTION W16011 - VA Medical Road - Section C-C'

- Toe Key & Bonding Benches

BOUNDARY COORDINATES

7 Top Boundaries

14 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	10.00	32.00	20.00	1
2	32.00	20.00	73.00	29.00	1
3	73.00	29.00	82.00	30.00	2
4	82.00	30.00	150.00	64.00	2
5	150.00	64.00	160.00	64.00	2
6	160.00	64.00	260.00	114.00	2
7	260.00	114.00	300.00	114.00	2
8	73.00	29.00	82.00	20.00	1
9	82.00	20.00	97.00	20.00	3
10	97.00	20.00	105.00	28.00	3
11	105.00	28.00	222.00	72.00	3
12	222.00	72.00	300.00	111.00	1
13	0.00	0.00	82.00	20.00	3
14	222.00	72.00	300.00	104.00	3

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	125.0	125.0	20.0	20.0	0.00	0.0	0
2	130.0	130.0	150.0	30.0	0.00	0.0	0
3	150.0	150.0	5000.0	32.0	0.00	0.0	0

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

2600 Trial Surfaces Have Been Generated.

200 Surfaces Initiate From Each Of 13 Points Equally Spaced

Along The Ground Surface Between X = 50.00 ft.

and X = 100.00 ft.

Each Surface Terminates Between X = 150.00 ft.

and X = 300.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial

Failure Surfaces Examined. They Are Ordered - Most Critical First.

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

Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.33	30.67
2	88.27	31.45
3	93.20	32.28
4	98.12	33.17
5	103.03	34.12
6	107.93	35.12
7	112.82	36.17
8	117.69	37.29

9	122.55	38.45
10	127.40	39.68
11	132.24	40.95
12	137.06	42.29
13	141.86	43.67
14	146.65	45.11
15	151.42	46.61
16	156.17	48.16
17	160.91	49.76
18	165.63	51.41
19	170.33	53.12
20	175.01	54.89
21	179.66	56.70
22	184.30	58.57
23	188.92	60.49
24	193.51	62.46
25	198.08	64.49
26	202.63	66.56
27	207.16	68.69
28	211.66	70.87
29	216.13	73.10
30	220.58	75.38
31	225.01	77.71
32	229.40	80.09
33	233.77	82.52
34	238.12	85.00
35	242.43	87.53
36	246.71	90.11
37	250.97	92.73
38	255.19	95.41
39	259.39	98.13
40	263.55	100.90
41	267.68	103.71
42	271.78	106.58
43	275.85	109.48
44	279.88	112.44
45	281.97	114.00

Circle Center At X = 17.1 ; Y = 467.0 and Radius, 441.3

*** 1.591 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.50	32.75
2	92.47	33.33
3	97.42	33.99
4	102.37	34.73
5	107.30	35.56
6	112.22	36.47
7	117.12	37.46
8	122.00	38.53
9	126.86	39.69
10	131.71	40.92
11	136.53	42.24
12	141.33	43.64
13	146.11	45.12
14	150.86	46.67
15	155.59	48.31
16	160.28	50.02
17	164.95	51.82
18	169.59	53.69
19	174.19	55.64
20	178.76	57.66
21	183.30	59.76
22	187.80	61.94
23	192.27	64.19
24	196.69	66.52
25	201.08	68.92

26	205.42	71.39
27	209.73	73.94
28	213.99	76.55
29	218.20	79.24
30	222.37	82.00
31	226.50	84.83
32	230.57	87.72
33	234.60	90.69
34	238.58	93.72
35	242.50	96.82
36	246.38	99.98
37	250.19	103.20
38	253.96	106.49
39	257.67	109.85
40	261.32	113.26
41	262.09	114.00

Circle Center At X = 55.4 ; Y = 329.9 and Radius, 298.9

*** 1.597 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	39.00
2	104.97	39.54
3	109.93	40.16
4	114.88	40.86
5	119.82	41.64
6	124.75	42.49
7	129.66	43.43
8	134.56	44.44
9	139.44	45.53
10	144.30	46.70
11	149.14	47.94
12	153.96	49.26
13	158.77	50.66
14	163.54	52.13
15	168.30	53.68
16	173.03	55.30
17	177.73	57.00
18	182.40	58.78
19	187.05	60.63
20	191.66	62.55
21	196.25	64.54
22	200.80	66.61
23	205.32	68.75
24	209.81	70.96
25	214.26	73.24
26	218.67	75.59
27	223.04	78.02
28	227.38	80.51
29	231.67	83.07
30	235.93	85.69
31	240.14	88.39
32	244.31	91.15
33	248.43	93.98
34	252.51	96.87
35	256.54	99.83
36	260.52	102.85
37	264.46	105.93
38	268.35	109.08
39	272.18	112.29
40	274.17	114.00

Circle Center At X = 68.4 ; Y = 352.1 and Radius, 314.7

*** 1.598 ***

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.83	36.92

2	100.78	37.66
3	105.71	38.48
4	110.63	39.36
5	115.54	40.31
6	120.44	41.32
7	125.32	42.41
8	130.18	43.56
9	135.03	44.78
10	139.87	46.06
11	144.68	47.41
12	149.48	48.83
13	154.25	50.31
14	159.00	51.86
15	163.74	53.47
16	168.45	55.15
17	173.13	56.89
18	177.80	58.70
19	182.43	60.57
20	187.04	62.51
21	191.63	64.51
22	196.18	66.57
23	200.71	68.69
24	205.20	70.88
25	209.67	73.12
26	214.11	75.43
27	218.51	77.80
28	222.88	80.23
29	227.21	82.72
30	231.52	85.27
31	235.78	87.88
32	240.01	90.55
33	244.20	93.27
34	248.36	96.05
35	252.48	98.89
36	256.55	101.79
37	260.59	104.74
38	264.58	107.74
39	268.54	110.80
40	272.45	113.92
41	272.55	114.00

Circle Center At X = 44.1 ; Y = 396.6 and Radius, 363.4
 *** 1.603 ***

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	91.67	34.83
2	96.63	35.48
3	101.57	36.20
4	106.51	37.01
5	111.43	37.89
6	116.33	38.86
7	121.23	39.90
8	126.10	41.02
9	130.95	42.22
10	135.79	43.49
11	140.60	44.85
12	145.39	46.28
13	150.16	47.79
14	154.90	49.38
15	159.61	51.04
16	164.30	52.77
17	168.96	54.59
18	173.59	56.47
19	178.19	58.43
20	182.76	60.47
21	187.29	62.58
22	191.79	64.76

23	196.26	67.01
24	200.68	69.34
25	205.07	71.73
26	209.42	74.20
27	213.73	76.74
28	218.00	79.34
29	222.22	82.01
30	226.41	84.75
31	230.54	87.56
32	234.63	90.44
33	238.68	93.38
34	242.68	96.38
35	246.62	99.45
36	250.52	102.58
37	254.37	105.77
38	258.16	109.03
39	261.91	112.34
40	263.71	114.00

Circle Center At X = 54.0 ; Y = 343.2 and Radius, 310.6

*** 1.605 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.33	30.67
2	88.23	31.69
3	93.11	32.76
4	97.99	33.88
5	102.85	35.04
6	107.70	36.26
7	112.54	37.52
8	117.36	38.83
9	122.18	40.18
10	126.97	41.58
11	131.76	43.03
12	136.53	44.53
13	141.29	46.07
14	146.03	47.66
15	150.75	49.30
16	155.46	50.98
17	160.15	52.71
18	164.83	54.48
19	169.49	56.30
20	174.12	58.16
21	178.75	60.07
22	183.35	62.03
23	187.93	64.03
24	192.49	66.07
25	197.04	68.16
26	201.56	70.30
27	206.06	72.47
28	210.54	74.70
29	214.99	76.96
30	219.43	79.27
31	223.84	81.62
32	228.23	84.02
33	232.60	86.46
34	236.94	88.94
35	241.25	91.46
36	245.55	94.03
37	249.81	96.63
38	254.05	99.28
39	258.27	101.97
40	262.46	104.70
41	266.62	107.48
42	270.75	110.29
43	274.86	113.14
44	276.07	114.00

Circle Center At X = -18.7 ; Y = 531.3 and Radius, 510.9

*** 1.607 ***

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	54.17	24.87
2	59.14	25.36
3	64.11	25.93
4	69.07	26.56
5	74.02	27.26
6	78.96	28.03
7	83.89	28.87
8	88.81	29.77
9	93.72	30.73
10	98.61	31.77
11	103.48	32.87
12	108.35	34.03
13	113.19	35.26
14	118.02	36.56
15	122.83	37.92
16	127.63	39.35
17	132.40	40.84
18	137.15	42.40
19	141.88	44.02
20	146.59	45.70
21	151.27	47.45
22	155.93	49.26
23	160.57	51.13
24	165.18	53.07
25	169.76	55.07
26	174.32	57.13
27	178.84	59.25
28	183.34	61.43
29	187.81	63.68
30	192.25	65.98
31	196.65	68.34
32	201.03	70.77
33	205.37	73.25
34	209.68	75.79
35	213.95	78.39
36	218.18	81.04
37	222.38	83.76
38	226.55	86.53
39	230.67	89.35
40	234.76	92.23
41	238.80	95.17
42	242.81	98.16
43	246.78	101.21
44	250.70	104.30
45	254.58	107.46
46	258.42	110.66
47	262.22	113.91
48	262.31	114.00

Circle Center At X = 19.8 ; Y = 392.7 and Radius, 369.5

*** 1.614 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	91.67	34.83
2	96.61	35.58
3	101.55	36.38
4	106.47	37.24
5	111.39	38.15
6	116.29	39.13
7	121.18	40.16
8	126.06	41.25
9	130.93	42.40

10	135.78	43.60
11	140.62	44.86
12	145.45	46.18
13	150.25	47.56
14	155.04	48.99
15	159.82	50.47
16	164.57	52.02
17	169.31	53.61
18	174.03	55.27
19	178.73	56.98
20	183.41	58.74
21	188.06	60.56
22	192.70	62.44
23	197.31	64.37
24	201.90	66.35
25	206.47	68.38
26	211.01	70.47
27	215.53	72.62
28	220.02	74.81
29	224.49	77.06
30	228.92	79.36
31	233.34	81.72
32	237.72	84.12
33	242.08	86.58
34	246.40	89.09
35	250.70	91.64
36	254.96	94.25
37	259.20	96.91
38	263.40	99.62
39	267.57	102.37
40	271.71	105.18
41	275.82	108.03
42	279.89	110.94
43	283.93	113.89
44	284.08	114.00

Circle Center At X = 30.9 ; Y = 455.9 and Radius, 425.5
 *** 1.614 ***

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.67	27.61
2	71.65	28.02
3	76.63	28.51
4	81.59	29.08
5	86.55	29.73
6	91.50	30.46
7	96.43	31.28
8	101.35	32.17
9	106.26	33.14
10	111.14	34.19
11	116.01	35.32
12	120.87	36.53
13	125.70	37.82
14	130.51	39.18
15	135.29	40.62
16	140.06	42.15
17	144.80	43.74
18	149.51	45.42
19	154.19	47.17
20	158.84	48.99
21	163.47	50.90
22	168.06	52.87
23	172.62	54.92
24	177.15	57.05
25	181.64	59.24
26	186.09	61.51
27	190.51	63.86

28	194.89	66.27
29	199.23	68.75
30	203.53	71.31
31	207.79	73.93
32	212.00	76.62
33	216.17	79.38
34	220.29	82.21
35	224.37	85.10
36	228.40	88.06
37	232.38	91.09
38	236.31	94.18
39	240.20	97.33
40	244.03	100.54
41	247.80	103.82
42	251.53	107.15
43	255.20	110.55
44	257.49	112.74

Circle Center At X = 43.9 ; Y = 335.1 and Radius, 308.3

*** 1.615 ***

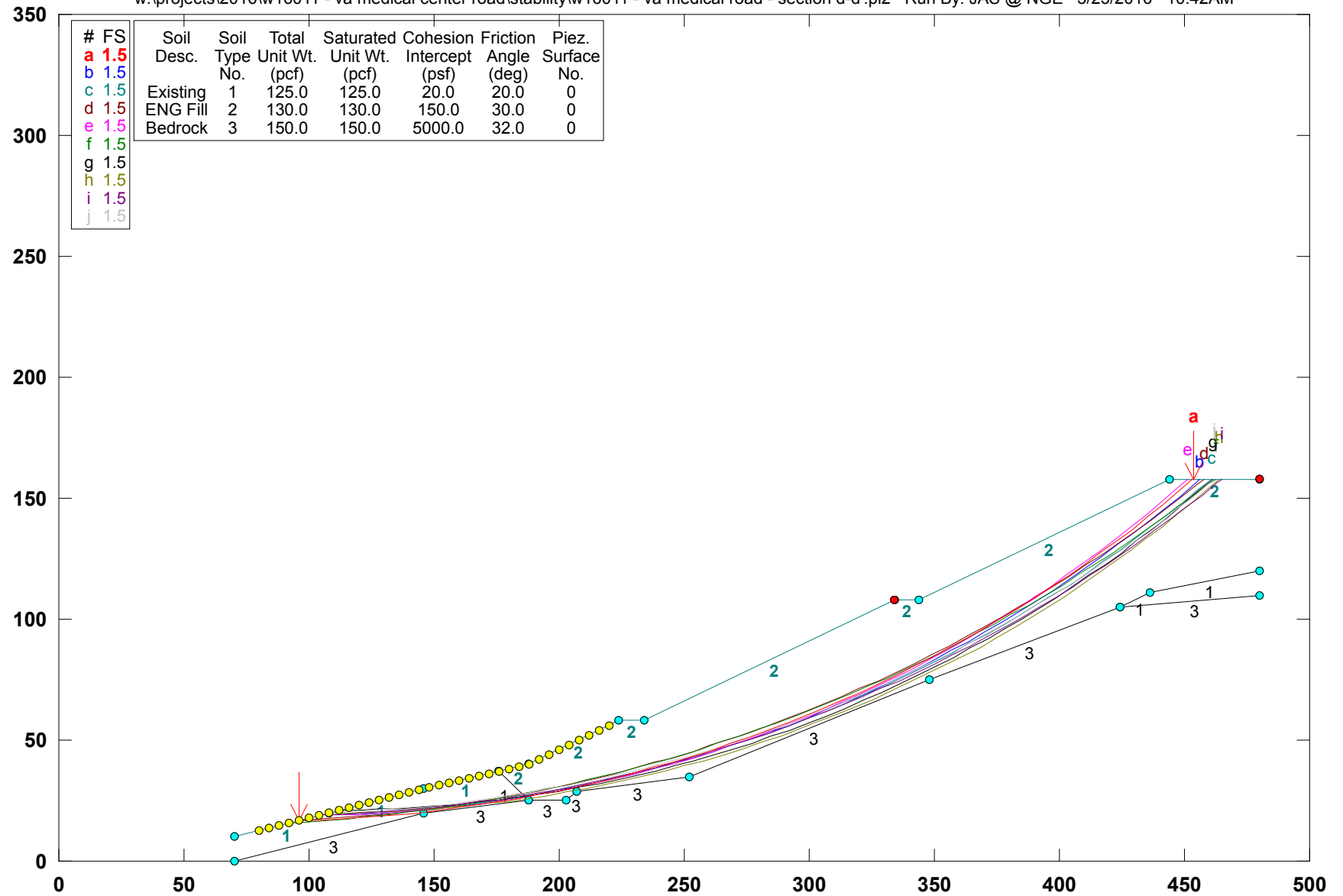
Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.67	27.61
2	71.64	28.17
3	76.60	28.80
4	81.55	29.50
5	86.49	30.28
6	91.41	31.12
7	96.33	32.04
8	101.23	33.03
9	106.12	34.09
10	110.99	35.22
11	115.84	36.42
12	120.67	37.70
13	125.49	39.04
14	130.29	40.45
15	135.06	41.94
16	139.81	43.49
17	144.54	45.11
18	149.25	46.80
19	153.93	48.56
20	158.58	50.39
21	163.21	52.28
22	167.81	54.24
23	172.38	56.27
24	176.92	58.37
25	181.43	60.53
26	185.91	62.75
27	190.35	65.04
28	194.76	67.40
29	199.14	69.82
30	203.48	72.30
31	207.78	74.85
32	212.05	77.46
33	216.27	80.13
34	220.46	82.86
35	224.61	85.65
36	228.72	88.50
37	232.78	91.41
38	236.80	94.38
39	240.78	97.41
40	244.72	100.50
41	248.60	103.64
42	252.45	106.84
43	256.24	110.10
44	259.99	113.41
45	260.64	114.00

Circle Center At X = 30.8 ; Y = 369.0 and Radius, 343.3
*** 1.624 ***

W16011 - VA Medical Road - Section D-D' - Toe Key & Bonding Benches

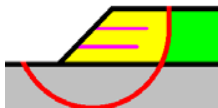
w:\projects\2016\w16011 - va medical center road\stability\w16011 - va medical road - section d-d'.pl2 Run By: JAS @ NGE 3/23/2016 10:42AM



STABL6H FSmin=1.5

Safety Factors Are Calculated By The Modified Bishop Method

STED



** STABL6H **

by

Purdue University

--Slope Stability Analysis--

Simplified Janbu, Simplified Bishop

or Spencer's Method of Slices

Run Date: 3/23/2016

Time of Run: 10:42AM

Run By: JAS @ NGE

Input Data Filename: W:w16011 - va medical road - section d-d'.in

Output Filename: W:w16011 - va medical road - section d-d'.OUT

Plotted Output Filename: W:w16011 - va medical road - section d-d'.PLT

PROBLEM DESCRIPTION W16011 - VA Medical Road - Section D-D'

- Toe Key & Bonding Benches

BOUNDARY COORDINATES

10 Top Boundaries

21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	70.00	10.00	108.00	20.00	1
2	108.00	20.00	146.00	30.00	1
3	146.00	30.00	176.00	37.00	1
4	176.00	37.00	188.00	40.00	2
5	188.00	40.00	224.00	58.00	2
6	224.00	58.00	234.00	58.00	2
7	234.00	58.00	334.00	108.00	2
8	334.00	108.00	344.00	108.00	2
9	344.00	108.00	444.00	158.00	2
10	444.00	158.00	480.00	158.00	2
11	176.00	37.00	188.00	25.00	1
12	188.00	25.00	203.00	25.00	3
13	203.00	25.00	207.00	29.00	3
14	207.00	29.00	252.00	35.00	3
15	252.00	35.00	348.00	75.00	3
16	348.00	75.00	424.00	105.00	3
17	424.00	105.00	436.00	111.00	1
18	436.00	111.00	480.00	120.00	1
19	70.00	0.00	146.00	20.00	3
20	146.00	20.00	188.00	25.00	3
21	424.00	105.00	480.00	110.00	3

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	125.0	125.0	20.0	20.0	0.00	0.0	0
2	130.0	130.0	150.0	30.0	0.00	0.0	0
3	150.0	150.0	5000.0	32.0	0.00	0.0	0

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

7200 Trial Surfaces Have Been Generated.

200 Surfaces Initiate From Each Of 36 Points Equally Spaced

Along The Ground Surface Between X = 80.00 ft.

and X = 220.00 ft.

Each Surface Terminates Between X = 334.00 ft.

and X = 480.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = 0.00 ft.

8.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial

Failure Surfaces Examined. They Are Ordered - Most Critical First.

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

Failure Surface Specified By 51 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.00	16.84

2	104.00	17.09
3	111.99	17.45
4	119.97	17.93
5	127.95	18.52
6	135.92	19.22
7	143.88	20.04
8	151.82	20.97
9	159.76	22.02
10	167.67	23.18
11	175.57	24.46
12	183.45	25.84
13	191.31	27.34
14	199.14	28.96
15	206.95	30.68
16	214.74	32.52
17	222.50	34.47
18	230.23	36.53
19	237.93	38.70
20	245.60	40.98
21	253.23	43.37
22	260.83	45.87
23	268.39	48.48
24	275.92	51.20
25	283.40	54.03
26	290.84	56.96
27	298.24	60.00
28	305.60	63.14
29	312.91	66.39
30	320.17	69.75
31	327.39	73.20
32	334.55	76.77
33	341.66	80.43
34	348.72	84.20
35	355.72	88.06
36	362.67	92.03
37	369.56	96.10
38	376.39	100.26
39	383.16	104.52
40	389.87	108.88
41	396.51	113.34
42	403.09	117.89
43	409.61	122.53
44	416.05	127.27
45	422.43	132.10
46	428.74	137.02
47	434.98	142.03
48	441.14	147.13
49	447.23	152.31
50	453.25	157.59
51	453.70	158.00

Circle Center At X = 82.8 ; Y = 574.0 and Radius, 557.3
 *** 1.490 ***

Failure Surface Specified By 50 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.00	18.95
2	112.00	19.15
3	119.99	19.46
4	127.98	19.90
5	135.96	20.45
6	143.93	21.12
7	151.89	21.91
8	159.84	22.82
9	167.78	23.85
10	175.69	24.99
11	183.59	26.26
12	191.47	27.63

13	199.33	29.13
14	207.17	30.74
15	214.98	32.47
16	222.76	34.31
17	230.52	36.27
18	238.25	38.35
19	245.94	40.54
20	253.60	42.84
21	261.23	45.25
22	268.82	47.78
23	276.37	50.43
24	283.88	53.18
25	291.35	56.04
26	298.78	59.02
27	306.16	62.10
28	313.49	65.30
29	320.78	68.60
30	328.02	72.01
31	335.20	75.53
32	342.33	79.15
33	349.41	82.88
34	356.43	86.71
35	363.40	90.65
36	370.30	94.69
37	377.15	98.83
38	383.93	103.08
39	390.65	107.42
40	397.30	111.86
41	403.89	116.40
42	410.40	121.04
43	416.85	125.78
44	423.23	130.61
45	429.53	135.53
46	435.77	140.55
47	441.92	145.66
48	448.00	150.86
49	454.00	156.15
50	456.04	158.00

Circle Center At X = 94.6 ; Y = 557.8 and Radius, 539.0

*** 1.491 ***

Failure Surface Specified By 50 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.00	18.95
2	112.00	19.19
3	119.99	19.55
4	127.97	20.02
5	135.95	20.60
6	143.92	21.30
7	151.88	22.11
8	159.83	23.04
9	167.76	24.08
10	175.68	25.23
11	183.58	26.50
12	191.46	27.87
13	199.32	29.36
14	207.15	30.97
15	214.97	32.68
16	222.76	34.51
17	230.52	36.44
18	238.25	38.49
19	245.96	40.65
20	253.63	42.91
21	261.27	45.29
22	268.87	47.77
23	276.44	50.37
24	283.97	53.07

25	291.46	55.87
26	298.91	58.79
27	306.32	61.81
28	313.69	64.93
29	321.00	68.16
30	328.28	71.50
31	335.50	74.94
32	342.67	78.48
33	349.80	82.12
34	356.86	85.87
35	363.88	89.71
36	370.84	93.65
37	377.74	97.70
38	384.59	101.84
39	391.37	106.08
40	398.10	110.41
41	404.76	114.84
42	411.35	119.37
43	417.89	123.99
44	424.35	128.70
45	430.75	133.50
46	437.08	138.40
47	443.34	143.38
48	449.52	148.45
49	455.63	153.61
50	460.68	158.00

Circle Center At X = 91.0 ; Y = 579.4 and Radius, 560.6

*** 1.491 ***

Failure Surface Specified By 51 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	96.00	16.84
2	103.99	17.28
3	111.97	17.81
4	119.94	18.46
5	127.91	19.21
6	135.86	20.06
7	143.81	21.02
8	151.74	22.08
9	159.65	23.24
10	167.55	24.51
11	175.43	25.88
12	183.29	27.36
13	191.14	28.94
14	198.96	30.62
15	206.76	32.40
16	214.53	34.29
17	222.28	36.28
18	230.00	38.37
19	237.70	40.56
20	245.36	42.85
21	252.99	45.25
22	260.60	47.74
23	268.16	50.33
24	275.70	53.02
25	283.19	55.81
26	290.66	58.70
27	298.08	61.69
28	305.46	64.77
29	312.80	67.95
30	320.10	71.23
31	327.35	74.60
32	334.56	78.06
33	341.73	81.62
34	348.84	85.28
35	355.91	89.03
36	362.93	92.87

37	369.90	96.80
38	376.81	100.82
39	383.67	104.94
40	390.48	109.14
41	397.23	113.43
42	403.92	117.81
43	410.56	122.28
44	417.14	126.84
45	423.65	131.48
46	430.11	136.20
47	436.50	141.01
48	442.83	145.91
49	449.09	150.88
50	455.29	155.94
51	457.75	158.00

Circle Center At X = 67.0 ; Y = 625.4 and Radius, 609.3

*** 1.493 ***

Failure Surface Specified By 49 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.00	18.95
2	112.00	19.10
3	119.99	19.38
4	127.98	19.78
5	135.97	20.30
6	143.94	20.95
7	151.90	21.72
8	159.85	22.62
9	167.79	23.63
10	175.71	24.77
11	183.61	26.03
12	191.49	27.42
13	199.34	28.92
14	207.18	30.55
15	214.98	32.30
16	222.76	34.16
17	230.51	36.15
18	238.23	38.26
19	245.91	40.49
20	253.56	42.83
21	261.17	45.29
22	268.74	47.87
23	276.28	50.57
24	283.77	53.38
25	291.21	56.31
26	298.61	59.36
27	305.96	62.51
28	313.26	65.79
29	320.51	69.17
30	327.71	72.66
31	334.85	76.27
32	341.93	79.99
33	348.96	83.81
34	355.92	87.74
35	362.83	91.78
36	369.67	95.93
37	376.45	100.18
38	383.16	104.54
39	389.80	109.00
40	396.37	113.56
41	402.87	118.22
42	409.30	122.99
43	415.65	127.85
44	421.93	132.81
45	428.13	137.86
46	434.25	143.01
47	440.29	148.26

48 446.25 153.59
 49 451.02 158.00
 Circle Center At X = 98.1 ; Y = 536.3 and Radius, 517.4
 *** 1.493 ***

Failure Surface Specified By 52 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	92.00	15.79
2	99.99	16.27
3	107.97	16.85
4	115.94	17.52
5	123.90	18.30
6	131.85	19.18
7	139.79	20.15
8	147.72	21.22
9	155.63	22.39
10	163.53	23.66
11	171.41	25.03
12	179.28	26.49
13	187.12	28.05
14	194.95	29.71
15	202.76	31.47
16	210.54	33.32
17	218.30	35.27
18	226.03	37.32
19	233.74	39.46
20	241.42	41.70
21	249.07	44.03
22	256.69	46.46
23	264.29	48.98
24	271.85	51.60
25	279.37	54.31
26	286.87	57.11
27	294.33	60.00
28	301.75	62.99
29	309.13	66.07
30	316.47	69.24
31	323.78	72.50
32	331.04	75.86
33	338.26	79.30
34	345.44	82.83
35	352.58	86.45
36	359.66	90.16
37	366.71	93.96
38	373.70	97.84
39	380.64	101.81
40	387.54	105.87
41	394.38	110.01
42	401.18	114.24
43	407.92	118.55
44	414.60	122.94
45	421.23	127.42
46	427.81	131.98
47	434.32	136.62
48	440.78	141.34
49	447.18	146.14
50	453.52	151.02
51	459.80	155.97
52	462.30	158.00

Circle Center At X = 57.4 ; Y = 659.2 and Radius, 644.3
 *** 1.493 ***

Failure Surface Specified By 49 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	112.00	21.05
2	120.00	21.16
3	128.00	21.38

4	135.99	21.73
5	143.98	22.20
6	151.95	22.79
7	159.92	23.51
8	167.88	24.35
9	175.82	25.31
10	183.75	26.39
11	191.65	27.60
12	199.54	28.92
13	207.41	30.37
14	215.26	31.94
15	223.08	33.63
16	230.87	35.44
17	238.63	37.37
18	246.37	39.41
19	254.07	41.58
20	261.73	43.87
21	269.36	46.27
22	276.96	48.79
23	284.51	51.42
24	292.02	54.17
25	299.49	57.04
26	306.92	60.02
27	314.29	63.12
28	321.62	66.32
29	328.90	69.65
30	336.13	73.08
31	343.30	76.62
32	350.42	80.27
33	357.48	84.03
34	364.48	87.90
35	371.42	91.88
36	378.30	95.96
37	385.12	100.15
38	391.87	104.44
39	398.55	108.84
40	405.17	113.34
41	411.71	117.94
42	418.19	122.64
43	424.59	127.44
44	430.91	132.33
45	437.16	137.33
46	443.34	142.42
47	449.43	147.60
48	455.44	152.88
49	461.11	158.00

Circle Center At X = 109.3 ; Y = 541.3 and Radius, 520.2
 *** 1.494 ***

Failure Surface Specified By 50 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.00	20.00
2	116.00	20.05
3	124.00	20.23
4	131.99	20.53
5	139.98	20.95
6	147.96	21.49
7	155.94	22.15
8	163.90	22.93
9	171.85	23.83
10	179.78	24.86
11	187.70	26.00
12	195.60	27.27
13	203.48	28.65
14	211.34	30.15
15	219.17	31.78
16	226.98	33.52

17	234.76	35.38
18	242.51	37.35
19	250.23	39.45
20	257.92	41.66
21	265.57	43.99
22	273.19	46.43
23	280.77	48.99
24	288.31	51.67
25	295.81	54.46
26	303.26	57.36
27	310.67	60.38
28	318.03	63.50
29	325.35	66.74
30	332.61	70.09
31	339.83	73.55
32	346.99	77.12
33	354.09	80.80
34	361.14	84.58
35	368.13	88.47
36	375.06	92.47
37	381.93	96.57
38	388.74	100.78
39	395.48	105.08
40	402.15	109.49
41	408.76	114.01
42	415.30	118.62
43	421.76	123.33
44	428.16	128.13
45	434.48	133.04
46	440.72	138.04
47	446.89	143.13
48	452.98	148.31
49	459.00	153.59
50	463.86	158.00

Circle Center At X = 108.4 ; Y = 546.8 and Radius, 526.8

*** 1.494 ***

Failure Surface Specified By 51 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.00	18.95
2	112.00	19.24
3	119.99	19.63
4	127.97	20.14
5	135.95	20.76
6	143.91	21.48
7	151.87	22.32
8	159.81	23.27
9	167.74	24.32
10	175.66	25.48
11	183.56	26.76
12	191.44	28.14
13	199.30	29.62
14	207.14	31.22
15	214.95	32.93
16	222.74	34.74
17	230.51	36.65
18	238.25	38.68
19	245.96	40.81
20	253.64	43.05
21	261.29	45.39
22	268.91	47.84
23	276.49	50.39
24	284.04	53.04
25	291.55	55.80
26	299.02	58.67
27	306.45	61.63
28	313.84	64.70

29	321.18	67.86
30	328.48	71.13
31	335.74	74.50
32	342.95	77.97
33	350.11	81.53
34	357.22	85.20
35	364.28	88.96
36	371.29	92.82
37	378.24	96.77
38	385.14	100.82
39	391.99	104.97
40	398.77	109.20
41	405.50	113.54
42	412.17	117.96
43	418.77	122.47
44	425.31	127.08
45	431.79	131.77
46	438.20	136.55
47	444.55	141.42
48	450.83	146.38
49	457.04	151.42
50	463.18	156.55
51	464.87	158.00

Circle Center At X = 87.1 ; Y = 600.8 and Radius, 582.1

*** 1.494 ***

Failure Surface Specified By 50 Coordinate Points

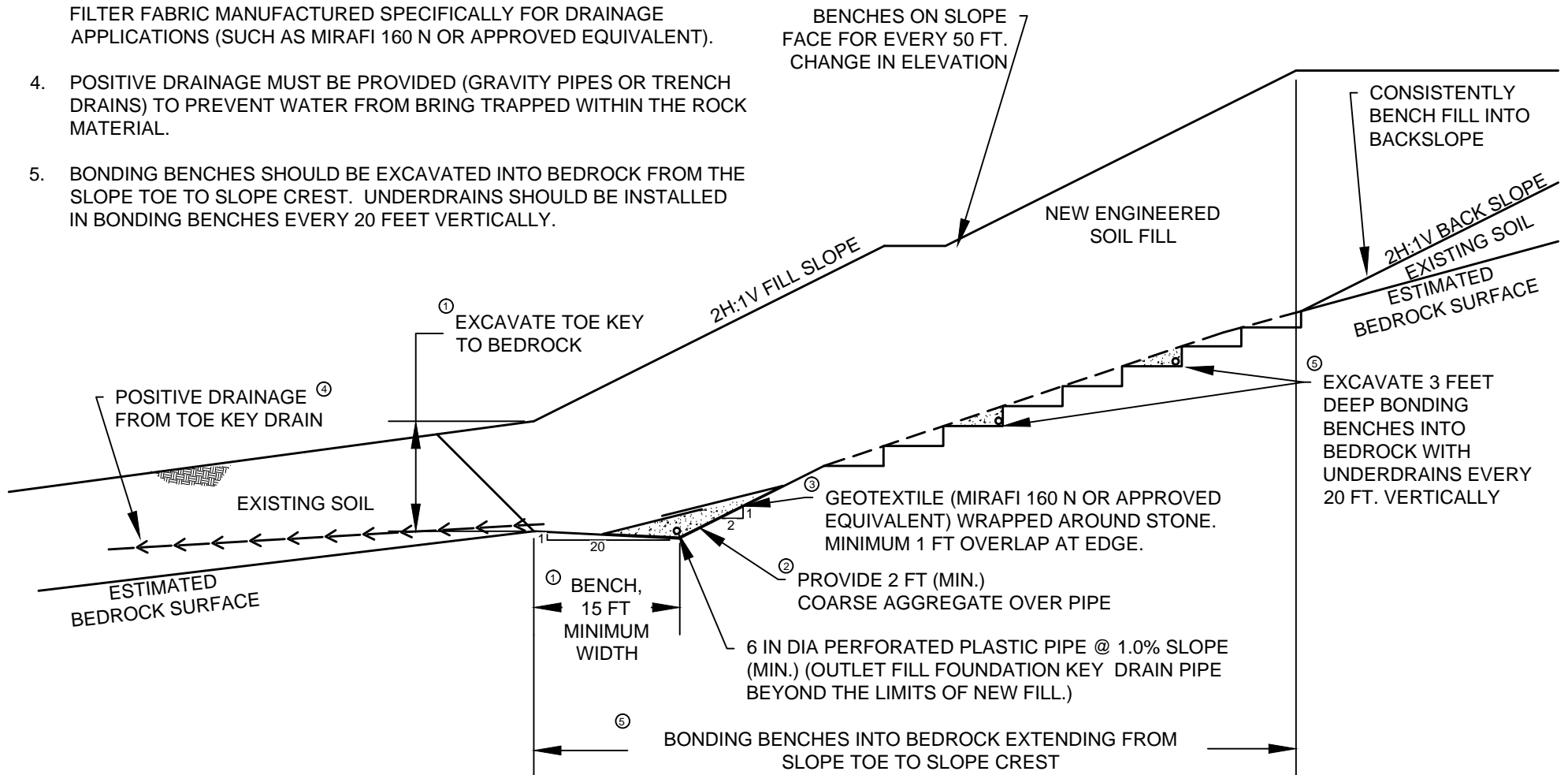
Point No.	X-Surf (ft)	Y-Surf (ft)
1	108.00	20.00
2	115.99	20.34
3	123.98	20.78
4	131.96	21.34
5	139.93	22.01
6	147.90	22.79
7	155.85	23.68
8	163.78	24.68
9	171.71	25.79
10	179.61	27.01
11	187.50	28.34
12	195.37	29.78
13	203.22	31.33
14	211.04	32.99
15	218.85	34.75
16	226.62	36.63
17	234.38	38.61
18	242.10	40.70
19	249.79	42.90
20	257.45	45.20
21	265.08	47.61
22	272.67	50.12
23	280.23	52.75
24	287.75	55.47
25	295.24	58.30
26	302.68	61.23
27	310.08	64.27
28	317.44	67.41
29	324.75	70.65
30	332.02	73.99
31	339.24	77.43
32	346.42	80.97
33	353.54	84.62
34	360.61	88.36
35	367.63	92.19
36	374.60	96.13
37	381.51	100.16
38	388.36	104.29
39	395.16	108.51

40	401.89	112.83	
41	408.57	117.24	
42	415.18	121.74	
43	421.73	126.33	
44	428.22	131.01	
45	434.64	135.79	
46	440.99	140.65	
47	447.28	145.60	
48	453.49	150.63	
49	459.64	155.75	
50	462.26	158.00	

Circle Center At X = 87.8 ; Y = 595.6 and Radius, 576.0
 *** 1.495 ***

NOTES;

1. EXCAVATE A MINIMUM 15 FEET WIDE FOUNDATION BENCH/TOE KEY ON BEDROCK BENEATH THE TOE OF THE FILL.
2. ROCK MATERIAL SHOULD CONSIST OF AASHTO #57 COARSE AGGREGATE.
3. ROCK MATERIAL SHOULD BE overlain BY A NON-WOVEN GEOTEXTILE FILTER FABRIC MANUFACTURED SPECIFICALLY FOR DRAINAGE APPLICATIONS (SUCH AS MIRAFI 160 N OR APPROVED EQUIVALENT).
4. POSITIVE DRAINAGE MUST BE PROVIDED (GRAVITY PIPES OR TRENCH DRAINS) TO PREVENT WATER FROM BEING TRAPPED WITHIN THE ROCK MATERIAL.
5. BONDING BENCHES SHOULD BE EXCAVATED INTO BEDROCK FROM THE SLOPE TOE TO SLOPE CREST. UNDERDRAINS SHOULD BE INSTALLED IN BONDING BENCHES EVERY 20 FEET VERTICALLY.



TYPICAL TOE KEY DETAIL FOR FILL SLOPES

W16011 - VA MEDICAL CENTER ROAD
(NOT TO SCALE)