

# **EXHIBIT 17**

## Slope Management Plan

# **SUMMARY**

October 16, 2023

Three Leaf Partners  
504 W. Juneau Avenue  
Milwaukee, WI 53203

## Hartland Apartments: Perimeter Slope Maintenance & Inspection Plan

Three Leaf Partners in conjunction with design professionals from Payne & Dolan, GeoTest, and Insight Landscape Design have worked collaboratively throughout the design of this project to evaluate the existing conditions of the former Palmer Sand & Gravel property, design the planned improvements to ensure a greenspace buffer is maintained adjacent to the existing slopes, document the existing stability of the existing cut slopes and to have a procedure for future landowners and property managers to monitor, detect and mitigate surface or global instability of the existing perimeter slopes.

### Existing Conditions

The subject property consists of glacial deposits (primarily sand and gravel) that were mined from the 1930s to the 1960s. The property was owned and operated by Palmer Sand & Gravel and produced road gravel for the construction industry. The existing perimeter slopes along Hill Street, adjacent to the cemeteries and residential properties that front on W. Capitol Drive have remained unchanged since extraction activities ceased in the 1960s. The embankment associated with Palmer Drive was constructed in the 1970s and has remained unchanged since that time. The vegetation present on the slopes is a dense mix of trees, shrubs and ground cover plant material consistent with 50+ years of growth with very few places where the soils are completely bare and exposed. A storm sewer outfall on Hill Street, likely constructed in the 1980s, discharges onto the gravelly slope east of the Village's water tower. This discharge has resulted in surface erosion and scour, but not resulted in any significant failures of the Hill Street cut slope.

Due to the gravelly nature of the existing slopes and the presence of large cobbles in the glacial deposit, the soils have a very high infiltration rate. The combination of the very high infiltration rate, the high percentage of large cobbles, and the absence of groundwater, make the slopes very durable to surface erosion. The presence of a dense mix of trees, shrubs and ground cover on the slopes is evidence of the durability and stability of the perimeter slopes.

The details of the geotechnical investigation, global stability analysis, surface erosion sensitivity analysis, baseline slope inspection and baseline vegetation analysis are all attached as appendices to serve as a resource for landowners and property management professionals.

### Proposed Improvements

The building and ponds associated with the subject development have been cited in a manner that places them all outside of a theoretical 2:1 slope stability setback projected from the top of the existing

perimeter slopes to the proposed finished grade of the development. Additionally, the northern area of the sand and gravel pit will be raised approximately 20 feet and reduce the exposed heights of the perimeter slopes to reduce the possibilities of slope failure. Further, excess overburden material will be placed at the bottom of the existing perimeter slopes and serve as a toe buttress to further reduce the possibilities of slope failure. The toe buttressing also provides a level area (10:1) at the bottom of the perimeter slopes where gravels or cobbles that become dislodged will gather and serve as visual indicators of instability to aid monitoring and inspection efforts. These areas are outside of the mowed turf areas and in the unoccupied open space of the development.

### **Global Stability**

Using the laboratory results of the geotechnical investigation, slope stabilities analyzed at four locations with the resulting factor of safety determined to be 1.5 or higher. The USACOE Slope Stability Manual (EM 1110-2-1902, 31 Oct 03) Section 3-4 provide factor of safety guidance for new embankments and multi-stage loading conditions. A factor of safety of 1.5 was determined to be the most suitable for analyzing the global stability of the existing cut slope embankment for the subject property. The USACOE guide also provides unsatisfactory slope performance characteristics which include: shear failure, surface sloughing, excessive deformation, liquefaction and piping. A slope inspection form has been developed to assist with identification of these conditions during future inspections.

### **Surface Erosion**

Given the glacial deposits present on this site, the large concern for slope instability is surface erosion which can be identified easy thru routine visual inspections and occurs slowly and incrementally in these gravelly soils with large cobbles, high infiltration rates and the absence of groundwater. Surface erosion is anticipated to occur primarily as a result of uncontrolled and concentrated surface water runoff. A dense mix of vegetation is indicative of stable slopes not experiencing surface erosion.

A Hill Street public storm sewer outfall had eroded the existing perimeter slope beneath the pipe outfall. A corrective action plan has been developed for this condition and will be completed as part of the overall development of the property. It should be noted that the runoff energy from the pipe outfall is dissipated by the large cobbles in the glacial deposit and runoff infiltrated before the flows reach the existing floor of the gravel pit. The corrective action plan for this area is designed to fill the washout beneath the outfall with the native sand and gravel with large cobbles, place coir logs parallel to the slope with live stakes and brush mats to dissipate energy, and rip-rap the slope from the pipe outfall to the proposed top of the toe buttress

### **Monitoring & Inspections**

A baseline inspection has been completed for the perimeter slopes that documents their condition prior to the start of construction activities. The slope inspection aimed to identify any signs of global instability, surface erosion, and to document the trees and shrubs that are present as well as to identify any signs in the growth patterns that are indicative of instability. The findings of both further reinforce that the existing slopes are stable.

The inspection did identify a Village of Hartland storm sewer outfall on the south side of Hill Street and east of the water tower that has caused erosion to the slope below the outfall. The pipe was likely installed in the 1980s and the erosion has occurred incrementally since the time of initial construction. A corrective action plan has been developed to repair the slope and stabilize the outfall of the pipe.

It is recommended that a qualified professional perform a perimeter slope inspection in accordance with the Slope Monitoring & Maintenance Agreement. This would also include a review of the vegetation growth patterns.

Respectfully,

A handwritten signature in black ink, appearing to read "Craig Donze". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Craig Donze, PE PLS  
Payne & Dolan  
Engineering Manager

Cc: Ryan Amtmann, PE, Village of Hartland Engineer

#### **Appendices**

Appendix A - Geotechnical Slope Stability Analysis, GeoTest, September 29, 2023

Appendix B – Slope Observations and Maintenance Manual, Insight Landscape Design, October 3, 2023

Appendix C – Master Grading Plan (Cut-Fill), Payne & Dolan, September 5, 2023

Appendix D – Slope Maintenance & Inspection Plan, Payne & Dolan, September 28, 2023

Appendix E – Slope Inspection and Maintenance Checklist, Payne & Dolan, October 3, 2023

Appendix F – Indicators of Slope Instability & Corrective Actions, Payne & Dolan, October 3, 2023

# **GEOTECHNICAL**

September 29, 2023

John Ford  
President  
Three Leaf Partners  
504 W. Juneau Avenue  
Milwaukee WI, 53203



Subject: Geotechnical Slope Stability Analysis - *revised*  
Hartland Quarry Apartments  
700 W. Capitol Drive, Hartland, Wisconsin

Dear Mr. Ford,

GeoTest, Inc. (GeoTest) has prepared this slope stability analysis for the west, north, and southeast bluffs around the perimeter of the above-referenced property. This report describes the subsurface exploration, laboratory testing, and computer analysis services, and presents our conclusions regarding the global (large scale) slope stability of the perimeter bluffs. This report does not address small, limited slope conditions that would be representative of surface erosion.

### **Project Description**

Three Leaf Partners is proposing to develop the property located at 700 W. Capitol Drive in the Village of Hartland, Wisconsin. The location of the project is illustrated in Figure 1 in Appendix A. The boundaries of the combined 45-acre property are illustrated in Figure 2 in Appendix A.

The proposed development consists of eighteen separate buildings, including a single-story club house, two-story apartment buildings, and single-story garage buildings. The development will also include parking and drive paved areas and multiple stormwater management devices. The proposed development is illustrated in Figure 3 in Appendix A.

The perimeter bluffs currently have slopes steeper than 1h:1v, with many sections close to 0.75h:1v. The proposed development plan assumes the final slopes will be designed for effectively 2h:1v, with toe buttresses ranging from 4h:1v to 10h:1v, for safety. The existing slope configurations will not be altered, given their height, age, and stable vegetative conditions.

### **Geotechnical Services Background**

GeoTest completed an initial slope stability analysis for seven selected bluff sections. That analysis (report dated July 17, 2023) concluded that the seven sections will have Factors of Safety ranging from 1.3 to 4.3, based on the preliminary site grading plans.



GeoTest also completed a geotechnical subsurface investigation (report dated May 4, 2023). That investigation provided geotechnical design parameters and recommendations related to the construction of buildings, pavements, and stormwater management systems.

### **Scope of Work**

#### **Geotechnical Subsurface Exploration**

To advance the slope stability analysis for the most critical bluff sections (along Palmer Drive and Hill Street, and adjacent to the two cemeteries), we initiated a geotechnical exploration program. The locations of the four cross-sections are illustrated on Figure 4 in Appendix A. The drilling scope consisted of four borings (B-1 through B-4) drilled to depths of 60 to 70 feet below the existing ground surface. The boring locations are also identified on Figure 4 in Appendix A.

The borings were drilled using conventional hollow-stem augers to avoid the introduction of drilling fluids into the soil profile. Soil samples were obtained at 5-foot intervals in the borings using split-barrel sampling procedures in general accordance with ASTM D1586. Representative portions of the samples were sealed in glass jars and returned to GeoTest for laboratory testing and classification.

Descriptive logs for each boring, which describe the method of drilling, sample types, sample depths, and observations regarding soil and groundwater conditions, were prepared at the time of sampling. These logs were utilized by a GeoTest geotechnical engineer as an aid to prepare the final logs included in Appendix B.

The ground surface elevations at the boring locations were interpolated from a preliminary topographic map produced by Payne & Dolan. Water level observations, if encountered, were noted on the field logs.

All drilling and sampling procedures are described in Appendix C.

#### **Laboratory Testing**

The laboratory testing program consisted of water content testing on all boring samples. In addition, a GeoTest geotechnical engineer examined and visually classified each sample, based on texture and plasticity, in accordance with the Unified Soil Classification System (USCS). The engineer grouped soil samples into strata that are illustrated on the logs.

The notes included on the logs and charts describing the system of classification are included in Appendix B. All laboratory testing procedures are described in Appendix C.

The recovered soil samples will be retained for 60 days after the date of this report. Unless other instructions as to their disposition are received, they will be discarded at that point.

### Soil and Groundwater Conditions

The following narrative is a generalization of the subsurface conditions encountered at the borings. Soil conditions can vary in areas between the sampling locations. For a more-detailed description of the subsurface conditions encountered at each sampling location, please refer to the attached logs in Appendix B.

#### Soil Conditions

The predominant soil profile encountered at the borings (beneath surface topsoil) consisted of stratified layers of native sand and gravel soils with varying clay, silt, cobble, and boulder content. They were classified as SC, SC-SM, SM, SW-SM, and GW-GM. No cohesive (clay or silt) layers were encountered or observed at the borings.

The soils recovered in the borings were similar to the soils (bluff samples) recovered during the May geotechnical investigation.

Buried concrete rubble fill was encountered at the initial location of B-1 (east of Palmer Drive) that caused auger refusal and prompted moving west of Palmer Drive.

The predominant native granular soils generally exhibited medium to very dense relative densities, with N-values ranging from 15 to sampler refusal (greater than 50 for 6 inches). The N-values were the lowest (medium dense) to depths of 3 to 15 feet.

Typically, moisture contents are considered high if they are above 15% in granular soils and above 20% in cohesive soils. The moisture contents in the native granular soils ranged from 1.6% to 12.6%, with an average of 5.5%.

Based on the field and laboratory data, four soil types were selected, with different physical characteristics used in the slope stability analysis. These were defined as follows:

Name	Soil Density	Friction Angle	Description
Soil 1	130 pcf	30 <sup>0</sup>	Medium Dense Sand with Fines
Soil 2	135 pcf	32 <sup>0</sup>	Very Dense Sand with Fines
Soil 3	140 pcf	33 <sup>0</sup>	Dense Sand and/or Gravel
Soil 4	145 pcf	35 <sup>0</sup>	Very Dense Sand and Gravel

The analyzed soil profiles consisting of these four generalized soil types are illustrated on the cross-sections included in Appendix D.

#### Groundwater Conditions

No free groundwater or perched water layers were encountered at the borings. These field observations were consistent with the laboratory testing.

### **Analysis and Conclusions**

Because of the relatively consistent nature of the soils observed during the May investigation and this additional analysis (granular soils), the additional slope stability analysis considered all field and laboratory data generated from both. The analysis was performed using STABLPRO 2015.4.5. The following table summarizes the results.

<b>Section</b>	<b>Factor of Safety (FoS)</b>	<b>Representative Boring</b>
1	2.4	1
2	1.5	2
3	1.7	3
4	1.5	4

*Note - The complete output reports and cross-sections for each section analysis are included in Appendix D.*

The above FoS results were assessed by referencing the following section in the United States Army Corps of Engineers (USACOE) Slope Stability Manual (*EM 1110-2-1902, 31 Oct 03*):

#### **3-1. General**

*b. Factor of safety guidance. (1) What is considered an acceptable factor of safety should reflect the differences between new slopes, where stability must be forecast, and existing slopes, where information regarding past slope performance is available. A history free of signs of slope movements provides firm evidence that a slope has been stable under the conditions it has experienced. Conversely, signs of significant movement indicate marginally stable or unstable conditions. In either case, the degree of uncertainty regarding shear strength and piezometric levels can be reduced through back analysis. Therefore, values of factors of safety that are lower than those required for new slopes can often be justified for existing slopes.*

#### **3-4. Other Slopes**

*a. Factors of safety. Factors of safety for slopes other than the slopes of dams should be selected consistent with the uncertainty involved in the parameters such as shear strength and pore water pressures that affect the calculated value of factor of safety and the consequences of failure. When the uncertainty and the consequences of failure are both small, it is acceptable to use small factors of safety, on the order of 1.3 or even smaller in some circumstances.*

*d. Excavated Slopes. (1) In principle, the stability of excavation slopes should be evaluated for both the end-of-construction and the long-term conditions. The long-term condition is usually critical. The stability of an*

*excavated slope decreases with time after construction as pore water pressures increase and the soils within the slope swell and become weaker. As a result, the critical condition for stability of excavated slopes is normally the long-term condition, when increase in pore water pressure and swelling and weakening of soils is complete. If the materials in which the excavation is made are so highly permeable that these changes occur completely as construction proceeds, the end-of-construction and the long-term conditions are the same. These considerations lead to the conclusion that an excavation that would be stable in the long-term condition would also be stable at the end of construction.*

Initially, the goal for this project was to create and maintain a minimum FoS of 1.5. The sections analyzed meet these criteria. However, further assessment, when considering the USACOE test above, concluded that a minimum FoS of 1.1 for global slope stability would be appropriate.

Additional analyses that targeted smaller sections of the slopes concluded that some portions near the tops of the slopes exhibited FoS in the 0.8 to 1.1 range. However, it is our opinion that these results are not representative of the global slope stability conditions that exist. The slopes have existed in their current state for decades, most are heavily vegetated, no slope failures are evident, the prevalent soils are granular, no groundwater or perched water conditions exist, and surface water flow onto the slopes is restricted. Therefore, the existing slope conditions are the most relevant indicator of their stability. In summary, the existing slopes are considered stable, and remediation is not warranted.

The proposed civil design creates minimum slopes of 2H:1V (theoretical) from the tops of each slope to the toes. The design incorporates toe buttresses that will serve to resist slope failures and provide a mid-level horizontal bench top to collect material that may erode from the upper slope section that will not be remodeled. The proposed slopes of the toe buttresses (minimum 4h:1v) will provide increased FoS.

There are three slope areas that have visual erosion and a lack of vegetation. A fourth area will be removed during site grading. These areas are illustrated on the Photograph Log in Appendix A. A mitigation plan for these three slopes will be addressed in a vegetation management plan prepared by others. These areas will also be specifically targeted to receive additional fills at their buttresses to further reduce the exposed height of the existing slopes.

### **General Qualifications**

The services provided by GeoTest on this project were performed with the degree of skill and care typically performed by other members of the geotechnical engineering profession, practicing in this locale, at this time. No other warranty, expressed or implied, is given.

We appreciate the opportunity to provide geotechnical engineering services for this project. If you have any questions, or require any further assistance, please feel free to contact us.

Sincerely,

*Michael D. Frede, P.E.*

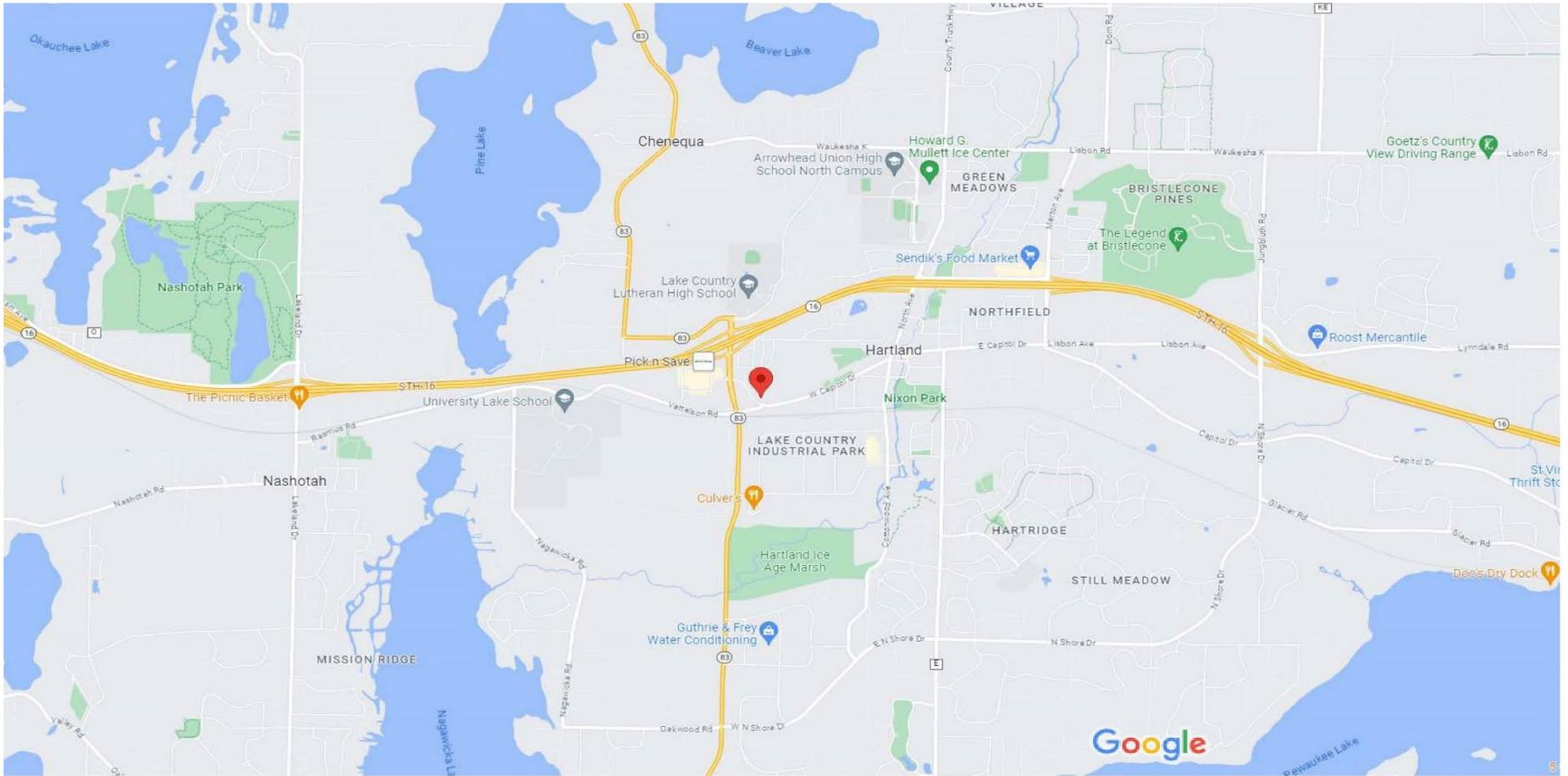
Michael D. Frede, P.E.  
Technical Director/Senior Engineer



## Appendix A

- Figure 1 – Site Location Diagram
- Figure 2 – Property Location Diagram
- Figure 3 – Proposed Development Diagram
- Figure 4 – Boring & Cross-Section Location Diagram
- Photographic Log





Map data ©2023 Google 2000 ft



**Project Name:** Hartland Quarry Apartments  
**Project Location:** 700 W. Capitol Drive  
Hartland, Wisconsin  
Waukesha County

**Project No.:** 7708  
**Date:** 4/29/23  
**Drawn By:** MDF  
**Scale:** NTS

**FIGURE 1**  
**Site Location**  
**Diagram**



**Project Name:** Hartland Quarry Apartments  
**Project Location:** 700 W. Capitol Drive  
 Hartland, Wisconsin  
 Waukesha County

**Project No.:** 7708  
**Date:** 9/5/23  
**Drawn By:** MDF  
**Scale:** NTS

**FIGURE 2**  
**Property Boundary**  
**Diagram**



JLA PROJECT NUMBER: W221013

**HARTLAND QUARRY DEVELOPMENT**  
Plan Commission Submittal

SUMMARY	
STACKED FLATS (2-8' ONES) =	240 UNITS
COVERED PARKING =	210 STALLS
DRIVEWAY PARKING =	210 STALLS
STREET PARKING =	48 STALLS
TOWNHOMES (2 STORIES) =	27 UNITS
COVERED PARKING =	54 STALLS
DRIVEWAY PARKING =	54 STALLS
SURFACE PARKING =	6 STALLS
CLUBHOUSE	19 STALLS
VISITOR PARKING =	19 STALLS
<b>TOTAL UNITS =</b>	<b>267 UNITS</b>



RENDERED ARCHITECTURAL SITE PLAN  
1" = 100'

**PROGRESS DOCUMENTS**  
These documents reflect progress and are not and shall not be subject to public review or comment. These documents are for informational purposes only and shall not be used for any other purpose without the express written consent of JLA Architects.

DATE OF RELEASE: 09/26/2023

REVISIONS ON SCHEDULE:

NO.	DATE	DESCRIPTION	BY

**ARCHITECTURAL SITE LAYOUT PLAN**

SHEET NUMBER:  
**ASP-100**



**Project Name:** Hartland Quarry Apartments  
**Project Location:** 700 W. Capitol Drive  
Hartland, Wisconsin  
Waukesha County

**Project No.:** 7708  
**Date:** 9/5/23  
**Drawn By:** MDF  
**Scale:** NTS

**FIGURE 3**  
**Proposed**  
**Development**  
**Diagram**



**Project Name:** Hartland Quarry Apartments  
**Project Location:** 700 W. Capitol Drive  
 Hartland, Wisconsin  
 Waukesha County

**Project No.:** 7708  
**Date:** 9/5/23  
**Drawn By:** MDF  
**Scale:** NTS

**FIGURE 4**  
**Boring & Cross-**  
**Section Location**  
**Diagram**

### Photographic Log

<b>Project:</b> Hartland Quarry Apartments		<b>Client:</b> Three Leaf Partners	<b>Project No.:</b> 7708
<b>Photo No.</b> 1	<b>Date</b> 9-7-23		
<b>Description:</b> Erosion area along Palmer Drive.			

<b>Photo No.</b> 2	<b>Date</b> 9-7-23		
<b>Description:</b> Erosion area near the neighboring barn.			

<b>Project:</b> Hartland Quarry Apartments	<b>Client:</b> Three Leaf Partners	<b>Project No.:</b> 7708
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<b>Photo No.</b> 3	<b>Date</b> 9-7-23	
<b>Description:</b> Erosion area near the North Point Church Cemetery.		

<b>Photo No.</b> 4	<b>Date</b> 9-7-23	
<b>Description:</b> Erosion area north of the industrial area.		



## Appendix B

- General Notes
- Boring Logs
  - B-1
  - B-2
  - B-3
  - B-4
- Legend
- Unified Soil Classification System (USCS)



## Drilling and Sampling Abbreviations:

<b>AD</b> Solid-Stem Auger	<b>OS</b> Osterberg Sampler, 3-inch-O.D. Shelby Tube
<b>AS</b> Auger Sample	<b>PMT</b> Pressuremeter Test (In Situ)
<b>BS</b> Bulk Sample	<b>RD</b> Rotary Drilling
<b>DD</b> Diamond Core Drilling	<b>SS</b> Split-Spoon Sampler, 1.375-inch-I.D., 2-inch-O.D. (Unless otherwise noted)
<b>FT</b> Fish Tail	<b>ST</b> Shelby Tube Sampler, 2-inch-O.D. (Unless otherwise noted)
<b>GP</b> Geoprobe	<b>VS</b> Vane Shear
<b>GS</b> Giddings Sampler	<b>WOH</b> Weight of Hammer
<b>HA</b> Hand-Auger Drilling	<b>WS</b> Wash Sample
<b>HS</b> Hollow-Stem Auger	

Standard Penetration (“N”): Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch-O.D. split-spoon sampler, except where otherwise noted.

## Water Level Measurement Abbreviations:

<b>AAR</b> After Auger Removal	<b>BCR</b> Before Casing Removal	<b>WS</b> While Sampling
<b>AB</b> After Boring	<b>DCI</b> Dry Cave In	
<b>ACR</b> After Casing Removal	<b>WCI</b> Wet Cave In	
<b>BAR</b> Before Auger Removal	<b>WD</b> While Drilling	
<b>BCI</b> Before Casing Installation	<b>WL</b> Water Level	

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In relatively pervious soils, the observed water levels are considered a reliable indicator of groundwater positions. In relatively impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations. In this case, other indicators of groundwater position, such as sealed observation wells or piezometers, may be required.

## Gradation Description and Terminology:

Coarse-grained granular soils have more than 50% of their dry weight retained on a #200 sieve (0.074 mm); they include boulders, cobbles, gravel, sand, and combinations thereof. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve. Fine-grained granular soils are non-cohesive, and include silt; fine-grained cohesive soils include silty clay, and clay.

Major Component of Sample	Size Range	Description of Components Present in Sample	Percent of Dry Weight
Boulders	Over 8" (200 mm)	Trace	<5
Cobbles	8" to 3" (200 to 75 mm)	Few	5 - 10
Gravel	3" to #4 sieve (75 to 4.76 mm)	Little	15 - 25
Sand	#4 to #200 sieve (4.76 to 0.074 mm)	Some	30 - 45
Silt	Passing #200 sieve (0.074 to 0.005 mm)		
Clay	Smaller than 0.005 mm		

### Consistency of Cohesive Soils

Unconfined Compressive Strength, Qu, tsf	Consistency
<0.25	Very Soft
0.25 - 0.49	Soft
0.50 - 0.99	Firm
1.00 - 1.99	Stiff
2.00 - 3.99	Very Stiff
>4.00	Hard

### Relative Density of Granular Soils

N, Blows per 12 inches	Relative Density
0 - 3	Very Loose
4 - 9	Loose
10 - 29	Medium Dense
30 - 49	Dense
50 - 80	Very Dense
>80	Extremely Dense



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-1  
 Page: 1 of 3

Drilling Start Date: 8/11/23  
 Drilling End Date: 8/11/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 60  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1007  
 Location (Lat, Long): 43.10481, -88.35907

DEPTH (ft)	LITHOLOGY	WATER LEVEL	COLLECT				SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
			Sample Type	Blow Counts	Recovery (ft)	N Value RQD%										
0																
0.00'						(0.00') Topsoil: 6 inches of Sandy Topsoil										
0.50'						(0.50') Clayey SAND (SC); mostly fine-coarse grained sand, few fine-coarse gravel, few silt, little clay, well-graded, medium dense, slightly moist, brown	6.4									1005
3.00'						(3.00') Silty, Clayey SAND and gravel (SC-SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, little clay, well-graded, dense, slightly moist, brown, occasional cobbles	6									
17.00'							9.5									
14.00'							1.6									
15.00'							2.2									
22.00'						(22.00') Silty SAND with gravel (SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, few clay, well-graded, very dense, slightly moist, brown, occasional cobbles	2.7									985

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-1  
 Page: 2 of 3

Drilling Start Date: 8/11/23	Boring Depth (ft): 60
Drilling End Date: 8/11/23	Boring Diameter (in): 6.0
Drilling Company: PTS	Sampling Method(s): Split Spoon
Drilling Method: Hollow Stem Auger	DTW During Drilling (ft): N/A
Drilling Equipment: CME55/Geoprobe 7822DT	DTW After Drilling (ft): N/A
Driller: Brian Szydzik/Jed Vela	Ground Surface Elev. (ft): 1007
Logged By: Michael Frede	Location (Lat, Long): 43.10481, -88.35907

DEPTH (ft)	LITHOLOGY	WATER LEVEL	COLLECT				SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
			Sample Type	Blow Counts	Recovery (ft)	N Value RQD%										
25						(22.00') Silty SAND with gravel (SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, few clay, well-graded, very dense, slightly moist, brown, occasional cobbles										980
			SS	50		(26.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders										
30																
			SS	17	0.30	50		3.9								
35																
			SS	8	0.30	69		2.3								
40																
			SS	19		50										
45																
			SS	33	0.50	69		2.3								
50																
			SS	19		50										
			SS	50												

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-1  
 Page: 3 of 3

Drilling Start Date: 8/11/23  
 Drilling End Date: 8/11/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 60  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1007  
 Location (Lat, Long): 43.10481, -88.35907

DEPTH (ft)	LITHOLOGY	WATER LEVEL	COLLECT				SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
			Sample Type	Blow Counts	Recovery (ft)	N Value RQD%										
50																955
55																950
60			SS	50	0.10		3.4									945
60						(60.00') Boring terminated										945
65																940
70																935
75																935

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-2  
 Page: 1 of 3

Drilling Start Date: 8/8/23	Boring Depth (ft): 70
Drilling End Date: 8/8/23	Boring Diameter (in): 6.0
Drilling Company: PTS	Sampling Method(s): Split Spoon
Drilling Method: Hollow Stem Auger	DTW During Drilling (ft): N/A
Drilling Equipment: CME55/Geoprobe 7822DT	DTW After Drilling (ft): N/A
Driller: Brian Szydzik/Jed Vela	Ground Surface Elev. (ft): 1025
Logged By: Michael Frede	Location (Lat, Long): 43.10544, -88.35778

DEPTH (ft)	LITHOLOGY	WATER LEVEL	COLLECT				SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
			Sample Type	Blow Counts	Recovery (ft)	N Value RQD%										
0																1025
			SS	7	0.80	15	(0.00') Topsoil: 4 inches of Sandy Topsoil									
				7			(0.50') Silty SAND with gravel (SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, well-graded, medium dense, slightly moist, brown, occasional cobbles	6.3								
				8												
			SS	5	0.70	19										
				9				5.9								
5				10												1020
			SS	11	0.70	30										
				13				4.5								
10				17												1015
			SS	50			(13.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders									
15																1010
			SS	5	0.40	50		5.5								
20				50												1005
			SS	50												
25																

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-2  
 Page: 2 of 3

Drilling Start Date: 8/8/23	Boring Depth (ft): 70
Drilling End Date: 8/8/23	Boring Diameter (in): 6.0
Drilling Company: PTS	Sampling Method(s): Split Spoon
Drilling Method: Hollow Stem Auger	DTW During Drilling (ft): N/A
Drilling Equipment: CME55/Geoprobe 7822DT	DTW After Drilling (ft): N/A
Driller: Brian Szydzik/Jed Vela	Ground Surface Elev. (ft): 1025
Logged By: Michael Frede	Location (Lat, Long): 43.10544, -88.35778

DEPTH (ft)	LITHOLOGY	WATER LEVEL	COLLECT				SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
			Sample Type	Blow Counts	Recovery (ft)	N Value RQD%										
25						(13.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders										1000
27			SS	19	0.20	59		8.6								995
30				27												
32				32												
35							(31.00') Silty SAND (SM); mostly fine-coarse grained sand, few fine-coarse gravel, little silt, well-graded, dense, slightly moist, brown									
35			SS	10	0.30	33		10.2								990
38				15												
40				18												
40			SS	16	1.00	44		4.4								985
42				21												
43				23												
45			SS	8	0.70	70	(42.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown	4.9								980
48				20												
50				50												
50			SS	50												

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-2  
 Page: 3 of 3

Drilling Start Date: 8/8/23  
 Drilling End Date: 8/8/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 70  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1025  
 Location (Lat, Long): 43.10544, -88.35778

DEPTH (ft)	LITHOLOGY	WATER LEVEL	COLLECT				SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
			Sample Type	Blow Counts	Recovery (ft)	N Value RQD%										
50						(42.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown										975
55			SS	11	0.80	37	(51.00') Well-graded SAND with silt and gravel (SW-SM); mostly fine-coarse grained sand, little fine-coarse gravel, few silt, dense, slightly moist, brown	9.6								970
60			SS	16	0.30	50	(57.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders	8.9								965
65			SS	50	0.10			2.3								960
70			SS	22	0.30	50		5								955
75							(70.00') Boring terminated									

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-3  
 Page: 1 of 3

Drilling Start Date: 8/9/23  
 Drilling End Date: 8/9/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 70  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1022  
 Location (Lat, Long): 43.10538, -88.35464

DEPTH (ft)	LITHOLOGY	WATER LEVEL	COLLECT			SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
			Sample Type	Blow Counts	Recovery (ft)										
0						(0.00') Topsoil: 5 inches of Sandy Topsoil									
0.50			SS	5	0.80	15	(0.50') Silty, Clayey SAND (SC-SM); mostly fine-coarse grained sand, few fine-coarse gravel, little silt, little clay, well-graded, medium dense, slightly moist, brown	4.6							1020
3.00			SS	5	1.20	33	(3.00') Silty SAND with gravel (SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, well-graded, dense, slightly moist, brown, occasional cobbles and boulders	6							1015
15.00			SS	15	0.70	41		8.1							1010
20.00			SS	5	1.00	39	(20.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, well-graded, very dense, slightly moist, brown, occasional cobbles and boulders	6.3							1005
25.00			SS	10	0.80	58		3.8							1000

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-3  
 Page: 2 of 3

Drilling Start Date: 8/9/23  
 Drilling End Date: 8/9/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 70  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1022  
 Location (Lat, Long): 43.10538, -88.35464

DEPTH (ft)	LITHOLOGY	WATER LEVEL	COLLECT				SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
			Sample Type	Blow Counts	Recovery (ft)	N Value RQD%										
25																995
						(20.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, well-graded, very dense, slightly moist, brown, occasional cobbles and boulders										
			SS	50												
30						(30.00') Well-graded SAND with silt and gravel (SW-SM); mostly fine-coarse grained sand, little fine-coarse gravel, few silt, dense, slightly moist, brown										990
			SS	17	0.20	48		4.3								
				22												
				26												985
35																
			SS	18	0.50	43		3.1								
				20												
				23												980
40						(41.00') Silty SAND with gravel (SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, well-graded, dense, slightly moist, brown										
			SS	17	0.80	36		3.4								
				15												
				21												975
45																
			SS	16	0.20	50		2.6								
				50												
50																

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-3  
 Page: 3 of 3

Drilling Start Date: 8/9/23	Boring Depth (ft): 70
Drilling End Date: 8/9/23	Boring Diameter (in): 6.0
Drilling Company: PTS	Sampling Method(s): Split Spoon
Drilling Method: Hollow Stem Auger	DTW During Drilling (ft): N/A
Drilling Equipment: CME55/Geoprobe 7822DT	DTW After Drilling (ft): N/A
Driller: Brian Szydzik/Jed Vela	Ground Surface Elev. (ft): 1022
Logged By: Michael Frede	Location (Lat, Long): 43.10538, -88.35464

DEPTH (ft)	LITHOLOGY	WATER LEVEL	COLLECT				SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
			Sample Type	Blow Counts	Recovery (ft)	N Value RQD%										
50	Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, well-graded, very dense, slightly moist, brown, occasional cobbles and boulders					(49.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, well-graded, very dense, slightly moist, brown, occasional cobbles and boulders										970
55		SS	27	0.60	56		6.2									
			22													
			34													
60		SS	10	0.70	52		5.3									
		28														
		24														
65	SS	13	0.20	50	4.2											
		50														
70	SS	19	0.30	50	6											
		50														
						(70.00') Boring terminated										950
75																

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-4  
 Page: 1 of 3

Drilling Start Date: 8/10/23  
 Drilling End Date: 8/10/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 70  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1022  
 Location (Lat, Long): 43.10332, -88.35357

DEPTH (ft)	LITHOLOGY	WATER LEVEL	COLLECT			SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
			Sample Type	Blow Counts	Recovery (ft)										
0															
8	SS		8	0.70	28	(0.50') Silty SAND (SM); mostly fine-coarse grained sand, few fine-coarse gravel, little silt, well-graded, medium dense, slightly moist, brown, occasional cobbles	12.6								1020
18			10												
5	SS		5	0.80	14		10.4								1015
6			8												
10	SS		4	0.60	15		8.9								1010
5			5												
15	SS		9	0.70	29		9.2								1005
14			15												
20	SS		13	0.40	28	(20.00') Well-graded SAND with silt and gravel (SW-SM); mostly fine-coarse grained sand, little fine-coarse gravel, few silt, dense, slightly moist, brown, occasional cobbles and boulders	8.7								1000
14			14												
25	SS		19	0.30	44		1.6								
21			21												
23			23												

NOTES:





Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-4  
 Page: 3 of 3

Drilling Start Date: 8/10/23  
 Drilling End Date: 8/10/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 70  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1022  
 Location (Lat, Long): 43.10332, -88.35357

DEPTH (ft)	LITHOLOGY	WATER LEVEL	COLLECT				SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
			Sample Type	Blow Counts	Recovery (ft)	N Value RQD%										
50	Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders					(46.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders										970
55		SS	12	0.50	67		5.2									
			17													
			50													
60		SS	20	0.50	52		5.3									
		19														
		33														
65																960
		SS	50													955
70																950
		SS	18	0.30	50	5										
		50														
						(70.00') Boring terminated										
75																

NOTES:



## BORING AND WELL LOG LEGEND

	<p><b>SURFACE</b>          ASPHALT          CONCRETE          FILL          TOPSOIL          AIR          ICE</p> <p><b>USCS</b>          Well-graded GRAVEL (GW)          Poorly graded GRAVEL (GP)          Silty GRAVEL (GM)          Clayey GRAVEL (GC)          Silty, Clayey GRAVEL (GC-GM)          Well-graded GRAVEL with silt (GW-GM)          Poorly graded GRAVEL with silt (GP-GM)          Well-graded GRAVEL with clay (GW-GC)          Poorly graded GRAVEL with clay (GP-GC)          Well-graded SAND (SW)          Poorly graded SAND (SP)          Silty SAND (SM)          Clayey SAND (SC)          Silty, Clayey SAND (SC-SM)          Well-graded SAND with silt (SW-SM)          Poorly graded SAND with silt (SP-SM)          Well-graded SAND with clay (SW-SC)          Poorly graded SAND with clay (SP-SC)          SILT (ML)          Lean CLAY (CL)          Silty CLAY (CL-ML)          Organic SOIL (OL)          Elastic SILT (MH)          Fat CLAY (CH)          Organic SOIL (OH)          Organic SOIL (OL/OH)          PEAT (PT)          BEDROCK          IGNEOUS Rock          METAMORPHIC Rock          SEDIMENTARY Rock          WATER</p> <p><b>Non-USCS</b>          Gravel          Sand          Silt          Clayey Silt          Silt &amp; Clay          Clay &amp; Silt          Silty Clay          Clay          Boulders          Cobbles          Peastone          Glacial Till          Iron Ore          Wood          Peat          Saprolite          Ash          Waste</p>		<p><b>Volume Descriptors</b>          Trace = &lt;5%          Few = 5-10%          Little = 15-25%          Some = 30-45%          Mostly = &gt;=50%</p> <p><b>Water Levels</b>   Water Level During Drilling   Water Level at End of Drilling/in Completed Well</p> <p><b>Well/Boring Completion</b>          Cap          Riser          Screen          End Plug          Annular Seal          Sanitary Seal (Bentonite Slurry/Chips/Pellets/Powder, Other)          Filter Pack (Sand, Gravel, Other)          Backfill</p> <p><b>Sample Type</b>   GR Grab   EN Encore   SS Split Spoon   SH Shelby Tube   CO Core Barrel   DP Direct Push   ID Lab Sample and ID</p> <p><b>NOTES:</b>          - The boring was backfilled with soils cuttings and bentonite chips upon completion.          - The stratification lines represent approximate boundaries between soil types          - The elevations are considered accurate to 1/2 foot.</p>
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# Unified Soil Classification System (USCS)



Major Divisions		Group symbols	Typical Names	Laboratory classification criteria				
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent . . . . . GW, GP, SW, SP More than 12 percent . . . . . GM, GC, SM, SC 5 to 12 percent . . . . . Borderline cases requiring dual symbols	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3		
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW		
		Gravels with fines (Appreciable amount of fines)	GM	d		Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. Between 4 and 7 are borderline cases requiring use of dual symbols
				u				
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3		
			SP	Poorly graded sands, gravelly sands, little or no fines		Note meeting all gradation requirements for SW		
	Sands with fines (Appreciable amount of fines)	SM	d	Silty sand, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols	
			u					
			SC					Clayey sands, sand-clay mixtures
	Fine-grained soils (More than half of material is smaller than No. 200 sieve size)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity		<p><b>Plasticity Chart</b></p> <p>For classification of fine-grained soils and fine fraction of coarse-grained soils</p> <p>Atterburg Limits plotting in hatched area are borderline classifications requiring use of dual symbols</p> <p>Equation of A-line: <math>PI = 0.73(LL - 20)</math></p>		
CL			Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays					
OL			Organic silts and organic silty clays of low plasticity					
Silt and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soil, elastic silts					
		CH	Inorganic clays of high plasticity, fat clays					
		OH	Organic clays of medium to high plasticity, organic silts					
Highly organic soils		Pt	Peat and other highly organic soils					



## Appendix C

- Drilling Procedures
- Sampling Procedures
- Laboratory Procedures



## **Hand-Auger Drilling (HA)**

A sampling device is driven into the soil to the desired sample depth by a sledge hammer. After extracting the sample, the hole is advanced by a hand auger until the next sampling depth is reached. The manual driving of the sampler, especially into cohesive soils, may result in some sample disturbance. However, there are some situations where this method is the only viable option.

## **Solid-Stem Auger Drilling (AD)**

Continuous flight augers are turned and hydraulically advanced by a truck- or track-mounted unit to create a borehole. In solid-stem auger drilling, casing and drilling mud are not typically used to maintain an open borehole.

## **Hollow-Stem Auger Drilling (HS)**

Continuous flight augers having open stems are used to advance the borehole. The open stem allows the sampling tool to be used without removing the augers from the borehole. Hollow-stem augers maintain an open borehole during the sampling operations. This sampling method is not appropriate for geotechnical investigation beneath the water table, especially in granular soils.

## **Rotary Drilling (RD)**

Various cutting bits, in conjunction with circulating drilling fluid, are used to advance the borehole. Surface casing is used to maintain sidewall stability in the top several meters of the borehole, and to facilitate the circulation of the drilling fluid into the mud tank.

## **Diamond Core Drilling (DD)**

A double-tube or triple-tube core barrel with a diamond bit cuts an annular space around a cylinder of rock or cemented material. When the coring has proceeded to the desired core run length, the core is broken off and the sample is retained by a core catcher just above the diamond bit. Samples recovered by this procedure are placed in sturdy core boxes in sequential order.

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### **Auger Sampling (AS)**

Soil samples are obtained as cuttings from the auger flights as they are lifted from the borehole. Auger samples provide a general indication of subsurface conditions; however, they do not provide undisturbed samples, nor do they provide samples from specific depths. Due to the possible loss of soil components, or the mixing of soil components from various elevations, auger samples may not be representative of in-situ soil conditions.

### **Split-Barrel Sampling (SS) - ASTM Standard D-1586-84**

A 2-inch-O.D. split-barrel sampler is driven into the soil a distance of 18 inches by a 140-pound hammer free-falling 30 inches. The first 6 inches of penetration is usually considered a seating drive. The Standard Penetration Resistance value is the number of blows of the hammer over the final 12 inches of driving. This value provides an indication of the in-place relative density of granular soils. The indication should be considered qualitative, since many variables such as drill crews, drill rigs, drilling procedures, and hammer-rod-sampler assemblies can significantly affect the Standard Penetration Resistance value. A representative portion of the soil sample is recovered from the split-barrel sampler, placed in a sample jar, and delivered to our laboratory for further examination and possible testing.

### **Shelby Tube Sampling Procedure (ST) - ASTM Standard D-1587-83**

A 2- or 3-inch-diameter thin-walled seamless steel tube having a sharp cutting edge is hydraulically pushed into the soil to obtain a relatively undisturbed sample. This procedure is generally used for cohesive soils. The Shelby tubes are carefully handled to minimize sample disturbance, and delivered to a laboratory where the soil is extruded from the tube, examined, and tested.

## ASTM 1586

### Standard Method for Penetration Test and Split-Barrel Sampling of Soils<sup>1</sup>

This standard is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of the last revision. A number in parentheses indicates the year of the last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

This method has been approved for use by agencies of the Department of Defense and for listing in the DOD Index of Specifications and Standards.

#### 1. Scope

1.1 This method describes the procedure, generally known as the Standard Penetration (SPT), for driving a split-barrel sampler to obtain a representative soil sample and a measure of the resistance of the soil to penetration of the sampler.

1.2 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For a specific precautionary statement, see 5.4.1.

1.3 The values stated in inch-pound units are to be regarded as the standard.

#### 2. Applicable Documents

##### 2.1 ASTM Standards:

D2487 Test Method for Classification of Soils for Engineering Purposes<sup>2</sup>

D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)<sup>2</sup>

D4220 Practice for Preserving and Transporting Soil Samples<sup>2</sup>

#### 3. Descriptions of Terms Specific to This Standard

3.1 anvil—that portion of the drive-weight assembly while the hammer strikes and through which the hammer energy passes into the drill rods.

3.2 cathead—the rotating drum or windlass in the rope-cathead lift system around which the operator wraps a rope to lift and drop the hammer by succes-

sively tightening and loosening the rope turns around the drum

3.3 drill rods—rods used to transmit downward force and torque to the drill bit while drilling a borehole.

3.4 drive-weight assembly—a device consisting of the hammer, hammer fall guide, the anvil, any hammer drop system.

3.5 hammer—that portion of the drive-weight assembly consisting of the  $140 \pm 2$  lb ( $63.5 \pm 1$  kg) impact weight which is successfully lifted and dropped to provide the energy that accomplishes the sampling and penetration.

3.6 hammer drop system—that portion of the drive-weight assembly by which the operator accomplishes the lifting and dropping of the hammer to produce the blow.

3.7 hammer fall guide—that part of the drive-weight assembly used to guide the fall of the hammer.

3.8 N-value—the blowcount representation of the penetration resistance of the soil. The N-value, reported in blows per foot, equals the sum of the number of blows required to drive the sampler over the depth interval of 6 to 18 in. (150 to 450 mm) (see 7.3).

3.9  $\Delta N$ —the number of blows obtained from each of the 6-in. (150-mm) intervals of sampler penetration (see 7.3).

3.10 number of rope turns—the total contact angle between the rope and the cathead at the beginning of the operator's rope slackening to drop the hammer; divided by  $360^\circ$  (see Fig. 1).

3.11 sampling rods—rods that connect the drive-weight assembly to the sampler. Drill rods are often used for this purpose.

3.12 SPT—abbreviation for Standard Penetration Test, a term by which engineers commonly refer to this method.

#### 4. Significance and Use

4.1 This method provides a soil sample for identification purposes and for laboratory tests appropriate for soil obtained from a sampler that may produce large shear strain disturbance in the sample.

4.2 This method is used extensively in a great variety of geotechnical exploration projects. Many local correlations and widely published correlations which relate SPT blowcount, or N-value, and the engineering behavior of earthworks and foundation are available.

#### 5. Apparatus

5.1 Drilling Equipment—Any drilling equipment that provides at the time of sampling a suitably clean open hole before insertion of the sampler and ensures that the penetration test is performed on undisturbed soil shall be acceptable. The following pieces of equipment have proven to be suitable for advancing a borehole in some subsurface conditions.

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<sup>1</sup>This method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

Current edition approved Sept. 11, 1984. Published November 1984. Originally published as D1586-58T. Last previous edition D1586-67 (1974).

<sup>2</sup>Annual Book of ASTM Standards, Vol 04.08.

5.1.1 Drag, Chopping and Fishtail Bits, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advance-ment drilling methods. To avoid disturbance of the underlying soil, bottom discharge bits are not permitted; only side discharging bits are permitted.

5.1.2 Roller-Cone Bits, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advance-ment drilling methods if the drilling fluid discharge is deflected.

5.1.3 Hollow-Stem Continuous Flight Augers, with or without a center bit assembly, may be used to drill the boring. The inside diameter of the hollow-stem augers shall be less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm).

5.1.4 Solid, Continuous Flight, Bucket and Hand Augers, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used if the soil on the side of the boring does not cave into the sampler or sampling rods during the sampling.

5.2 Sampling Rods--Flush-joint steel drill rods shall be used to connect the split-barrel sampler to the drive-weight assembly. The sampling rod shall have a stiffness (moment of inertia) equal to or greater than that of a parallel wall "A" rod (a steel rod which has an outside diameter of 1 5/8 in. (41.2 mm) and an inside diameter of 1 1/8 in. (28.5 mm)).

NOTE 1--Recent research and comparative testing indicates the type rod used, with stiffness ranging from "A" size rod to "N" size rod, will usually have a negligible effect on the N-values to depths of at least 100 ft. (30 m).

5.3 Split-Barrel Sampler--The sampler shall be constructed with the dimensions indicated in Fig. 2. The driving shoe shall be hardened steel and shall be replaced or repaired when it becomes dented or distorted. The use of liners to produce a constant inside diameter of 1 3/8 in. (35 mm) is permitted, but shall be noted on the penetration record if used. The use of a sampler retainer basket is permitted, and should also be noted on the penetration record if used.

NOTE 2--Both theory and available test data suggest that N-values may increase 10 to 30% when liners are used.

#### 5.4 Drive-Weight Assembly:

5.4.1 Hammer and Anvil--The hammer shall weigh  $140 \pm 2$  lb ( $63.5 \pm 1$  kg) and shall be a solid rigid metallic mass. The hammer shall strike the anvil and make steel on steel contact when it is dropped. A hammer fall guide permitting a free fall shall be used. Hammers used with the cathead and rope method shall have an unimpeded overlift capacity of at least 4 in. (100 mm). For safety reasons, the use of hammer assembly with an internal anvil is encouraged.

NOTE 3--It is suggested that the hammer fall guide be permanently marked to enable the operator or inspector to judge the hammer drop height.

5.4.2 Hammer Drop System--Rope-cathead, trip, semi-automatic, or automatic hammer drop systems may be used, providing the lifting apparatus will not cause penetration of the sampler while re-engaging and lifting the hammer.

5.5 Accessory Equipment--Accessories such as labeled, sample containers, data sheets, and groundwater level measuring devices shall be provided in accordance with the requirements of the project and other ASTM standards.

### 6. Drilling Procedure

6.1 The boring shall be advanced incrementally to permit intermittent or continuous sampling. Test intervals and locations are normally stipulated by the project engineer or geologist. Typically, the intervals selected are 5 ft. (1.5 m) or less in homogeneous strata with test and sampling locations at every change of strata.

6.2 Any drilling procedure that provides a suitably clean and stable hole before insertion of the sampler and assures that the penetration test is performed on essentially undisturbed soil shall be acceptable. Each of the following procedures have proven to be acceptable for some subsurface conditions. The subsurface conditions anticipated should be considered when selecting the drilling method to be used.

6.2.1 Open-hole rotary drilling method.

6.2.2 Continuous flight hollow-stem auger method.

6.2.3 Wash boring method.

6.2.4 Continuous flight solid auger method.

6.3 Several drilling methods produce unacceptable borings. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. The continuous flight solid auger method shall not be used for advancing the boring below a water table or below the upper confining bed of a confined non-cohesive stratum that is under artesian pressure. Casing may not be advanced below the sampling elevation prior to sampling. Advancing a boring with bottom discharge bits is not permissible. It is not permissible to advance the boring for subsequent insertion of the sampler solely by means of previous sampling with the SPT sampler.

6.4 The drilling fluid within the boring or hollow-stem augers shall be maintained at or above the in situ groundwater level at all times during drilling, removal of drill rods, and sampling.

### 7. Sampling and Testing Procedure

7.1 After the boring has been advanced to the desired sampling elevation and excessive cuttings have been removed, prepare for the test with the following sequence of operations.

7.1.1 Attach the split-barrel sampler to the sampling rods and lower into borehole. Do not allow the sampler to drop onto the soil to be sampled.

7.1.2 Position the hammer above and attach the anvil to the top of the sampling rods. This may be done before the sampling rods and sampler are lowered into the borehole.

7.1.3 Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the boring, remove the sampler and sampling rods from the boring and remove the cuttings.

7.1.4 Mark the drill rods in three successive 6-in. (0.15-m) increments so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-in. (0.15-m) increment.

7.2 Drive the sampler with blows from the 140-lb (63.5-kg) hammer and count the number of blows applied in

each 6-in. (0.15-m) increment until one of the following occurs:

7.2.1 A total of 50 blows have been applied during any one of the three 6-in. (0.15-m) increments described in 7.1.4.

7.2.2 A total of 100 blows have been applied.

7.2.3 There is no observed advance of the sampler during the application of 10 successive blows of the hammer.

7.2.4 The sampler is advanced the complete 18 in. (0.45 m) without the limiting blow counts occurring as described in 7.2.1, 7.2.2, or 7.2.3.

7.3 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6 in. of penetration is termed the "standard penetration resistance", or the "N-value". If the sampler is driven less than 18 in. (0.45 m), as permitted in 7.2.1, 7.2.2, or 7.2.3, the number of blows per each complete 6 in. (0.15-m) increment and per each partial increment shall be recorded on the boring log. For partial increments, the depth of penetration shall be reported to the nearest 1 in. (25 mm), in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the hammer, this information should be noted on the boring log.

7.4 The raising and dropping of the 140-lb (63.5-kg) hammer shall be accomplished using either the following two methods:

7.4.1 By using a trip, automatic, or semi-automatic hammer drop system which lifts the 140-lb (63.5 kg) hammer and allows it to drop  $30 \pm 1.0$  in. (0.76 m  $\pm$  25 mm) unimpeded.

7.4.2 By using a cathead to pull a rope attached to the hammer. When the cathead and rope method is used the system and operation shall conform to the following:

7.4.2.1 The cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 in. (150 to 250 mm).

7.4.2.2 The cathead should be operated at a minimum speed of rotation of 100 RPM, or the approximate speed of rotation shall be reported on the boring log.

7.4.2.3 No more than 2 1/4 rope turns on the cathead may be used during the performance of the penetration test,

as shown in Fig. 1.

NOTE 4—The operator should generally use either 1 3/4 of 2 1/4 rope turns, depending upon whether or not the rope comes off the top (1 3/4 turns) or the bottom (2 1/4 turns) of the cathead. It is generally known and accepted that 2 3/4 or more rope turns considerably impedes the fall of the hammer and should not be used to perform the test. The cathead rope should be maintained in a relatively dry, clean, and unfrayed condition.

7.4.2.4 For each hammer blow, a 30-in. (0.76 m) lift and drop shall be employed by the operator. The operation of pulling and throwing the rope shall be performed rhythmically without holding the rope at the top of the stroke.

7.5 Bring the sampler to the surface and open. Record the percent recovery or length of sample recovered. Describe the soil samples recovered as to composition, color, stratification, and condition, then place one or more representative portions of the sample into sealable moisture-proof containers (jars) without ramming or distorting any apparent stratification. Seal each container to prevent evaporation of soil moisture. Affix labels to the containers bearing job designation, boring number, sample depth, and the blow count per 6-in. (0.15 m) increment. Protect the samples against extreme temperature changes. If there is a soil change within the jar for each stratum and note its location in the sampler barrel.

## 8. Report

8.1 Drilling information shall be recorded in the filed and shall include the following:

- 8.1.1 Name and location of job,
- 8.1.2 Names of crew,
- 8.1.3 Type and make of drilling machine,
- 8.1.4 Weather conditions,
- 8.1.5 Date and time of start and finish of boring,
- 8.1.6 Boring number and location (station and coordinates, if available and applicable),
- 8.1.7 Surface evaluation, if applicable
- 8.1.8 Method of advancing and cleaning the boring,
- 8.1.9 Method of keeping boring open,
- 8.1.10 Depth of water surface and

drilling depth at time of a noted loss of drilling fluid, and time and date when reading or notation was made,

- 8.1.11 Location of strata changes,
  - 8.1.12 Size of casing, depth of cased portion of boring,
  - 8.1.13 Equipment and method of driving sampler,
  - 8.1.14 Type of sampler and length and inside diameter of barrel (note use of liners),
  - 8.1.15 Size, type and section length of the sampling rods, and
  - 8.1.16 Remarks.
- 8.2 Data obtained for each sample shall be recorded in the field and shall include the following:
- 8.2.1 Sample depth and, if utilized, the sample number,
  - 8.2.2 Description of soil,
  - 8.2.3 Strata changes within sample,
  - 8.2.4 Sampler penetration and recovery lengths, and
  - 8.2.5 Number of blows per 6-in. (0.15 m) or partial increment.

## 9. Precision and Bias

9.1 Variations in N-values of 100% or more have been observed when using different standard penetration test apparatus and drillers for adjacent borings in the same soil formation. Current opinion, based on field experience, indicates that when using the same apparatus and driller N-values in the same soil can be reproduced with coefficient or variation of about 10%.

9.2 The use of faulty equipment, such as extremely massive or damaged anvil, a rusty cathead, a low speed cathead, an old, oily rope, or massive or poorly lubricated rope sheaves can significantly contribute to differences in N-values obtained between operator-drill rig systems.

9.3 The variability in N-values produced by different drill rigs and operators may be reduced by measuring the part of the hammer energy delivered into the drilling rods from the sampler and adjusting N on the basis of comparative energies. A method for energy measurement and N-value adjustment is currently under development.

ASTM Designation: D 1595

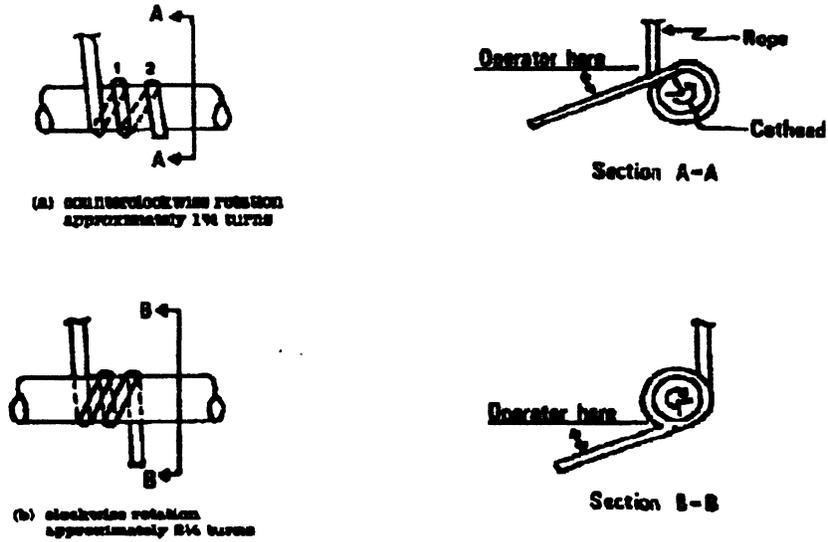
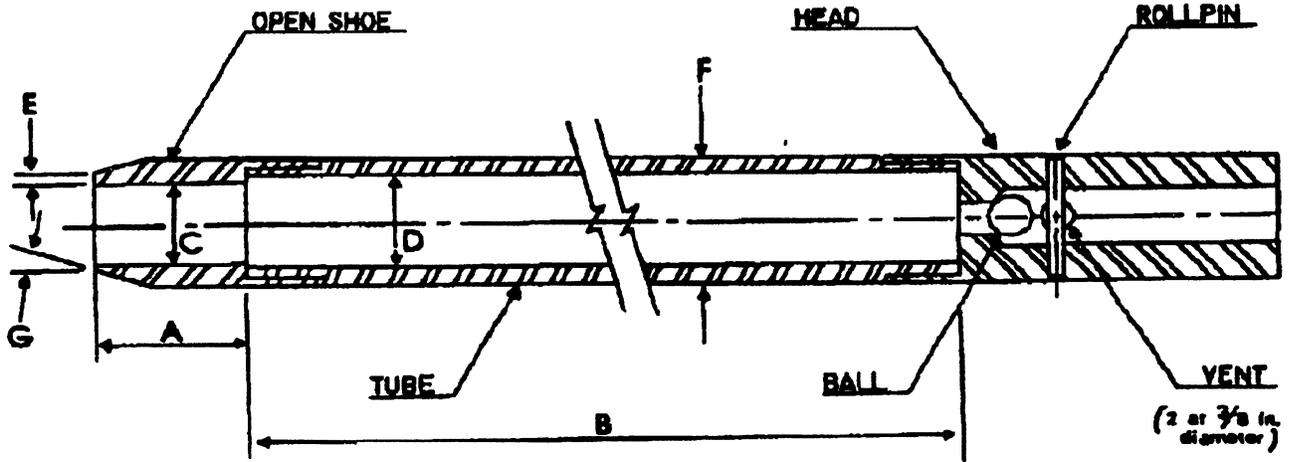


FIG. 1 Definitions of the number of rope turns and the angle for (a) counterclockwise rotation and (b) clockwise rotation of the cathead



- |  |  |
|--|--|
| A = 1.0 to 2.0 in. (25 to 50 mm)                 | E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)             |
| B = 18.0 to 30.0 in. (0.457 to 0.762 m)          | F = 2.00 ± 0.05 - 0.00 in. (50.8 ± 1.3 - 0.0 mm) |
| C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)          | G = 16.0° to 23.0°                               |
| D = 1.50 ± 0.05 - 0.00 in. (38.1 ± 1.3 - 0.0 mm) |  |

The 1 1/2 in. (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

FIG. 2 Split-Barrel Sampler

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This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, PA 19103.

### **Water Content ( $W_c$ )**

The water content of a soil is determined by weighing a moist soil sample, drying it in an oven for approximately 24 hours, and reweighing the sample to determine the moisture loss. The water content is the ratio of the weight of water in the soil to the weight of the dry soil. Water content is typically expressed as a percentage.

### **Calibrated Hand Penetrometer ( $Q_p$ )**

In the calibrated hand penetrometer test, the unconfined compressive strength of a soil is estimated to a maximum value of 4.5 tons per square foot (tsf) by measuring the resistance of the soil sample to penetration by a spring-calibrated plunger. The hand penetrometer test device has been carefully calibrated by its manufacturer with the results of numerous unconfined compressive strength tests. This test provides a quick, simple, and low-cost testing procedure from which soil strength can be estimated.

### **Unconfined Compression Test ( $Q_u$ )**

In the unconfined compression strength test, an undisturbed cylinder of soil is loaded axially until the soil fails to carry additional load, or until 20% strain has been reached, whichever occurs first. The undrained shear strength of a cohesive soil is usually considered to equal half of the unconfined compressive strength.

### **Dry Density ( $\gamma_d$ )**

The dry density of a soil is the weight of dry soil in a unit volume. The soil's total unit weight is typically calculated by weighing a cylinder of soil, and dividing the weight by the cylinder's volume as calculated by measuring the cylinder's height and diameter at several locations. The soil's dry density is then determined by correcting the cylinder's weight to account for its water content measured as described above. Use of this value is often made when estimating the degree of compaction of a soil.

### **Classification of Samples**

Soil samples are classified on the basis of their texture and plasticity in accordance with the Unified Soil Classification System (USCS). The two-letter designator in parentheses following each soil description on the boring logs represents the applicable unified classification. If the designator is capitalized, the classification has been confirmed by the appropriate index testing. If the designator is lower-case, the classification has been visually estimated.

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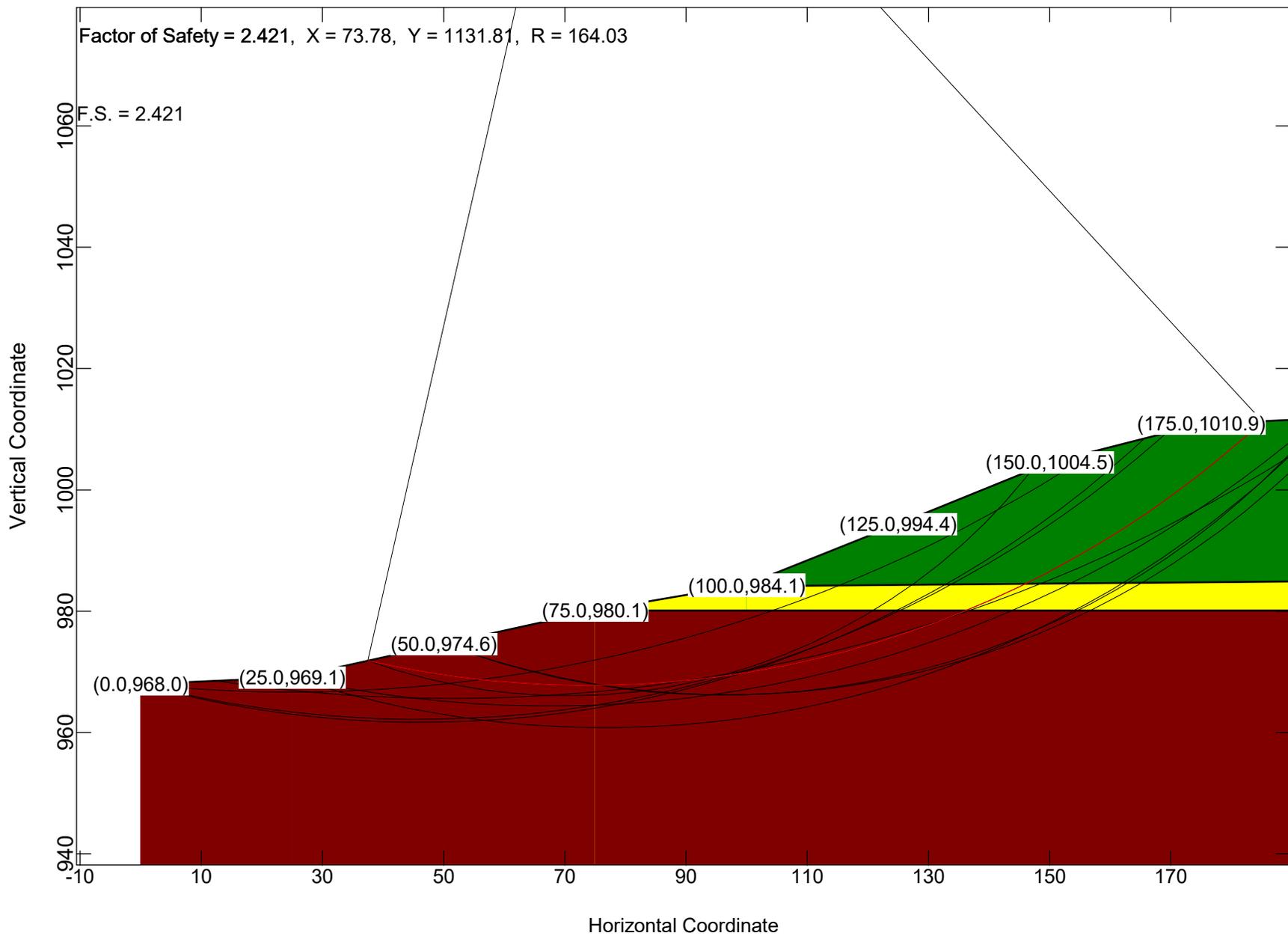


## Appendix D

- Slope Stability Analyses
  - Section 1 (B-1)
  - Section 2 (B-2)
  - Section 3 (B-3)
  - Section 4 (B-4)



# SECTION 1



=====

STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 1c.sl4d  
Name of output file : Hartland Quarry - Section 1c.sl4o  
Name of plot output file : Hartland Quarry - Section 1c.sl4p

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Time and Date of Analysis  
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Date: September 05, 2023 Time: 18:05:02

1

PROBLEM DESCRIPTION Section 1c - After Grading

BOUNDARY COORDINATES

8 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	967.98	25.00	969.08	4
2	25.00	969.08	50.00	974.60	4
3	50.00	974.60	75.00	980.12	4
4	75.00	980.12	100.00	984.41	2
5	100.00	984.41	125.00	994.36	1
6	125.00	994.36	150.00	1004.49	1
7	150.00	1004.49	175.00	1010.86	1
8	175.00	1010.86	200.00	1012.00	1
9	100.00	984.12	200.00	985.00	2
10	75.00	980.12	200.00	980.12	4

1

#### ISOTROPIC SOIL PARAMETERS

##### 4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	30.0	0.00	0.0	0
2	135.0	0.0	0.0	32.0	0.00	0.0	0
3	140.0	0.0	0.0	33.0	0.00	0.0	0
4	145.0	0.0	0.0	35.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft.  
and X = 50.00 ft.

Each Surface Terminates Between X = 125.00 ft.  
and X = 200.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

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

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

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	971.84
2	42.39	970.81
3	47.31	969.93
4	52.26	969.20
5	57.23	968.62
6	62.21	968.19
7	67.20	967.91
8	72.20	967.79
9	77.20	967.81
10	82.20	967.99
11	87.19	968.33
12	92.16	968.81
13	97.12	969.45
14	102.06	970.23
15	106.97	971.17
16	111.85	972.26
17	116.70	973.49
18	121.50	974.87
19	126.26	976.40
20	130.97	978.07
21	135.63	979.89
22	140.24	981.84
23	144.78	983.94
24	149.25	986.17
25	153.65	988.54



26	4.1	0.99E+04	0.00E+00							
27	4.5	0.11E+05	0.00E+00							
28	1.2	0.28E+04	0.00E+00							
29	3.3	0.78E+04	0.00E+00							
30	0.8	0.18E+04	0.00E+00							
31	3.7	0.83E+04	0.00E+00							
32	4.3	0.91E+04	0.00E+00							
33	4.3	0.81E+04	0.00E+00							
34	4.2	0.71E+04	0.00E+00							
35	4.1	0.60E+04	0.00E+00							
36	4.0	0.49E+04	0.00E+00							
37	0.5	0.56E+03	0.00E+00							
38	3.4	0.30E+04	0.00E+00							
39	3.8	0.20E+04	0.00E+00							
40	2.9	0.47E+03	0.00E+00							

-----

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	12.50	968.53
2	17.45	967.83
3	22.42	967.23
4	27.39	966.72
5	32.37	966.31
6	37.36	966.00
7	42.36	965.78
8	47.36	965.65
9	52.36	965.63
10	57.36	965.70
11	62.35	965.86
12	67.35	966.12
13	72.33	966.48
14	77.31	966.93
15	82.28	967.48
16	87.24	968.13
17	92.19	968.87
18	97.11	969.71
19	102.03	970.64
20	106.92	971.66
21	111.79	972.78
22	116.65	973.99
23	121.47	975.30
24	126.27	976.69
25	131.05	978.18
26	135.79	979.77
27	140.50	981.44

28	145.18	983.20
29	149.82	985.05
30	154.43	987.00
31	159.00	989.03
32	163.53	991.14
33	168.02	993.35
34	172.46	995.64
35	176.86	998.01
36	181.21	1000.47
37	185.52	1003.02
38	189.77	1005.64
39	193.98	1008.35
40	198.13	1011.14
41	199.32	1011.97

Circle Center At X = 51.3 ; Y = 1225.5 and Radius, 259.8

\*\*\* 2.549 \*\*\*

1

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	25.00	969.08
2	29.89	968.05
3	34.81	967.14
4	39.75	966.36
5	44.71	965.71
6	49.68	965.18
7	54.66	964.79
8	59.66	964.52
9	64.65	964.38
10	69.65	964.38
11	74.65	964.50
12	79.65	964.75
13	84.63	965.13
14	89.60	965.64
15	94.56	966.28
16	99.51	967.04
17	104.42	967.94
18	109.32	968.96
19	114.19	970.11
20	119.02	971.38
21	123.82	972.77

22	128.59	974.29
23	133.31	975.94
24	137.99	977.70
25	142.62	979.59
26	147.20	981.59
27	151.73	983.71
28	156.20	985.95
29	160.61	988.31
30	164.96	990.77
31	169.24	993.35
32	173.46	996.04
33	177.60	998.84
34	181.67	1001.74
35	185.67	1004.75
36	189.58	1007.86
37	193.42	1011.07
38	194.17	1011.73

Circle Center At X = 67.4 ; Y = 1157.6 and Radius, 193.3

\*\*\* 2.564 \*\*\*

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	974.60
2	54.71	972.92
3	59.48	971.42
4	64.30	970.11
5	69.18	968.98
6	74.09	968.04
7	79.03	967.29
8	84.00	966.73
9	88.98	966.36
10	93.98	966.19
11	98.98	966.21
12	103.98	966.41
13	108.96	966.81
14	113.93	967.41
15	118.86	968.19
16	123.77	969.16
17	128.63	970.32
18	133.45	971.67
19	138.21	973.20

20	142.91	974.91
21	147.53	976.80
22	152.09	978.87
23	156.56	981.11
24	160.94	983.52
25	165.22	986.10
26	169.40	988.84
27	173.47	991.74
28	177.43	994.80
29	181.27	998.00
30	184.98	1001.35
31	188.56	1004.84
32	192.01	1008.46
33	194.91	1011.77

Circle Center At X = 96.0 ; Y = 1096.2 and Radius, 130.0

\*\*\* 2.585 \*\*\*

1

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	974.60
2	54.72	972.95
3	59.50	971.48
4	64.33	970.19
5	69.21	969.08
6	74.12	968.15
7	79.06	967.40
8	84.03	966.83
9	89.01	966.44
10	94.01	966.24
11	99.01	966.23
12	104.01	966.40
13	108.99	966.75
14	113.97	967.29
15	118.91	968.01
16	123.83	968.91
17	128.71	970.00
18	133.55	971.26
19	138.34	972.70
20	143.07	974.32
21	147.74	976.11

22	152.34	978.07
23	156.86	980.20
24	161.30	982.49
25	165.66	984.95
26	169.92	987.56
27	174.08	990.34
28	178.14	993.26
29	182.08	996.33
30	185.91	999.55
31	189.62	1002.90
32	193.20	1006.39
33	196.65	1010.01
34	198.35	1011.92

Circle Center At X = 96.9 ; Y = 1101.7 and Radius, 135.5

\*\*\* 2.618 \*\*\*

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	0.00	967.98
2	4.98	967.51
3	9.97	967.15
4	14.96	966.89
5	19.96	966.74
6	24.96	966.68
7	29.96	966.74
8	34.95	966.89
9	39.95	967.15
10	44.93	967.51
11	49.91	967.98
12	54.88	968.55
13	59.83	969.22
14	64.77	969.99
15	69.70	970.87
16	74.60	971.85
17	79.48	972.93
18	84.34	974.11
19	89.17	975.40
20	93.98	976.78
21	98.75	978.26
22	103.50	979.84
23	108.21	981.52

24	112.88	983.29
25	117.52	985.17
26	122.11	987.13
27	126.67	989.20
28	131.18	991.35
29	135.64	993.61
30	140.06	995.95
31	144.43	998.38
32	148.74	1000.90
33	153.01	1003.52
34	157.22	1006.22
35	157.48	1006.40

Circle Center At X = 25.0 ; Y = 1207.6 and Radius, 241.0

\*\*\* 2.672 \*\*\*

1

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	25.00	969.08
2	29.77	967.59
3	34.59	966.24
4	39.44	965.04
5	44.33	963.99
6	49.25	963.09
7	54.19	962.34
8	59.15	961.73
9	64.13	961.28
10	69.12	960.98
11	74.12	960.83
12	79.12	960.83
13	84.12	960.98
14	89.11	961.28
15	94.09	961.74
16	99.05	962.34
17	104.00	963.10
18	108.91	964.00
19	113.80	965.05
20	118.66	966.25
21	123.47	967.60
22	128.24	969.09
23	132.97	970.73

24	137.64	972.51
25	142.26	974.43
26	146.81	976.48
27	151.31	978.68
28	155.73	981.01
29	160.08	983.47
30	164.36	986.06
31	168.55	988.79
32	172.66	991.63
33	176.68	994.61
34	180.61	997.70
35	184.45	1000.91
36	188.18	1004.23
37	191.82	1007.66
38	195.34	1011.21
39	195.91	1011.81

Circle Center At X = 76.6 ; Y = 1125.9 and Radius, 165.1

\*\*\* 2.684 \*\*\*

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	0.00	967.98
2	4.86	966.80
3	9.75	965.76
4	14.67	964.85
5	19.60	964.07
6	24.56	963.42
7	29.54	962.91
8	34.52	962.54
9	39.52	962.29
10	44.52	962.19
11	49.52	962.22
12	54.51	962.38
13	59.50	962.68
14	64.48	963.12
15	69.45	963.69
16	74.40	964.39
17	79.33	965.23
18	84.24	966.20
19	89.11	967.31
20	93.96	968.54

21	98.77	969.91
22	103.54	971.40
23	108.27	973.02
24	112.95	974.78
25	117.59	976.65
26	122.17	978.65
27	126.69	980.78
28	131.16	983.03
29	135.57	985.39
30	139.90	987.88
31	144.17	990.48
32	148.37	993.20
33	152.49	996.03
34	156.54	998.96
35	160.50	1002.01
36	164.38	1005.17
37	168.18	1008.42
38	169.24	1009.39

Circle Center At X = 45.9 ; Y = 1147.0 and Radius, 184.8

\*\*\* 2.714 \*\*\*

1

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	0.00	967.98
2	4.84	966.72
3	9.71	965.60
4	14.61	964.62
5	19.54	963.78
6	24.49	963.08
7	29.46	962.52
8	34.45	962.10
9	39.44	961.83
10	44.44	961.70
11	49.44	961.71
12	54.43	961.86
13	59.42	962.16
14	64.41	962.60
15	69.37	963.18
16	74.32	963.90
17	79.24	964.77

18	84.14	965.77
19	89.01	966.92
20	93.84	968.20
21	98.64	969.62
22	103.39	971.18
23	108.09	972.87
24	112.75	974.69
25	117.35	976.65
26	121.89	978.74
27	126.37	980.96
28	130.79	983.30
29	135.14	985.77
30	139.41	988.36
31	143.61	991.08
32	147.73	993.91
33	151.77	996.86
34	155.72	999.92
35	159.58	1003.10
36	163.35	1006.38
37	165.62	1008.47

Circle Center At X = 46.5 ; Y = 1136.7 and Radius, 175.0

\*\*\* 2.764 \*\*\*

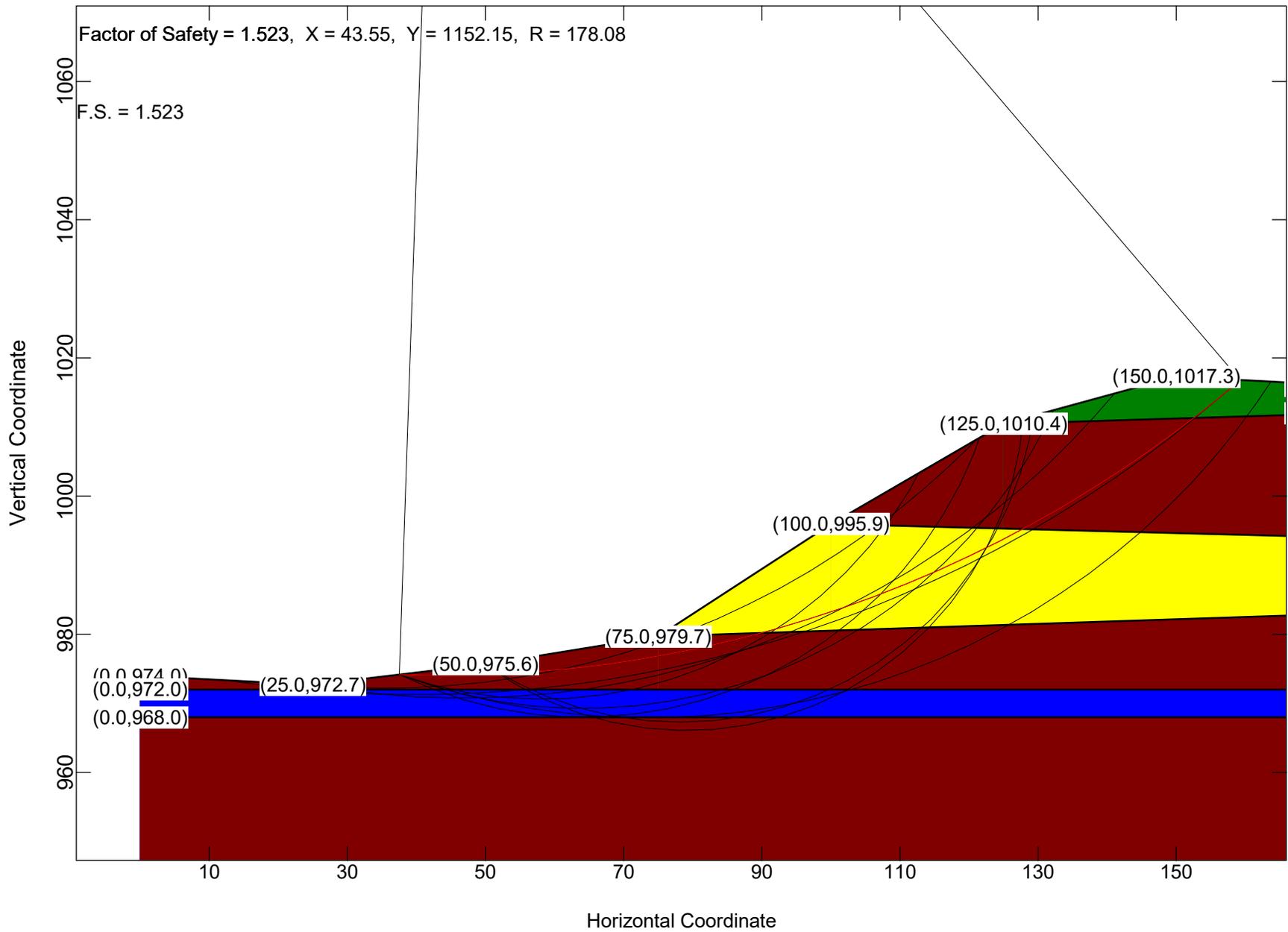
Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	971.84
2	42.25	970.26
3	47.07	968.93
4	51.95	967.85
5	56.88	967.02
6	61.84	966.45
7	66.83	966.13
8	71.83	966.07
9	76.83	966.27
10	81.81	966.72
11	86.76	967.42
12	91.67	968.38
13	96.52	969.60
14	101.30	971.05
15	106.00	972.76
16	110.61	974.70



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T 1781.12 +

# SECTION 2



=====

STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2c.sl4d  
Name of output file : Hartland Quarry - Section 2c.sl4o  
Name of plot output file : Hartland Quarry - Section 2c.sl4p

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Time and Date of Analysis

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Date: September 05, 2023 Time: 17:16:57

1

PROBLEM DESCRIPTION Section 2c- After Grading

BOUNDARY COORDINATES

7 Top Boundaries  
12 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
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1	0.00	974.00	25.00	972.70	4
2	25.00	972.70	50.00	975.63	4
3	50.00	975.63	75.00	979.70	4
4	75.00	979.70	100.00	995.94	2
5	100.00	995.94	125.00	1010.44	4
6	125.00	1010.44	150.00	1017.28	1
7	150.00	1017.28	175.00	1016.00	1
8	125.00	1010.44	175.00	1012.00	4
9	100.00	995.94	175.00	994.00	2
10	75.00	979.70	175.00	983.00	4
11	0.00	972.00	175.00	972.00	3
12	0.00	968.00	175.00	968.00	4

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	30.0	0.00	0.0	0
2	135.0	0.0	0.0	32.0	0.00	0.0	0
3	140.0	0.0	0.0	33.0	0.00	0.0	0
4	145.0	0.0	0.0	35.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft. and X = 50.00 ft.

Each Surface Terminates Between X = 100.00 ft. and X = 175.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y =900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

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

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

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	974.17
2	42.50	974.07
3	47.50	974.11
4	52.50	974.29
5	57.49	974.61
6	62.46	975.07
7	67.43	975.67
8	72.37	976.41
9	77.30	977.29
10	82.19	978.31
11	87.06	979.46
12	91.89	980.75
13	96.68	982.17
14	101.43	983.73
15	106.14	985.42
16	110.79	987.24
17	115.40	989.20
18	119.94	991.28
19	124.43	993.49
20	128.85	995.82
21	133.21	998.27
22	137.49	1000.85
23	141.70	1003.55



0.00E+00									
15	4.8	0.70E+04	0.00E+00						
0.00E+00									
16	3.3	0.54E+04	0.00E+00						
0.00E+00									
17	1.4	0.25E+04	0.00E+00						
0.00E+00									
18	4.7	0.87E+04	0.00E+00						
0.00E+00									
19	4.7	0.94E+04	0.00E+00						
0.00E+00									
20	4.6	0.99E+04	0.00E+00						
0.00E+00									
21	4.5	0.10E+05	0.00E+00						
0.00E+00									
22	4.5	0.11E+05	0.00E+00						
0.00E+00									
23	0.6	0.14E+04	0.00E+00						
0.00E+00									
24	2.7	0.64E+04	0.00E+00						
0.00E+00									
25	1.1	0.26E+04	0.00E+00						
0.00E+00									
26	4.4	0.94E+04	0.00E+00						
0.00E+00									
27	4.3	0.84E+04	0.00E+00						
0.00E+00									
28	4.2	0.72E+04	0.00E+00						
0.00E+00									
29	4.1	0.61E+04	0.00E+00						
0.00E+00									
30	4.1	0.49E+04	0.00E+00						
0.00E+00									
31	0.1	0.12E+03	0.00E+00						
0.00E+00									
32	2.5	0.23E+04	0.00E+00						
0.00E+00									
33	1.3	0.93E+03	0.00E+00						
0.00E+00									
34	3.9	0.16E+04	0.00E+00						
0.00E+00									
35	1.5	0.14E+03	0.00E+00						
0.00E+00									

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Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
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1	25.00	972.70
2	29.94	971.92
3	34.91	971.34
4	39.89	970.97
5	44.89	970.80
6	49.89	970.83
7	54.88	971.06
8	59.86	971.49
9	64.82	972.13
10	69.75	972.97
11	74.64	974.01
12	79.49	975.24
13	84.28	976.67
14	89.01	978.30
15	93.67	980.11
16	98.25	982.11
17	102.75	984.30
18	107.15	986.67
19	111.46	989.21
20	115.65	991.93
21	119.74	994.81
22	123.70	997.86
23	127.54	1001.06
24	131.24	1004.42
25	134.81	1007.93
26	138.23	1011.58
27	141.03	1014.83

Circle Center At X = 46.6 ; Y = 1093.9 and Radius, 123.2

\*\*\* 1.544 \*\*\*

1

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	974.17
2	42.23	972.55
3	47.06	971.25
4	51.96	970.27
5	56.92	969.63
6	61.91	969.31
7	66.91	969.33

8	71.90	969.67
9	76.85	970.35
10	81.75	971.35
11	86.57	972.68
12	91.29	974.33
13	95.90	976.28
14	100.36	978.54
15	104.66	981.08
16	108.79	983.91
17	112.71	987.00
18	116.43	990.35
19	119.91	993.94
20	123.15	997.75
21	126.12	1001.77
22	128.83	1005.97
23	131.24	1010.35
24	132.21	1012.41

Circle Center At X = 64.2 ; Y = 1044.5 and Radius, 75.3

\*\*\* 1.547 \*\*\*

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	975.63
2	54.32	973.11
3	58.86	971.02
4	63.59	969.38
5	68.45	968.21
6	73.40	967.50
7	78.39	967.28
8	83.38	967.55
9	88.33	968.29
10	93.18	969.51
11	97.89	971.19
12	102.41	973.32
13	106.71	975.87
14	110.74	978.83
15	114.47	982.16
16	117.85	985.84
17	120.87	989.83
18	123.49	994.09
19	125.68	998.58

20	127.43	1003.27
21	128.72	1008.10
22	129.30	1011.62

Circle Center At X = 78.2 ; Y = 1019.0 and Radius, 51.7

\*\*\* 1.629 \*\*\*

1

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	12.50	973.35
2	17.45	972.66
3	22.42	972.11
4	27.41	971.70
5	32.40	971.42
6	37.40	971.29
7	42.40	971.29
8	47.39	971.44
9	52.39	971.72
10	57.37	972.14
11	62.34	972.70
12	67.29	973.40
13	72.22	974.24
14	77.12	975.21
15	82.00	976.32
16	86.84	977.56
17	91.65	978.94
18	96.41	980.46
19	101.13	982.10
20	105.81	983.88
21	110.43	985.78
22	115.00	987.81
23	119.51	989.97
24	123.96	992.26
25	128.34	994.66
26	132.65	997.19
27	136.89	999.84
28	141.06	1002.60
29	145.15	1005.48
30	149.15	1008.48
31	153.07	1011.58
32	156.91	1014.79

33            159.19        1016.81

Circle Center At X = 39.7 ; Y = 1150.8 and Radius, 179.5

\*\*\*        1.639        \*\*\*

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	25.00	972.70
2	29.99	972.36
3	34.99	972.23
4	39.99	972.30
5	44.98	972.59
6	49.95	973.08
7	54.90	973.79
8	59.82	974.69
9	64.70	975.81
10	69.52	977.13
11	74.28	978.64
12	78.98	980.36
13	83.60	982.27
14	88.14	984.37
15	92.58	986.66
16	96.93	989.13
17	101.16	991.79
18	105.29	994.62
19	109.29	997.62
20	113.16	1000.78
21	116.90	1004.10
22	120.49	1007.58
23	121.01	1008.13

Circle Center At X = 35.7 ; Y = 1091.7 and Radius, 119.5

\*\*\*        1.644        \*\*\*

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	974.17
2	42.08	972.16
3	46.81	970.54
4	51.66	969.31
5	56.59	968.49
6	61.57	968.07
7	66.57	968.06
8	71.56	968.46
9	76.49	969.27
10	81.34	970.48
11	86.08	972.08
12	90.67	974.07
13	95.08	976.43
14	99.28	979.14
15	103.24	982.18
16	106.95	985.54
17	110.36	989.19
18	113.47	993.11
19	116.24	997.28
20	118.66	1001.65
21	120.71	1006.21
22	121.50	1008.41

Circle Center At X = 64.2 ; Y = 1029.0 and Radius, 60.9

\*\*\* 1.671 \*\*\*

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	975.63
2	54.17	972.87
3	58.60	970.56
4	63.25	968.70
5	68.05	967.33
6	72.98	966.46
7	77.96	966.09
8	82.96	966.24
9	87.92	966.89
10	92.78	968.05
11	97.51	969.69

12	102.03	971.81
13	106.32	974.38
14	110.33	977.37
15	114.01	980.76
16	117.32	984.51
17	120.24	988.57
18	122.72	992.91
19	124.75	997.48
20	126.30	1002.23
21	127.36	1007.11
22	127.82	1011.21

Circle Center At X = 79.1 ; Y = 1015.0 and Radius, 49.0

\*\*\* 1.705 \*\*\*

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	974.17
2	42.28	972.69
3	47.16	971.60
4	52.11	970.91
5	57.10	970.62
6	62.10	970.74
7	67.07	971.25
8	71.99	972.17
9	76.81	973.48
10	81.52	975.18
11	86.07	977.25
12	90.44	979.68
13	94.59	982.46
14	98.52	985.56
15	102.17	988.97
16	105.54	992.66
17	108.61	996.62
18	111.34	1000.80
19	112.69	1003.30

Circle Center At X = 58.2 ; Y = 1032.5 and Radius, 61.9

\*\*\* 1.723 \*\*\*

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	974.17
2	42.25	972.60
3	47.06	971.25
4	51.94	970.13
5	56.86	969.24
6	61.81	968.58
7	66.79	968.15
8	71.79	967.94
9	76.79	967.97
10	81.78	968.24
11	86.76	968.73
12	91.71	969.45
13	96.61	970.41
14	101.47	971.58
15	106.27	972.99
16	111.00	974.61
17	115.65	976.45
18	120.21	978.51
19	124.67	980.77
20	129.02	983.24
21	133.25	985.91
22	137.35	988.77
23	141.31	991.81
24	145.13	995.04
25	148.79	998.44
26	152.30	1002.01
27	155.63	1005.74
28	158.79	1009.61
29	161.76	1013.63
30	163.74	1016.58

Circle Center At X = 73.6 ; Y = 1075.7 and Radius, 107.8

\*\*\* 1.752 \*\*\*

0.00      223.80      447.60      671.41      895.21      1119.01

X	0.00	+	-----+	-----+	-----+	-----+	**-----+
		-					.**
		-					.2*
		-					.41*
		-					.0*
		-					***
	223.80	+					
		-					
		-					
		-					
		-					
A	447.60	+					
		-					
		-					
		-					
		-					
X	671.41	+					
		-					
		-					
		-					
		-					
I	895.21	+					
		-					
		-					
		-					
		-					
S	1119.01	+					
		-					
		-					
		-					
		-					
	1342.81	+					
		-					
		-					
		-					
		-					
F	1566.61	+					
		-					
		-					
		-					

T 1790.41 +

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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2c.sl4d  
Name of output file : Hartland Quarry - Section 2c.sl4o  
Name of plot output file : Hartland Quarry - Section 2c.sl4p

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Time and Date of Analysis

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Date: September 05, 2023 Time: 17:16:57

1

PROBLEM DESCRIPTION Section 2c- After Grading

BOUNDARY COORDINATES

7 Top Boundaries  
12 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
--------------	------------	------------	-------------	-------------	---------------------

1	0.00	974.00	25.00	972.70	4
2	25.00	972.70	50.00	975.63	4
3	50.00	975.63	75.00	979.70	4
4	75.00	979.70	100.00	995.94	2
5	100.00	995.94	125.00	1010.44	4
6	125.00	1010.44	150.00	1017.28	1
7	150.00	1017.28	175.00	1016.00	1
8	125.00	1010.44	175.00	1012.00	4
9	100.00	995.94	175.00	994.00	2
10	75.00	979.70	175.00	983.00	4
11	0.00	972.00	175.00	972.00	3
12	0.00	968.00	175.00	968.00	4

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	30.0	0.00	0.0	0
2	135.0	0.0	0.0	32.0	0.00	0.0	0
3	140.0	0.0	0.0	33.0	0.00	0.0	0
4	145.0	0.0	0.0	35.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft. and X = 50.00 ft.

Each Surface Terminates Between X = 100.00 ft. and X = 175.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y =900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

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

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

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	974.17
2	42.50	974.07
3	47.50	974.11
4	52.50	974.29
5	57.49	974.61
6	62.46	975.07
7	67.43	975.67
8	72.37	976.41
9	77.30	977.29
10	82.19	978.31
11	87.06	979.46
12	91.89	980.75
13	96.68	982.17
14	101.43	983.73
15	106.14	985.42
16	110.79	987.24
17	115.40	989.20
18	119.94	991.28
19	124.43	993.49
20	128.85	995.82
21	133.21	998.27
22	137.49	1000.85
23	141.70	1003.55



0.00E+00									
15	4.8	0.70E+04	0.00E+00						
0.00E+00									
16	3.3	0.54E+04	0.00E+00						
0.00E+00									
17	1.4	0.25E+04	0.00E+00						
0.00E+00									
18	4.7	0.87E+04	0.00E+00						
0.00E+00									
19	4.7	0.94E+04	0.00E+00						
0.00E+00									
20	4.6	0.99E+04	0.00E+00						
0.00E+00									
21	4.5	0.10E+05	0.00E+00						
0.00E+00									
22	4.5	0.11E+05	0.00E+00						
0.00E+00									
23	0.6	0.14E+04	0.00E+00						
0.00E+00									
24	2.7	0.64E+04	0.00E+00						
0.00E+00									
25	1.1	0.26E+04	0.00E+00						
0.00E+00									
26	4.4	0.94E+04	0.00E+00						
0.00E+00									
27	4.3	0.84E+04	0.00E+00						
0.00E+00									
28	4.2	0.72E+04	0.00E+00						
0.00E+00									
29	4.1	0.61E+04	0.00E+00						
0.00E+00									
30	4.1	0.49E+04	0.00E+00						
0.00E+00									
31	0.1	0.12E+03	0.00E+00						
0.00E+00									
32	2.5	0.23E+04	0.00E+00						
0.00E+00									
33	1.3	0.93E+03	0.00E+00						
0.00E+00									
34	3.9	0.16E+04	0.00E+00						
0.00E+00									
35	1.5	0.14E+03	0.00E+00						
0.00E+00									

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Failure Surface Specified By 27 Coordinate Points

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

1	25.00	972.70
2	29.94	971.92
3	34.91	971.34
4	39.89	970.97
5	44.89	970.80
6	49.89	970.83
7	54.88	971.06
8	59.86	971.49
9	64.82	972.13
10	69.75	972.97
11	74.64	974.01
12	79.49	975.24
13	84.28	976.67
14	89.01	978.30
15	93.67	980.11
16	98.25	982.11
17	102.75	984.30
18	107.15	986.67
19	111.46	989.21
20	115.65	991.93
21	119.74	994.81
22	123.70	997.86
23	127.54	1001.06
24	131.24	1004.42
25	134.81	1007.93
26	138.23	1011.58
27	141.03	1014.83

Circle Center At X = 46.6 ; Y = 1093.9 and Radius, 123.2

\*\*\* 1.544 \*\*\*

1

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	974.17
2	42.23	972.55
3	47.06	971.25
4	51.96	970.27
5	56.92	969.63
6	61.91	969.31
7	66.91	969.33

8	71.90	969.67
9	76.85	970.35
10	81.75	971.35
11	86.57	972.68
12	91.29	974.33
13	95.90	976.28
14	100.36	978.54
15	104.66	981.08
16	108.79	983.91
17	112.71	987.00
18	116.43	990.35
19	119.91	993.94
20	123.15	997.75
21	126.12	1001.77
22	128.83	1005.97
23	131.24	1010.35
24	132.21	1012.41

Circle Center At X = 64.2 ; Y = 1044.5 and Radius, 75.3

\*\*\* 1.547 \*\*\*

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	975.63
2	54.32	973.11
3	58.86	971.02
4	63.59	969.38
5	68.45	968.21
6	73.40	967.50
7	78.39	967.28
8	83.38	967.55
9	88.33	968.29
10	93.18	969.51
11	97.89	971.19
12	102.41	973.32
13	106.71	975.87
14	110.74	978.83
15	114.47	982.16
16	117.85	985.84
17	120.87	989.83
18	123.49	994.09
19	125.68	998.58

20	127.43	1003.27
21	128.72	1008.10
22	129.30	1011.62

Circle Center At X = 78.2 ; Y = 1019.0 and Radius, 51.7

\*\*\* 1.629 \*\*\*

1

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	12.50	973.35
2	17.45	972.66
3	22.42	972.11
4	27.41	971.70
5	32.40	971.42
6	37.40	971.29
7	42.40	971.29
8	47.39	971.44
9	52.39	971.72
10	57.37	972.14
11	62.34	972.70
12	67.29	973.40
13	72.22	974.24
14	77.12	975.21
15	82.00	976.32
16	86.84	977.56
17	91.65	978.94
18	96.41	980.46
19	101.13	982.10
20	105.81	983.88
21	110.43	985.78
22	115.00	987.81
23	119.51	989.97
24	123.96	992.26
25	128.34	994.66
26	132.65	997.19
27	136.89	999.84
28	141.06	1002.60
29	145.15	1005.48
30	149.15	1008.48
31	153.07	1011.58
32	156.91	1014.79

33            159.19        1016.81

Circle Center At X = 39.7 ; Y = 1150.8 and Radius, 179.5

\*\*\*        1.639        \*\*\*

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	25.00	972.70
2	29.99	972.36
3	34.99	972.23
4	39.99	972.30
5	44.98	972.59
6	49.95	973.08
7	54.90	973.79
8	59.82	974.69
9	64.70	975.81
10	69.52	977.13
11	74.28	978.64
12	78.98	980.36
13	83.60	982.27
14	88.14	984.37
15	92.58	986.66
16	96.93	989.13
17	101.16	991.79
18	105.29	994.62
19	109.29	997.62
20	113.16	1000.78
21	116.90	1004.10
22	120.49	1007.58
23	121.01	1008.13

Circle Center At X = 35.7 ; Y = 1091.7 and Radius, 119.5

\*\*\*        1.644        \*\*\*

1

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	974.17
2	42.08	972.16
3	46.81	970.54
4	51.66	969.31
5	56.59	968.49
6	61.57	968.07
7	66.57	968.06
8	71.56	968.46
9	76.49	969.27
10	81.34	970.48
11	86.08	972.08
12	90.67	974.07
13	95.08	976.43
14	99.28	979.14
15	103.24	982.18
16	106.95	985.54
17	110.36	989.19
18	113.47	993.11
19	116.24	997.28
20	118.66	1001.65
21	120.71	1006.21
22	121.50	1008.41

Circle Center At X = 64.2 ; Y = 1029.0 and Radius, 60.9

\*\*\* 1.671 \*\*\*

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	975.63
2	54.17	972.87
3	58.60	970.56
4	63.25	968.70
5	68.05	967.33
6	72.98	966.46
7	77.96	966.09
8	82.96	966.24
9	87.92	966.89
10	92.78	968.05
11	97.51	969.69

12	102.03	971.81
13	106.32	974.38
14	110.33	977.37
15	114.01	980.76
16	117.32	984.51
17	120.24	988.57
18	122.72	992.91
19	124.75	997.48
20	126.30	1002.23
21	127.36	1007.11
22	127.82	1011.21

Circle Center At X = 79.1 ; Y = 1015.0 and Radius, 49.0

\*\*\* 1.705 \*\*\*

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	974.17
2	42.28	972.69
3	47.16	971.60
4	52.11	970.91
5	57.10	970.62
6	62.10	970.74
7	67.07	971.25
8	71.99	972.17
9	76.81	973.48
10	81.52	975.18
11	86.07	977.25
12	90.44	979.68
13	94.59	982.46
14	98.52	985.56
15	102.17	988.97
16	105.54	992.66
17	108.61	996.62
18	111.34	1000.80
19	112.69	1003.30

Circle Center At X = 58.2 ; Y = 1032.5 and Radius, 61.9

\*\*\* 1.723 \*\*\*

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	974.17
2	42.25	972.60
3	47.06	971.25
4	51.94	970.13
5	56.86	969.24
6	61.81	968.58
7	66.79	968.15
8	71.79	967.94
9	76.79	967.97
10	81.78	968.24
11	86.76	968.73
12	91.71	969.45
13	96.61	970.41
14	101.47	971.58
15	106.27	972.99
16	111.00	974.61
17	115.65	976.45
18	120.21	978.51
19	124.67	980.77
20	129.02	983.24
21	133.25	985.91
22	137.35	988.77
23	141.31	991.81
24	145.13	995.04
25	148.79	998.44
26	152.30	1002.01
27	155.63	1005.74
28	158.79	1009.61
29	161.76	1013.63
30	163.74	1016.58

Circle Center At X = 73.6 ; Y = 1075.7 and Radius, 107.8

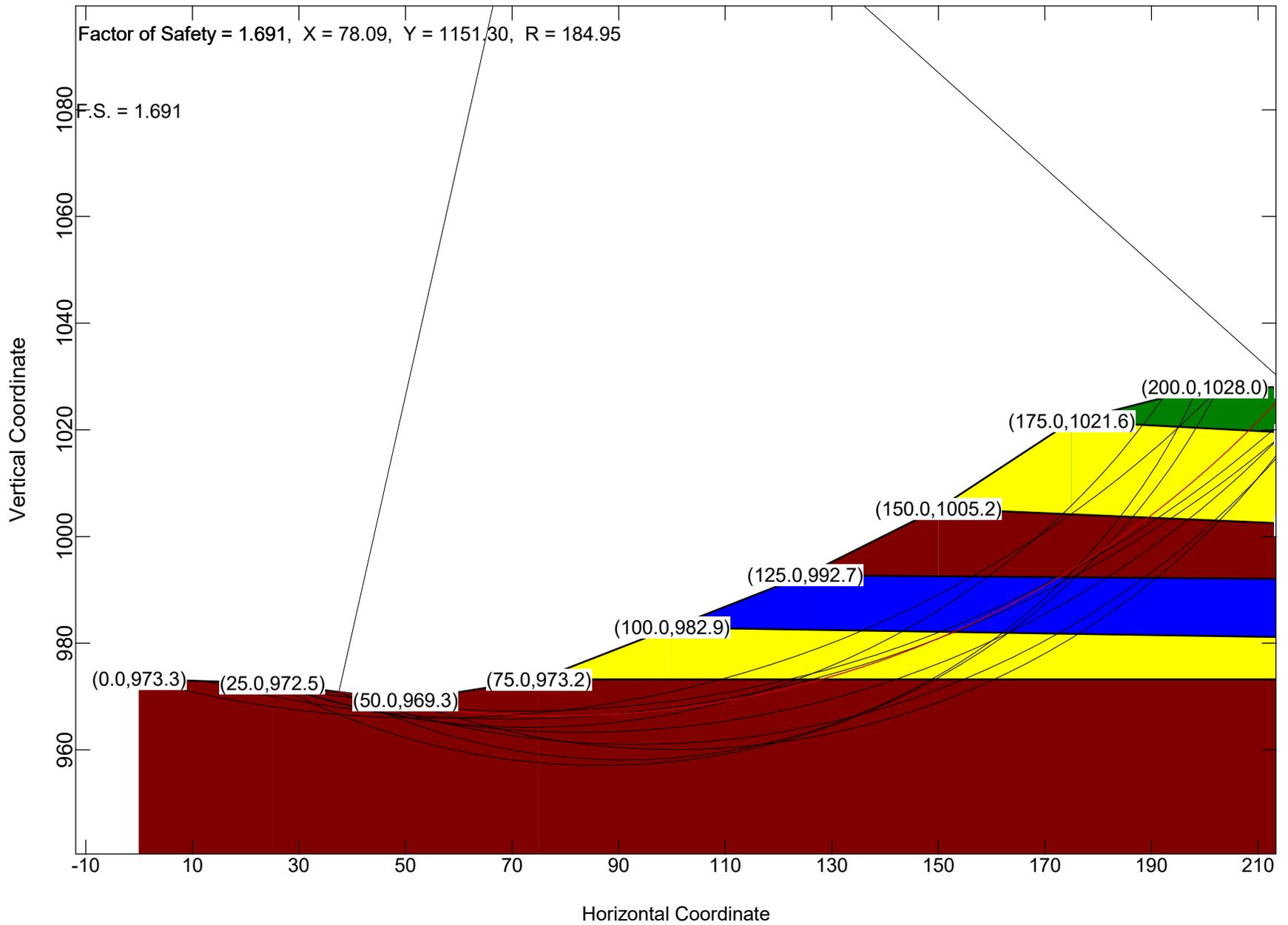
\*\*\* 1.752 \*\*\*

0.00      223.80      447.60      671.41      895.21      1119.01

X	0.00	+	-----+	-----+	-----+	-----+	**-----+
		-					.**
		-					.2*
		-					.41*
		-					.0*
		-					***
	223.80	+					
		-					
		-					
		-					
		-					
A	447.60	+					
		-					
		-					
		-					
		-					
X	671.41	+					
		-					
		-					
		-					
		-					
I	895.21	+					
		-					
		-					
		-					
		-					
S	1119.01	+					
		-					
		-					
		-					
		-					
	1342.81	+					
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		-					
F	1566.61	+					
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T 1790.41 +

# SECTION 3



=====

STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 3c.sl4d  
Name of output file : Hartland Quarry - Section 3c.sl4o  
Name of plot output file : Hartland Quarry - Section 3c.sl4p

-----  
Time and Date of Analysis  
-----

Date: September 05, 2023 Time: 18:33:43

1

PROBLEM DESCRIPTION Section 3c - After Grading

BOUNDARY COORDINATES

9 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	973.30	25.00	972.46	4
2	25.00	972.46	50.00	969.25	4
3	50.00	969.25	75.00	973.21	4
4	75.00	973.21	100.00	982.92	2
5	100.00	982.92	125.00	992.74	3
6	125.00	992.74	150.00	1005.22	4
7	150.00	1005.22	175.00	1021.61	2
8	175.00	1021.61	200.00	1028.00	1
9	200.00	1028.00	225.00	1028.00	1
10	175.00	1021.61	225.00	1019.00	2
11	150.00	1005.22	225.00	1002.00	4
12	125.00	992.74	225.00	992.00	3
13	100.00	982.92	225.00	981.00	2
14	75.00	973.21	225.00	973.21	4

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	30.0	0.00	0.0	0
2	135.0	0.0	0.0	32.0	0.00	0.0	0
3	140.0	0.0	0.0	33.0	0.00	0.0	0
4	145.0	0.0	0.0	35.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft.  
and X = 50.00 ft.

Each Surface Terminates Between X = 175.00 ft.  
and X = 225.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -45.0 And 0.0 deg.

1

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

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

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	970.85
2	42.39	969.82
3	47.31	968.92
4	52.25	968.16
5	57.21	967.53
6	62.19	967.03
7	67.17	966.67
8	72.17	966.44
9	77.17	966.35
10	82.17	966.39
11	87.17	966.57
12	92.16	966.88
13	97.14	967.33
14	102.10	967.91
15	107.05	968.62
16	111.98	969.47
17	116.88	970.46
18	121.75	971.57
19	126.60	972.82
20	131.40	974.19
21	136.17	975.70



14	5.0	0.95E+04	0.00E+00							
15	2.9	0.59E+04	0.00E+00							
16	2.1	0.45E+04	0.00E+00							
17	4.9	0.11E+05	0.00E+00							
18	4.9	0.12E+05	0.00E+00							
19	4.9	0.13E+05	0.00E+00							
20	4.9	0.13E+05	0.00E+00							
21	3.2	0.90E+04	0.00E+00							
22	1.6	0.45E+04	0.00E+00							
23	1.4	0.40E+04	0.00E+00							
24	3.4	0.10E+05	0.00E+00							
25	4.8	0.15E+05	0.00E+00							
26	4.7	0.15E+05	0.00E+00							
27	4.7	0.16E+05	0.00E+00							
28	4.4	0.15E+05	0.00E+00							
29	0.2	0.72E+03	0.00E+00							
30	2.6	0.90E+04	0.00E+00							
31	2.0	0.72E+04	0.00E+00							
32	4.5	0.16E+05	0.00E+00							
33	4.5	0.17E+05	0.00E+00							
34	4.4	0.17E+05	0.00E+00							
35	4.3	0.17E+05	0.00E+00							
36	0.2	0.88E+03	0.00E+00							
37	2.3	0.88E+04	0.00E+00							
38	1.8	0.67E+04	0.00E+00							
39	4.2	0.15E+05	0.00E+00							
40	4.1	0.14E+05	0.00E+00							
41	4.0	0.12E+05	0.00E+00							
42	0.2	0.64E+03	0.00E+00							
43	3.7	0.10E+05	0.00E+00							
44	3.9	0.97E+04	0.00E+00							
45	3.0	0.68E+04	0.00E+00							
46	0.7	0.15E+04	0.00E+00							
47	3.7	0.66E+04	0.00E+00							
48	3.6	0.48E+04	0.00E+00							
49	0.2	0.22E+03	0.00E+00							
50	3.3	0.28E+04	0.00E+00							
51	3.4	0.13E+04	0.00E+00							
52	1.0	0.72E+02	0.00E+00							

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Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	25.00	972.46
2	29.75	970.88
3	34.54	969.47

4	39.38	968.23
5	44.27	967.15
6	49.18	966.24
7	54.13	965.50
8	59.10	964.93
9	64.08	964.53
10	69.07	964.30
11	74.07	964.24
12	79.07	964.36
13	84.06	964.65
14	89.04	965.11
15	94.00	965.74
16	98.94	966.54
17	103.84	967.51
18	108.71	968.64
19	113.54	969.95
20	118.32	971.42
21	123.04	973.05
22	127.71	974.85
23	132.31	976.80
24	136.85	978.91
25	141.30	981.18
26	145.68	983.60
27	149.97	986.16
28	154.17	988.87
29	158.27	991.73
30	162.28	994.73
31	166.18	997.86
32	169.97	1001.12
33	173.64	1004.51
34	177.19	1008.03
35	180.63	1011.66
36	183.93	1015.41
37	187.11	1019.28
38	190.15	1023.25
39	192.09	1025.98

Circle Center At X = 73.2 ; Y = 1109.7 and Radius, 145.4

\*\*\* 1.714 \*\*\*

1

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
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1	25.00	972.46
2	29.89	971.43
3	34.81	970.51
4	39.74	969.70
5	44.69	969.01
6	49.66	968.43
7	54.64	967.97
8	59.63	967.63
9	64.62	967.40
10	69.62	967.29
11	74.62	967.30
12	79.62	967.42
13	84.61	967.66
14	89.60	968.01
15	94.58	968.49
16	99.54	969.07
17	104.50	969.77
18	109.43	970.59
19	114.34	971.52
20	119.23	972.57
21	124.09	973.73
22	128.93	975.00
23	133.73	976.38
24	138.50	977.88
25	143.24	979.49
26	147.94	981.20
27	152.59	983.03
28	157.20	984.96
29	161.77	987.00
30	166.28	989.15
31	170.75	991.40
32	175.16	993.75
33	179.51	996.21
34	183.81	998.76
35	188.05	1001.42
36	192.22	1004.17
37	196.33	1007.02
38	200.37	1009.97
39	204.34	1013.01
40	208.24	1016.14
41	212.07	1019.36
42	215.82	1022.66
43	219.49	1026.06
44	221.49	1028.00

Circle Center At X = 71.9 ; Y = 1182.1 and Radius, 214.8

\*\*\* 1.723 \*\*\*

Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	0.00	973.30
2	4.84	972.04
3	9.71	970.90
4	14.60	969.87
5	19.52	968.96
6	24.45	968.17
7	29.41	967.50
8	34.38	966.95
9	39.36	966.52
10	44.35	966.21
11	49.35	966.02
12	54.35	965.95
13	59.35	966.00
14	64.34	966.17
15	69.33	966.46
16	74.32	966.87
17	79.29	967.40
18	84.25	968.05
19	89.19	968.82
20	94.11	969.71
21	99.01	970.71
22	103.88	971.83
23	108.72	973.07
24	113.54	974.43
25	118.31	975.90
26	123.06	977.49
27	127.76	979.19
28	132.42	981.00
29	137.03	982.92
30	141.60	984.96
31	146.12	987.10
32	150.58	989.35
33	154.99	991.71
34	159.34	994.18
35	163.63	996.75
36	167.86	999.42
37	172.02	1002.19
38	176.11	1005.06
39	180.14	1008.03
40	184.09	1011.09
41	187.96	1014.25

42	191.76	1017.50
43	195.48	1020.84
44	199.12	1024.27
45	202.67	1027.79
46	202.88	1028.00

Circle Center At X = 54.8 ; Y = 1173.7 and Radius, 207.7

\*\*\* 1.816 \*\*\*

1

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	970.85
2	42.01	968.69
3	46.60	966.72
4	51.28	964.95
5	56.02	963.37
6	60.83	962.00
7	65.69	960.83
8	70.60	959.87
9	75.54	959.11
10	80.51	958.57
11	85.50	958.24
12	90.50	958.11
13	95.50	958.20
14	100.49	958.50
15	105.46	959.02
16	110.41	959.74
17	115.32	960.67
18	120.19	961.80
19	125.01	963.15
20	129.76	964.69
21	134.45	966.44
22	139.06	968.38
23	143.58	970.51
24	148.01	972.83
25	152.33	975.34
26	156.55	978.03
27	160.65	980.90
28	164.62	983.93
29	168.46	987.14
30	172.16	990.50

31	175.72	994.01
32	179.12	997.67
33	182.37	1001.47
34	185.45	1005.41
35	188.37	1009.47
36	191.10	1013.66
37	193.66	1017.95
38	196.04	1022.35
39	198.23	1026.85
40	198.57	1027.63

Circle Center At X = 90.9 ; Y = 1076.3 and Radius, 118.2

\*\*\* 1.826 \*\*\*

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	12.50	972.88
2	17.36	971.69
3	22.24	970.61
4	27.14	969.63
5	32.07	968.77
6	37.01	968.01
7	41.97	967.37
8	46.94	966.83
9	51.92	966.40
10	56.91	966.08
11	61.91	965.88
12	66.91	965.78
13	71.91	965.80
14	76.90	965.92
15	81.90	966.16
16	86.89	966.50
17	91.87	966.96
18	96.83	967.53
19	101.79	968.20
20	106.73	968.99
21	111.64	969.88
22	116.54	970.88
23	121.42	971.99
24	126.27	973.21
25	131.09	974.54
26	135.88	975.97

27	140.64	977.50
28	145.36	979.15
29	150.05	980.89
30	154.69	982.74
31	159.30	984.69
32	163.86	986.74
33	168.37	988.89
34	172.83	991.15
35	177.25	993.50
36	181.61	995.94
37	185.91	998.48
38	190.16	1001.12
39	194.35	1003.85
40	198.48	1006.67
41	202.54	1009.59
42	206.54	1012.59
43	210.47	1015.68
44	214.33	1018.85
45	218.12	1022.11
46	221.84	1025.46
47	224.54	1028.00

Circle Center At X = 68.7 ; Y = 1191.9 and Radius, 226.1

\*\*\* 1.838 \*\*\*

1

Failure Surface Specified By 45 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	25.00	972.46
2	29.77	970.97
3	34.58	969.61
4	39.43	968.38
5	44.31	967.28
6	49.21	966.31
7	54.14	965.48
8	59.10	964.78
9	64.06	964.22
10	69.05	963.79
11	74.04	963.50
12	79.03	963.34
13	84.03	963.31
14	89.03	963.43

15	94.03	963.68
16	99.01	964.06
17	103.98	964.58
18	108.94	965.23
19	113.88	966.02
20	118.79	966.94
21	123.68	967.99
22	128.54	969.18
23	133.36	970.49
24	138.15	971.94
25	142.89	973.52
26	147.59	975.22
27	152.25	977.05
28	156.85	979.01
29	161.39	981.09
30	165.88	983.29
31	170.31	985.62
32	174.67	988.06
33	178.97	990.62
34	183.19	993.30
35	187.34	996.09
36	191.41	998.99
37	195.40	1002.00
38	199.31	1005.12
39	203.14	1008.34
40	206.87	1011.66
41	210.51	1015.09
42	214.06	1018.61
43	217.52	1022.23
44	220.87	1025.94
45	222.63	1028.00

Circle Center At X = 82.4 ; Y = 1147.8 and Radius, 184.5

\*\*\* 1.839 \*\*\*

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	970.85
2	42.22	969.21
3	46.99	967.71
4	51.81	966.36
5	56.66	965.16

6	61.55	964.11
7	66.47	963.21
8	71.41	962.46
9	76.38	961.87
10	81.36	961.43
11	86.35	961.15
12	91.35	961.01
13	96.35	961.04
14	101.34	961.22
15	106.33	961.55
16	111.31	962.03
17	116.27	962.67
18	121.20	963.47
19	126.11	964.41
20	130.99	965.51
21	135.83	966.76
22	140.64	968.15
23	145.39	969.69
24	150.10	971.38
25	154.75	973.22
26	159.34	975.19
27	163.87	977.31
28	168.33	979.57
29	172.72	981.96
30	177.04	984.49
31	181.27	987.15
32	185.42	989.94
33	189.48	992.86
34	193.45	995.90
35	197.32	999.06
36	201.09	1002.34
37	204.77	1005.74
38	208.33	1009.25
39	211.78	1012.86
40	215.12	1016.58
41	218.35	1020.40
42	221.45	1024.32
43	224.18	1028.00

Circle Center At X = 93.1 ; Y = 1122.8 and Radius, 161.8

\*\*\* 1.880 \*\*\*

Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	969.25
2	54.71	967.57
3	59.47	966.05
4	64.29	964.71
5	69.15	963.53
6	74.05	962.52
7	78.97	961.68
8	83.93	961.02
9	88.91	960.52
10	93.90	960.21
11	98.89	960.06
12	103.89	960.10
13	108.89	960.30
14	113.88	960.68
15	118.84	961.24
16	123.79	961.96
17	128.71	962.86
18	133.59	963.93
19	138.44	965.18
20	143.23	966.58
21	147.98	968.16
22	152.67	969.90
23	157.29	971.80
24	161.85	973.87
25	166.33	976.09
26	170.73	978.46
27	175.04	980.99
28	179.26	983.67
29	183.39	986.49
30	187.41	989.45
31	191.33	992.56
32	195.14	995.80
33	198.84	999.17
34	202.41	1002.66
35	205.86	1006.28
36	209.18	1010.02
37	212.37	1013.87
38	215.42	1017.83
39	218.34	1021.90
40	221.11	1026.06
41	222.30	1028.00

Circle Center At X = 100.5 ; Y = 1103.3 and Radius, 143.2

\*\*\* 1.885 \*\*\*

Failure Surface Specified By 43 Coordinate Points

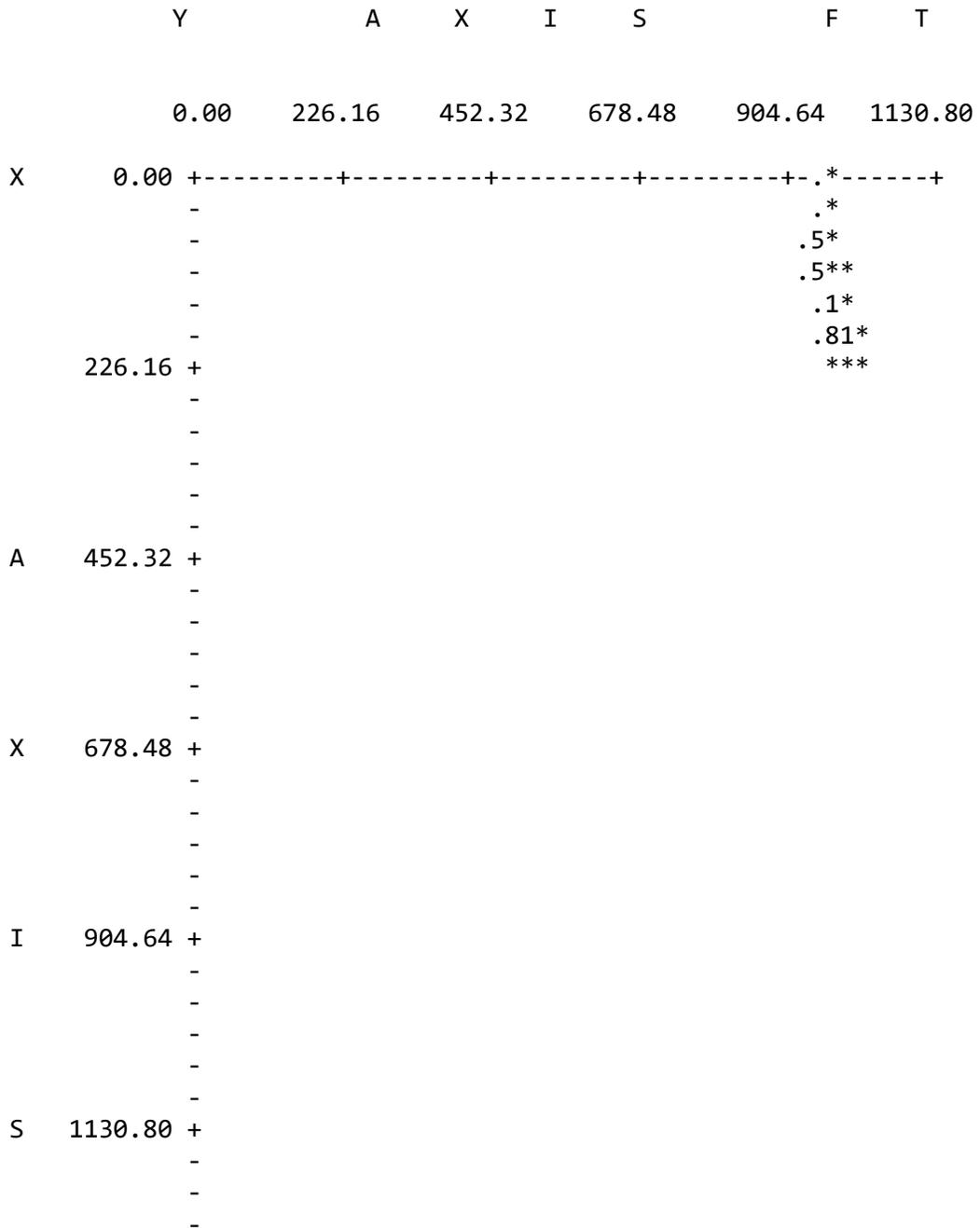
Point No.	X-Surf ft.	Y-Surf ft.
1	25.00	972.46
2	29.46	970.19
3	33.99	968.09
4	38.61	966.17
5	43.30	964.43
6	48.05	962.86
7	52.85	961.48
8	57.71	960.29
9	62.60	959.28
10	67.54	958.46
11	72.50	957.83
12	77.48	957.39
13	82.47	957.14
14	87.47	957.08
15	92.47	957.21
16	97.46	957.54
17	102.43	958.05
18	107.38	958.76
19	112.30	959.65
20	117.18	960.73
21	122.02	962.00
22	126.80	963.45
23	131.53	965.09
24	136.19	966.90
25	140.77	968.89
26	145.28	971.06
27	149.70	973.39
28	154.03	975.89
29	158.26	978.56
30	162.38	981.39
31	166.40	984.37
32	170.29	987.51
33	174.06	990.79
34	177.71	994.21
35	181.22	997.77
36	184.59	1001.46
37	187.82	1005.28
38	190.90	1009.22
39	193.82	1013.28
40	196.59	1017.44
41	199.20	1021.71
42	201.64	1026.07

43            202.63        1028.00

Circle Center At X = 86.5 ; Y = 1087.6 and Radius, 130.6

\*\*\*        1.904        \*\*\*

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1356.96 +  
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F 1583.12 +  
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T 1809.28 +



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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 4c.sl4d  
Name of output file : Hartland Quarry - Section 4c.sl4o  
Name of plot output file : Hartland Quarry - Section 4c.sl4p

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Time and Date of Analysis

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Date: September 05, 2023 Time: 14:07:39

1

PROBLEM DESCRIPTION Section 4c - After Grading

BOUNDARY COORDINATES

9 Top Boundaries  
12 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
--------------	------------	------------	-------------	-------------	---------------------

1	0.00	964.00	25.00	964.00	4
2	25.00	964.00	50.00	966.38	4
3	50.00	966.38	75.00	967.48	4
4	75.00	967.48	100.00	970.99	4
5	100.00	970.99	125.00	975.42	4
6	125.00	975.42	150.00	989.75	2
7	150.00	989.75	175.00	1005.66	3
8	175.00	1005.66	200.00	1026.34	1
9	200.00	1026.34	225.00	1027.00	1
10	175.00	1005.66	225.00	1011.00	3
11	150.00	989.75	225.00	985.00	2
12	125.00	975.42	225.00	976.00	4

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	30.0	0.00	0.0	0
2	135.0	0.0	0.0	32.0	0.00	0.0	0
3	140.0	0.0	0.0	33.0	0.00	0.0	0
4	145.0	0.0	0.0	35.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft. and X = 50.00 ft.

Each Surface Terminates Between X = 175.00 ft. and X = 225.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y =900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

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

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

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	25.00	964.00
2	29.99	963.66
3	34.98	963.41
4	39.98	963.25
5	44.98	963.17
6	49.98	963.19
7	54.98	963.30
8	59.97	963.50
9	64.97	963.78
10	69.95	964.16
11	74.93	964.63
12	79.90	965.18
13	84.86	965.83
14	89.80	966.56
15	94.73	967.39
16	99.65	968.30
17	104.55	969.30
18	109.43	970.39
19	114.29	971.56
20	119.13	972.82
21	123.94	974.17
22	128.73	975.61
23	133.49	977.13





0.00E+00  
32 2.2 0.21E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
33 4.6 0.48E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
34 4.6 0.54E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
35 1.9 0.24E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
36 2.7 0.35E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
37 4.5 0.64E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
38 4.5 0.67E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
39 0.1 0.13E+03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
40 4.3 0.70E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
41 4.4 0.77E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
42 4.3 0.82E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
43 4.3 0.85E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
44 4.2 0.89E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
45 1.5 0.33E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
46 1.9 0.42E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
47 0.7 0.16E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
48 4.1 0.81E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
49 4.1 0.66E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
50 4.0 0.50E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
51 4.0 0.35E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
52 3.9 0.19E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00  
53 2.8 0.42E+03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
0.00E+00

-----  
Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	965.19
2	42.39	964.16
3	47.31	963.26
4	52.25	962.50
5	57.21	961.87
6	62.19	961.38
7	67.18	961.02
8	72.17	960.80
9	77.17	960.71
10	82.17	960.76
11	87.17	960.95
12	92.16	961.27
13	97.14	961.73
14	102.10	962.32
15	107.05	963.05
16	111.97	963.92
17	116.87	964.91
18	121.74	966.04
19	126.58	967.31
20	131.38	968.70
21	136.14	970.23
22	140.86	971.88
23	145.53	973.66
24	150.16	975.57
25	154.72	977.60
26	159.24	979.76
27	163.69	982.03
28	168.07	984.43
29	172.39	986.95
30	176.64	989.59
31	180.82	992.33
32	184.92	995.20
33	188.94	998.17
34	192.88	1001.25
35	196.73	1004.44
36	200.50	1007.73
37	204.17	1011.12
38	207.75	1014.61
39	211.23	1018.20
40	214.62	1021.88
41	217.90	1025.65
42	218.88	1026.84

Circle Center At X = 77.8 ; Y = 1144.2 and Radius, 183.5

\*\*\* 1.606 \*\*\*

## Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	12.50	964.00
2	17.46	963.39
3	22.44	962.88
4	27.42	962.46
5	32.41	962.14
6	37.40	961.91
7	42.40	961.77
8	47.40	961.74
9	52.40	961.79
10	57.40	961.95
11	62.39	962.19
12	67.38	962.53
13	72.36	962.97
14	77.33	963.50
15	82.29	964.13
16	87.24	964.85
17	92.18	965.67
18	97.09	966.58
19	101.99	967.58
20	106.87	968.67
21	111.73	969.86
22	116.56	971.14
23	121.37	972.51
24	126.15	973.98
25	130.90	975.53
26	135.62	977.17
27	140.31	978.91
28	144.97	980.73
29	149.59	982.64
30	154.17	984.64
31	158.72	986.73
32	163.22	988.90
33	167.68	991.16
34	172.10	993.50
35	176.47	995.92
36	180.80	998.43
37	185.07	1001.02
38	189.30	1003.69
39	193.47	1006.44
40	197.60	1009.27

41	201.66	1012.18
42	205.68	1015.17
43	209.63	1018.23
44	213.52	1021.36
45	217.36	1024.57
46	220.00	1026.87

Circle Center At X = 46.9 ; Y = 1224.3 and Radius, 262.6

\*\*\* 1.621 \*\*\*

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	966.38
2	54.71	964.70
3	59.47	963.18
4	64.29	961.84
5	69.15	960.66
6	74.05	959.65
7	78.98	958.82
8	83.93	958.16
9	88.91	957.67
10	93.90	957.36
11	98.90	957.22
12	103.90	957.26
13	108.89	957.48
14	113.88	957.86
15	118.85	958.43
16	123.79	959.16
17	128.71	960.07
18	133.59	961.15
19	138.43	962.41
20	143.22	963.83
21	147.97	965.41
22	152.65	967.17
23	157.27	969.08
24	161.82	971.16
25	166.29	973.39
26	170.68	975.78
27	174.99	978.32
28	179.20	981.02
29	183.32	983.85
30	187.33	986.83

31	191.24	989.95
32	195.04	993.21
33	198.72	996.59
34	202.28	1000.10
35	205.71	1003.74
36	209.01	1007.49
37	212.18	1011.35
38	215.22	1015.33
39	218.11	1019.41
40	220.86	1023.59
41	222.90	1026.94

Circle Center At X = 100.3 ; Y = 1099.9 and Radius, 142.7

\*\*\* 1.657 \*\*\*

1

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	25.00	964.00
2	29.94	963.22
3	34.90	962.56
4	39.87	962.02
5	44.85	961.60
6	49.84	961.30
7	54.84	961.12
8	59.84	961.05
9	64.84	961.11
10	69.83	961.29
11	74.82	961.59
12	79.81	962.00
13	84.78	962.54
14	89.73	963.20
15	94.67	963.97
16	99.59	964.86
17	104.49	965.87
18	109.36	967.00
19	114.20	968.24
20	119.02	969.60
21	123.79	971.08
22	128.53	972.67
23	133.24	974.37
24	137.89	976.18

25	142.51	978.11
26	147.08	980.15
27	151.59	982.29
28	156.06	984.54
29	160.47	986.90
30	164.82	989.37
31	169.11	991.93
32	173.33	994.60
33	177.50	997.37
34	181.59	1000.24
35	185.62	1003.21
36	189.57	1006.27
37	193.45	1009.43
38	197.25	1012.68
39	200.97	1016.01
40	204.61	1019.44
41	208.17	1022.95
42	211.64	1026.55
43	211.73	1026.65

Circle Center At X = 59.9 ; Y = 1169.5 and Radius, 208.4

\*\*\* 1.713 \*\*\*

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	965.19
2	42.22	963.54
3	46.99	962.05
4	51.81	960.71
5	56.67	959.51
6	61.56	958.48
7	66.48	957.59
8	71.42	956.87
9	76.39	956.30
10	81.37	955.88
11	86.37	955.63
12	91.37	955.53
13	96.37	955.59
14	101.36	955.81
15	106.35	956.18
16	111.32	956.71
17	116.27	957.40

18	121.20	958.25
19	126.10	959.25
20	130.96	960.40
21	135.79	961.71
22	140.57	963.16
23	145.31	964.77
24	149.99	966.53
25	154.61	968.44
26	159.17	970.48
27	163.67	972.68
28	168.09	975.01
29	172.43	977.48
30	176.70	980.09
31	180.88	982.83
32	184.98	985.70
33	188.98	988.70
34	192.88	991.82
35	196.69	995.07
36	200.38	998.43
37	203.98	1001.91
38	207.46	1005.50
39	210.82	1009.20
40	214.07	1013.00
41	217.19	1016.91
42	220.19	1020.91
43	223.06	1025.00
44	224.36	1026.98

Circle Center At X = 92.0 ; Y = 1113.9 and Radius, 158.4

\*\*\* 1.763 \*\*\*

1

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	966.38
2	54.48	964.15
3	59.05	962.13
4	63.71	960.31
5	68.44	958.69
6	73.24	957.29
7	78.09	956.10
8	83.00	955.13

9	87.94	954.37
10	92.91	953.84
11	97.90	953.52
12	102.90	953.43
13	107.90	953.56
14	112.89	953.90
15	117.85	954.47
16	122.79	955.26
17	127.69	956.27
18	132.54	957.49
19	137.33	958.92
20	142.05	960.57
21	146.69	962.42
22	151.25	964.47
23	155.71	966.73
24	160.07	969.18
25	164.32	971.82
26	168.44	974.65
27	172.44	977.65
28	176.30	980.83
29	180.01	984.18
30	183.57	987.69
31	186.98	991.35
32	190.21	995.16
33	193.28	999.11
34	196.17	1003.19
35	198.87	1007.40
36	201.39	1011.72
37	203.71	1016.15
38	205.84	1020.67
39	207.76	1025.29
40	208.22	1026.56

Circle Center At X = 102.5 ; Y = 1066.4 and Radius, 113.0

\*\*\* 1.784 \*\*\*

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	966.38
2	54.45	964.10
3	58.99	962.00
4	63.61	960.08

5	68.30	958.35
6	73.05	956.81
7	77.87	955.45
8	82.73	954.29
9	87.63	953.32
10	92.57	952.55
11	97.54	951.97
12	102.53	951.60
13	107.52	951.42
14	112.52	951.44
15	117.52	951.65
16	122.50	952.07
17	127.46	952.68
18	132.40	953.50
19	137.29	954.50
20	142.15	955.70
21	146.95	957.09
22	151.69	958.68
23	156.37	960.45
24	160.97	962.40
25	165.49	964.53
26	169.93	966.85
27	174.26	969.33
28	178.50	971.99
29	182.63	974.82
30	186.64	977.80
31	190.53	980.94
32	194.29	984.24
33	197.91	987.68
34	201.40	991.26
35	204.74	994.98
36	207.93	998.83
37	210.97	1002.80
38	213.85	1006.89
39	216.56	1011.09
40	219.10	1015.40
41	221.47	1019.80
42	223.66	1024.30
43	224.85	1027.00

Circle Center At X = 109.5 ; Y = 1077.2 and Radius, 125.8

\*\*\* 1.806 \*\*\*

Point No.	X-Surf ft.	Y-Surf ft.
1	12.50	964.00
2	17.26	962.48
3	22.07	961.09
4	26.90	959.83
5	31.77	958.69
6	36.67	957.68
7	41.59	956.81
8	46.54	956.06
9	51.50	955.45
10	56.48	954.97
11	61.47	954.62
12	66.46	954.41
13	71.46	954.32
14	76.46	954.37
15	81.46	954.55
16	86.45	954.87
17	91.43	955.31
18	96.39	955.89
19	101.34	956.60
20	106.27	957.44
21	111.18	958.41
22	116.05	959.52
23	120.90	960.75
24	125.71	962.10
25	130.49	963.59
26	135.22	965.20
27	139.91	966.94
28	144.55	968.80
29	149.14	970.78
30	153.67	972.89
31	158.15	975.11
32	162.57	977.45
33	166.92	979.91
34	171.21	982.48
35	175.43	985.17
36	179.57	987.96
37	183.64	990.87
38	187.63	993.88
39	191.54	997.00
40	195.37	1000.22
41	199.11	1003.54
42	202.75	1006.96
43	206.31	1010.47
44	209.77	1014.08
45	213.14	1017.78
46	216.41	1021.56

47	219.57	1025.44
48	220.69	1026.89

Circle Center At X = 72.1 ; Y = 1142.7 and Radius, 188.4

\*\*\* 1.951 \*\*\*

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	37.50	965.19
2	42.01	963.03
3	46.60	961.05
4	51.27	959.27
5	56.02	957.68
6	60.82	956.30
7	65.68	955.11
8	70.58	954.13
9	75.52	953.35
10	80.48	952.77
11	85.47	952.40
12	90.47	952.25
13	95.47	952.29
14	100.46	952.55
15	105.44	953.01
16	110.39	953.68
17	115.32	954.56
18	120.20	955.64
19	125.03	956.92
20	129.81	958.40
21	134.52	960.07
22	139.16	961.94
23	143.71	964.01
24	148.18	966.26
25	152.54	968.69
26	156.81	971.30
27	160.96	974.09
28	164.99	977.05
29	168.89	980.17
30	172.67	983.45
31	176.30	986.89
32	179.78	990.47
33	183.12	994.20
34	186.30	998.06



# **SLOPE MAINTENANCE MANUAL**

## Hartland Quarry Slope Observations and Maintenance Manual

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Project Name: Hartland Quarry

Project Number: L23-043

Date: October 3<sup>rd</sup>, 2023      Time: 7:30 am

Present at site: InSite landscape Design -Michael Davis,

General:

During the site visit on the morning of the 3<sup>rd</sup>, several observations were made.

1. While conducting field observations, initially the entire rim of the quarry was walked and visually inspected, and in general, at the top of slope, there are very few places where it is completely bare and exposed. And of those unvegetated slopes, it was noticed to contain a great deal of aggregate at the surface. The overall site has heavy, dense diverse mix of overall cover. It contains trees, understory shrubs and ground cover plant material.





2. Some of the plant material observed:

- |  |   |
|--|---|
| ○ <i>Celtis occidentalis</i>             | ○ <i>Aronia melanocarpa</i> var. <i>elata</i> |
| ○ <i>Juglans nigra</i>                   | ○ <i>Ceanothus americanus</i>                 |
| ○ <i>Ostrya virginiana</i>               | ○ <i>Diervilla lonicera</i>                   |
| ○ <i>Populus deltoides</i>               | ○ <i>Rhus glabra</i>                          |
| ○ <i>Malus ioensis</i>                   | ○ <i>Rubus occidentalis</i>                   |
| ○ <i>Prunus serotina</i>                 | ○ <i>Vaccinium angustifolium</i>              |
| ○ <i>Betula alleghaniensis</i>           |   |
| ○ <i>Alnus incana</i> var. <i>rugosa</i> | ○ <i>Schizachyrium scoparium</i>              |
| ○ <i>Juglans cinerea</i>                 | ○ <i>Andropogon gerardii</i>                  |
| ○ <i>Prunus virginiana</i>               | ○ <i>Agastache foeniculum</i>                 |
|  | ○ <i>Silphium laciniatum</i>                  |
| ○ <i>Pinus strobus</i>                   | ○ <i>Rudbeckia subtomentosa</i>               |
| ○ <i>Thuja occidentalis</i>              | ○ <i>Lupinus perennis</i>                     |
| ○ <i>Pinus banksiana</i>                 | ○ <i>Anemone canadensis</i>                   |
| ○ <i>Picea glauca</i>                    | ○ <i>Fragaria virginiana</i>                  |

3. While conducting field observations at the rim of the quarry there appeared to be no real glaring evidence of active erosion trenches or ditches was discovered on the quarry site. Erosion ditches are created when (a lot of) water meets relatively loose moraine material, gravel and/or soil. The water entrains this material: First an erosion groove is formed, then an erosion gully and then an erosion ditch. It is important to maintain the dense plant material at the rim or top of the slope of the site.
4. While conducting field observations at the bottom of the slopes there did not appear to be evidence to concentrated debris and sediment transportation of an active erosion ditch from the slopes above, leaving a pile of sediment or wash out on the quarry floor.

The following are more specific observations of 4 potential areas of concern.

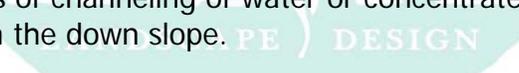
<b>Project:</b> Hartland Quarry Apartments		<b>Client:</b> Three Leaf Partners	<b>Project No.:</b> 7708
<b>Photo No.</b> 1	<b>Date</b> 9-7-23		
<b>Description:</b> Erosion area along Palmer Drive.			

While conducting field observations at the slope identified in aerial photo #1 was observed to show no real signs of slope erosion, landslide, and instability in loess; instead, there was dense multilayer vegetation and large pieces of stone and a piece of equipment.



<b>Photo No.</b> 2	<b>Date</b> 9-7-23	
<b>Description:</b> Erosion area near the neighboring barn.		

While conducting field observations at the slope identified in aerial photo #2. This adjacent to the Jackson property at 431 Street. Prior to inspecting we obtained permission to walk the top of the slope on Mrs. Jackson's property. Among the things observed was that there is a storm drain outfall from Hill Street that is one of the reasons for the base spot in this area. It was observed to show no real signs of slope erosion that would need to be addressed at this time as is not causing, instability in loess or a landslide. In other areas there were signs of plant material lost and a few fallen trees which could indicate some erosion, but no significant signs of channeling of water or concentrated flow that would indicate the start of a groove in the down slope.



<b>Project:</b> Hartland Quarry Apartments		<b>Client:</b> Three Leaf Partners	<b>Project No.:</b> 7708
<b>Photo No.</b> 3	<b>Date</b> 9-7-23		
<b>Description:</b> Erosion area near the North Point Church Cemetery.			

While conducting field observations at the slope identified in aerial photo #3. This area of concern is adjacent to the North Point Church off of Capitol Drive. It was observed to show some areas of bare ground with empty patches lacking vegetation. There was an abundance of exposed aggregate ranging from small pebble size to larger boulders being exposed. The aggregate appears to be helping hold the slope together and preventing erosion. No real signs of slope erosion, landslide, and instability in loess.

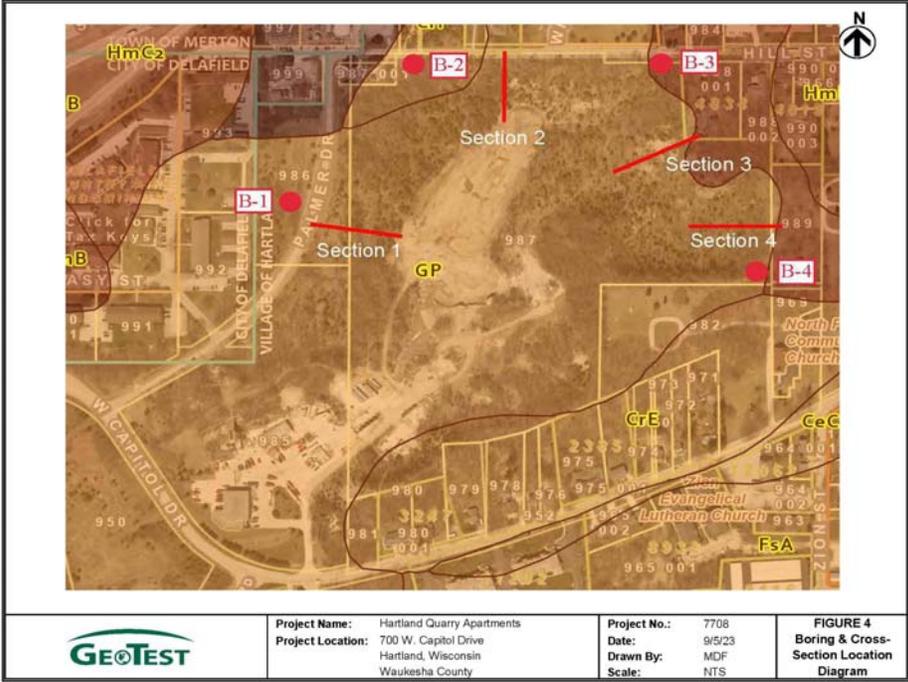


<b>Photo No.</b> 4	<b>Date</b> 9-7-23	
<b>Description:</b>  <b>Erosion area north of the industrial area.</b>		

While conducting field observations at the slope identified in aerial photo #4. This area of concern is located on the north western part of the parcel off of Palmer Drive, south of photo #1. It was observed to show some areas of bare ground with empty patches lacking vegetation. There was an abundance of exposed aggregate ranging from small pebble size to larger cobble sized rocks. The areas are noticeable and larger but the slope is holding itself together and there is not real evidence of erosion or slope instability.



Another section that was inspected (#5) while conducting field observations was approximately the midpoint of the norther parcel boundary along Hill Street. (approximately near the label Section 2 on the figure 4 diagram below) There is very little room at the top of slope and the guardrail along Hill Street. Also, there are several wind fall trees which could indicate erosion. But upon closer inspection there is really not much evidence of slope erosion or instability. Consistence with other areas, there was dense multilayer vegetation.



All of these areas should be inspected on a routine with a written and photographic report. It is recommended that it be done annually after the winter melt and spring rains.



NO.	REVISION DESCRIPTION	DATE



**HARTLAND APARTMENTS**  
 700 W. CAPITOL DRIVE  
 HARTLAND, WI  
**THREE LEAF PARTNERS**  
 504 W. JUNEAU AVE  
 MILWAUKEE, WI 53202

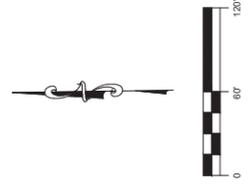
**SLOPE MAINTENANCE & INSPECTION PLAN**

**SHEET TITLE**

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 Checked: CJD  
 2023/09/28  
 P&ID Project No: 490686  
 Sheet No: 1

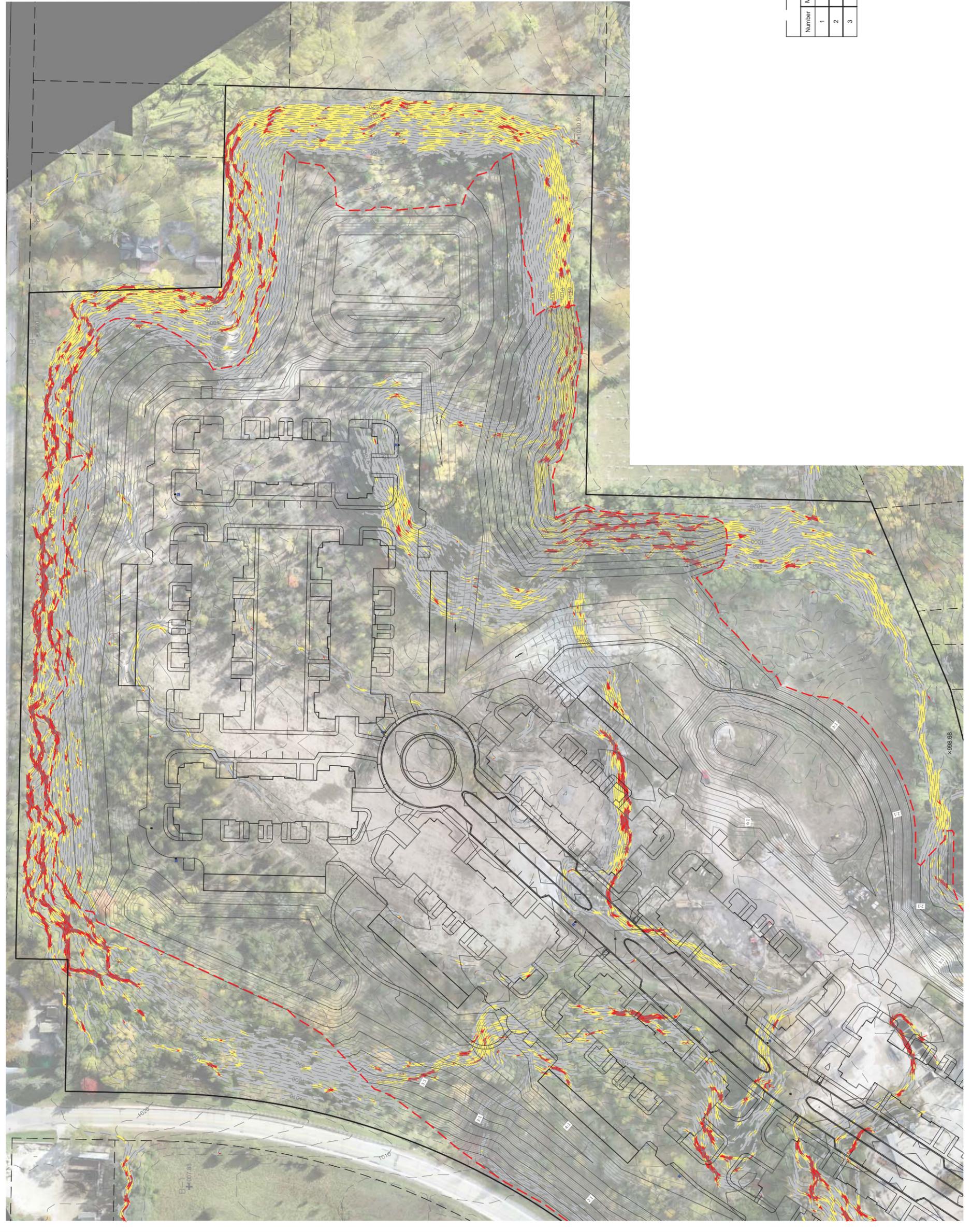
**PRELIMINARY  
 NOT FOR  
 CONSTRUCTION**



Slopes Table

Number	Minimum Slope	Maximum Slope	Color
1	40.00%	66.67%	Grey
2	66.67%	100.00%	Yellow
3	100.00%	100000.00%	Red

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 Milwaukee Area (414) 259-1181  
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In the event that active erosion trenches or ditches are discovered on the quarry site there are several strategies to implement base on what type of erosion and where it is

How to stop erosion and protect/restore eroded land

Bare spots are often caused by inadequate growing conditions or by runoff washing away topsoil. In either case, once the protective vegetative cover is gone, erosion can occur. The best solution will often be done by a multiple pronged approach.

### 1. Replant Vegetation Suited to Site Conditions

Well-established vegetation can stabilize the soil. When an area is replanted choose plants that are adapted to the conditions of the site, both in terms of moisture and sun or shade levels. If the plants cannot take root and spread, your erosion problems will not be solved. On slopes with a grade that exceeds 3:1, a non-grass low-maintenance vegetation should be considered.

#### Understory groundcovers for shaded areas

wild ginger,  
Lamiastrum (especially Herman's Pride),  
pachysandra,  
vinca  
sweet woodruff  
Bunchberry  
Goldenstar.  
Trailing Periwinkle  
Moneywort  
Deadnettle  
variegated yellow archangel  
Matteuccia struthiopteris

#### Understory groundcovers for sunny areas

Creeping Thyme  
Yellow Alyssum  
Ice Plant  
Creeping Juniper  
Eurybia macrophylla  
Anemone canadensis  
Phlox sublate  
Rhus aromatica  
Rudbeckia laciniata  
Eurybia macrophylla  
Eupatorium coelestinum  
Chasmanthium latifolium

#### Woody Shrubs

#### Woody Shrubs

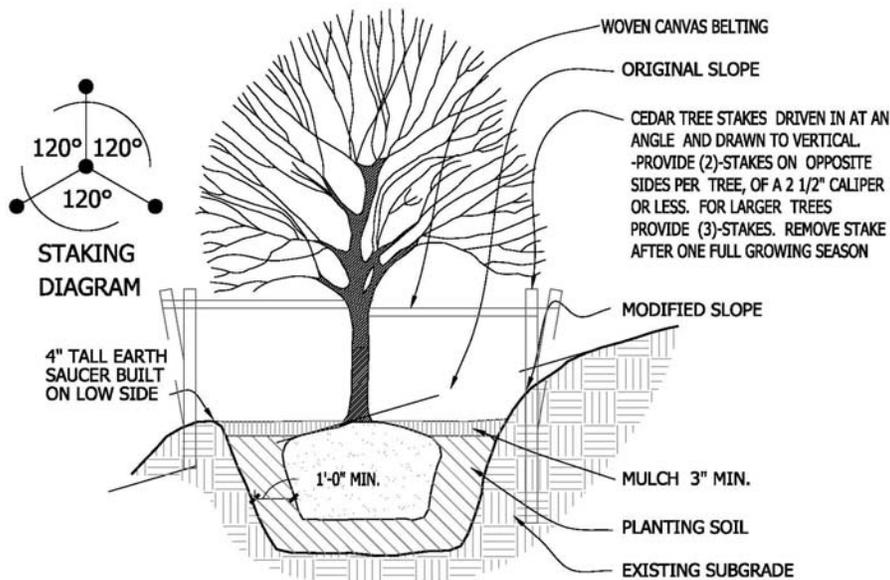
#### Woody Shrubs

Aronia arbutifolia,  
Clethra alnifolia  
Cotoneaster lacteus  
Cotoneaster horizontalis  
Forsythia  
Physocarpus opulifolius,  
Rosa carolina  
Rhus typhina  
Sambucus canadensis,  
Sorbaria sorbifolia  
Stephanandra incisa 'Crispa'  
Symphoricarpos orbiculatus  
Vaccinium angustifolium  
Viburnum dentatum  
Viburnum cassinoides  
Juniperus horizontalis

Trees

Acer glabrum  
Acer macrophyllum  
Alnus rhombifolia  
Alnus rubra  
Platanus occidentalis  
Pseudotsuga menziesii  
Salix nigra  
Taxodium distichum

Crataegus douglasii  
Gleditsia triacanthos f. inermis  
Juniperus virginiana  
Malus fusca  
  
Prunus Virginiana  
  
Thuja plicata



**1** **SLOPE PLANTING DETAIL**  
REFER TO TYPICAL DECIDUOUS TREE DETAIL FOR STAKING SCALE: NONE

2. Terraces

Terraces can be implemented along the contour of the slope (intersecting the flow path). Shorter terraces in series are more effective than higher terraces.

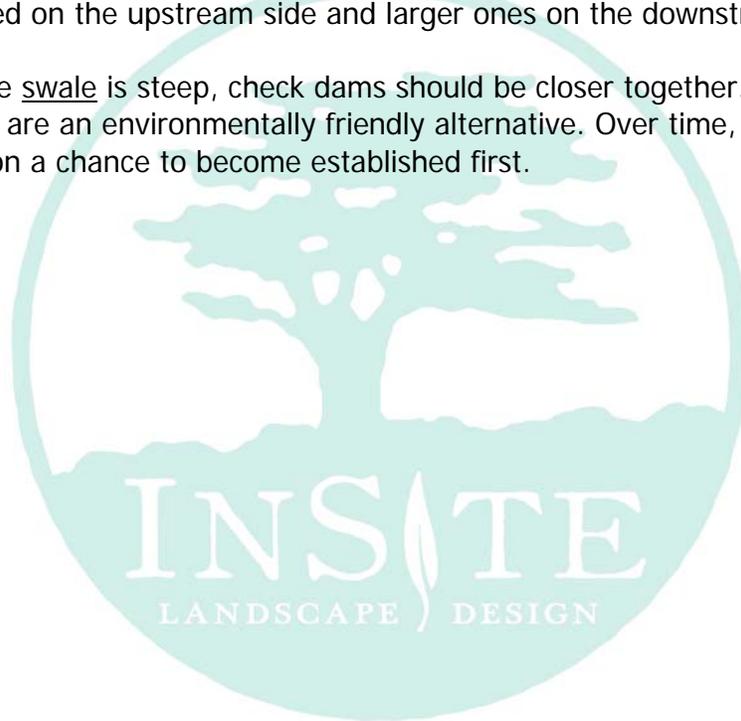
A variety of landscaping materials including coir fiber biologs, stone aggregate or wood can be used to create terraces. In the case of inspection area #5 previously mentioned. The tree windfall stacked up at the top of the slope were dissipating the waters energy as it flowed over the crest and protected the slope.

It is important to have a good drainage system (gravel or gravel with perforated pipes) installed behind your terrace retaining wall. Please note that 3:1 or steeper slopes may call for the use of tiered walls, which requires professional engineering and a building permit.

### 3. Build Check Dams

If erosion is occurring within an erosion ditch, channel, or a narrow flow path, a series of check dams can slow down surface runoff. Check dams can be built by arranging a pile of stones a few inches high across the flow path or using coir fiber biologs.

- Arrange the pile so that the lowest elevation at the top of the stones is at the center and both ends are highest.
- The stones should be large enough that they will not be displaced during heavy flows. Finer stones should be placed on the upstream side and larger ones on the downstream end of the check dam.
- If the slope of the swale is steep, check dams should be closer together.
- Coir fiber biologs are an environmentally friendly alternative. Over time, they will break down, giving vegetation a chance to become established first.



March 26<sup>th</sup>, 2024

**RE: PRAIRIE SEED MIX INSTALLATION AND MAINTENANCE**

**Project No.: L23-043 Hartland Quarry**

Installing, restoring and maintaining native plant communities and creating attractive, dynamic landscapes using native plants is a challenging and fun pursuit. However, to successfully achieve project goals, many variables must be understood and considered.

The successful establishment of native plant communities' rests on six major factors:

1. selection of a suitable site
2. appropriate materials selection
3. appropriate site preparation
4. proper installation technique
5. post-installation site management
6. time

During the first 6 to 12 months of a seeding project, it may be difficult to differentiate between the germinated native seed and undesirable weeds. Although some of the wildflower and grass species will be recognizable within the first year, it may take a few growing seasons for the native plant community to mature and fully establish not unlike other plant material.

**Management of Native Plant Communities**

For optimal establishment, a newly seeded prairie should receive the equivalent of one inch of water per week for the first 2 to 4 weeks, either via rainfall or irrigation. On small sites, watering is always beneficial, especially during extended dry periods while seeds are germinating and plants are becoming established.

Do not pull weeds while seed is germinating and seedlings are establishing or desirable plants may be uprooted with the weeds. Weeds also provide fuel for burning during the first few years of prairie establishment, if burning is allowed by your municipality and is feasible.

Controlled burns are one of the most effective prairie management tools. Burning is essential to the long-term maintenance of your prairie. Burns should be conducted only by experienced persons who are properly equipped and trained in fire management techniques and safety. Controlled burns in urban/populated areas can be inherently tricky and may not be allowed. Coupled with the severe slopes of the quarry edge may make it impractical, treacherous and hazardous to burn.

If allowed and feasible, conduct controlled burns from mid-October through April if allowed by the community.

Burn the prairie annually for the first two to three years and every fifth year thereafter is possible. If there is insufficient growth to sustain a good, fruitful burn, the burn can be delayed until the second year.

Large sites should be divided into sections and only one section burned each year. This enhances prairie diversity, leaves habitat undisturbed and promotes a safer, more easily controlled burn.

If burning is not practical or allowed, mowing may be substituted. Mow in late fall annually the first three years and every third year thereafter. (Where feasible, mowing of the severe slopes of the quarry edge more than likely will make mowing impractical, treacherous and hazardous). Exotic, invasive species may need to be aggressively managed with the appropriate herbicides.

Although native plants require the same care and attention as non-native, cultivated varieties in the first few growing seasons, once established, native plants should survive and thrive for many years with little maintenance.

### **Prairie Seed Installation Recommendations**

Optimum seeding time:

October 1 (fall) to May 15 (late spring)

(Seeding can be done outside of this window but establishment may take longer. Do not seed during the summer when soil moisture and rainfall may be limited.)

### **Seedbed preparation:**

Existing vegetative growth should be removed or killed with herbicides. Surface till the seedbed to a depth of two to four inches. If the ground is wet, delay tilling until the soil dries enough to break apart when tilled. Lightly compact the tilled soil with a roller, cultipacker or similar implement. Tilling can usually be omitted if using a no-till seed drill.

### **Sowing seed:**

Sow seed by hand or with a broadcaster and press into the soil with a roller, cultipacker or similar equipment. Do not cover seed more than ¼" deep. If not already included in the seed mix, plant a cover crop of seed oats at 32 pounds per acre and annual ryegrass at 10 pounds per acre with the seed. If using a no-till seed drill, follow the manufacturer's recommendations, being careful not to cover the seed more than ¼" deep. A one-inch thick mulch layer of crimped straw is recommended on erosion-prone areas.

### **Wetland Seed Installation Recommendations**

Optimum seeding time:

October 1 (fall) to May 15 (late spring)

(Seeding can be done outside of this window but establishment may take longer. Do not seed during the summer when soil moisture and rainfall may be limited.)

Before you plant, be sure surrounding soils are stabilized and cannot erode into the wetland. If the slopes are newly constructed and exposed, the germination and growth of wetland seeds can be severely inhibited by siltation, sedimentation and cloudy water.

Vegetation on surrounding slopes is the best protection from erosion damage. A quick growing cover crop such as oats, annual Ryegrass or turfgrasses is acceptable, but seeding of permanent native species is advised for optimal long- term stabilization and natural appeal.

Other controls such as silt fences, erosion control blankets, straw mulches and straw bale dams should be installed as required to protect your wetland. The type of soil substrate is important to planting success. A heavy clay substrate is not conducive to seed germination and growth. You should consider incorporating topsoil, peat, compost or black dirt into the substrate before planting if your soil is heavy or nutrient-poor.

Make sure required permits (if any) have been obtained.

### **If wetland is temporarily dry:**

Successful planting can be accomplished by planting when the wetland is dry. If the wetland has not naturally dried down then pumping out the water or using outlet water controls (if available) may be appropriate. Remember to obtain any required permits.

Scarify the soil surface by shallow tilling or raking.

Seed that is packaged we should be sown in the lower elevations of the wetland where water levels will be deeper. Dry-packaged seed should be sown on the higher elevations but can overlap into the wet-seed areas.

Press seed firmly into the soil using a roller, cultipacker or similar equipment. Very light raking is an acceptable alternative, but be careful to not cover seed more than ¼" deep.

Restore water level or wait for normal rainfall to bring water level up after seeding. If feasible, use outlet controls to maintain water level depths between ½" and 6" until seed germinates and wetland vegetation is well established.

### **If wetland is wet:**

In instances where water level control is not possible, satisfactory results may be obtained by following the techniques listed below.

Sow wet packaged seed into 4"-6" of standing water. Mixing seed with damp clay balls aids in distribution and anchoring of seed in desired locations.

Rake or till lightly an area 6" – 10" above waterline elevation (actual seeding area along shore will vary with degree of shoreline slope) If undesirable weed growth is present, mow or kill before tilling.

### **Winter sowing:**

Successful planting can also be accomplished from winter seeding. Sow wet and dry- packaged seed in the zones as described above directly on bare ground during a winter thaw or on old, frozen snow (do not apply to loose, newly-fallen snow due to the potential for wind loss). Normal freezing and thawing will create openings in the ground, allowing the seed to work its way naturally into the soil. The seed will be in place to germinate when conditions are right in the spring.

### **Natural Area Maintenance**

Natural areas are dynamic systems, and a maintenance and management plan require flexibility in order to accommodate the development of the site. Native plants tend to germinate and develop at a slower rate than ornamental perennials or turf grass. Regular maintenance during

the native plant establishment period, usually three to five years, greatly improves the success of the project.

The maintenance of the natural areas can include:

- Exotic & Invasive Species Control
- Over-Seeding Supplemental Planting Regular Site Inspections Water Control & Irrigation

Species such as Canada thistle, cattails, reed canary grass, common reed and purple loosestrife are invasive weeds which establish quickly in a newly disturbed area. Upon establishment, these species spread exponentially to nuisance levels, crowding out other desirable plants and reducing the overall diversity and aesthetics of a site. A focused and dedicated maintenance program will reduce the competition from weed species, allowing desirable native plants to develop.

It is recommended that natural area managers that are well versed in principles of restoration ecology and the techniques used in site management strategies such as:

- Mowing (Where feasible, mowing of the severe slopes of the quarry edge more than likely will make mowing impractical, treacherous and hazardous)
- Chemical Application
- Prescribed Burning Hand-Weeding (Controlled burns of the severe slopes of the quarry edge more than likely will make a controlled burn impractical, treacherous and hazardous). Controlled burns of the severe slopes of the quarry edge more than likely will make a controlled burn impractical, treacherous and hazardous. Burning in a urban/residential setting may add the hazard cause this maintenance practice prohibited.
- Over-Seeding
- Supplemental Replanting

### **Native Vegetated Mat (NVM) Installation Guidelines**

#### Site Assessment and Suitability Requirements:

Match the Native Vegetated Mat species to the eco-region, hydrology, soil type and sunlight conditions present on site.

Select the appropriate core material for NVM.

- Degradable Core - A degradable "coir" core may be used for most installations including areas where burning will be required, low scour (hydraulic energy) exists or due to permitting restrictions.
- Non-Degradable Core (geosynthetic) - Use a "non woven needle- punched UV stabilized polypropylene fabric" core in areas that have high scour rates (high shear forces), wave energy (hydraulic piping), suppression of weed bank or other difficult conditions.

Choose a mat for areas where; unstable soil conditions exist and mechanically stabilized earth (MSE) is required such as the Envirolok System, and or the encapsulation of growing media is required and rip rap or green armor of soil surface is required.

### Preparation:

Eliminate surface and subsurface compaction to allow rapid deep root development of natives. Eliminate all existing unwanted vegetation! Use a non-selective non-persisting herbicide like glyphosate or repeated mechanical weed control cultivations or smothering techniques. Eliminate surface roughness (clods, small tree stumps, etc.) to prevent root pruning from air gaps. Amend soil with clean compost or other media and mix into surface to decrease transitional rooting time into existing soil.

### Transportation:

Native Vegetated Mat must be kept cool and moist during transportation to avoid root hair pruning (dry back). A refrigerated air ride truck may be necessary for long hauls. A tarped truck or trailer can be sufficient for short hauls.

### Installation:

Handle the Native Vegetated Mat with care to minimize root and vegetative damage. Keep the material moist and cool at all times at the install site.

Install NVM within 48 hours of being loaded onto the truck.

Install NVM seams tightly to prevent edge dry back.

Tuck the edges of NVM into the ground by cutting a lip into the soil with a spade.

Lay Native Vegetated Mat so that the ends of the pieces do not line up with the adjoining row, but create a staggered pattern. If using a non-degradable core NVM in a hydraulic application, install the NVM in a shingle like layout to prevent a breach of the material layers.

If the NVM is in or near the water the leading edge should be check slotted into the lake or stream bed.

Stone may also be needed to secure the toe NVM and/or break up the hydraulic energy to help protect the vegetation.

Anchor the NVM with wood stakes, landscape staples, j-hooked rebar or earth anchors to prevent the NVM from moving, slipping down-slope or floating in a hydraulic application. The number and type of stakes will be site dependent.

### Irrigation:

Water the Native Vegetated Mat as soon as possible after installation. If soil is excessively dry pre water site or water as NVM is laid. Wetting hot exposed soil will also reduce heat injury to perishable prairie root hairs. Initially soak soil the NVM to a nearly saturated condition. Water every day for the first 5 to 7 days. Plan for at least 1" per week. For 2 to 4 weeks after installation for establishment, water to a wet condition and let dry back making the roots grow deeper for moisture.

### Maintenance:

Watering - High quality Native Vegetated Mat will require very little maintenance once rooted. In extreme conditions such as a drought, the NVM may have to be watered after the 4 week period. It may take a few growing seasons for the prairie roots to their full rooting potential.

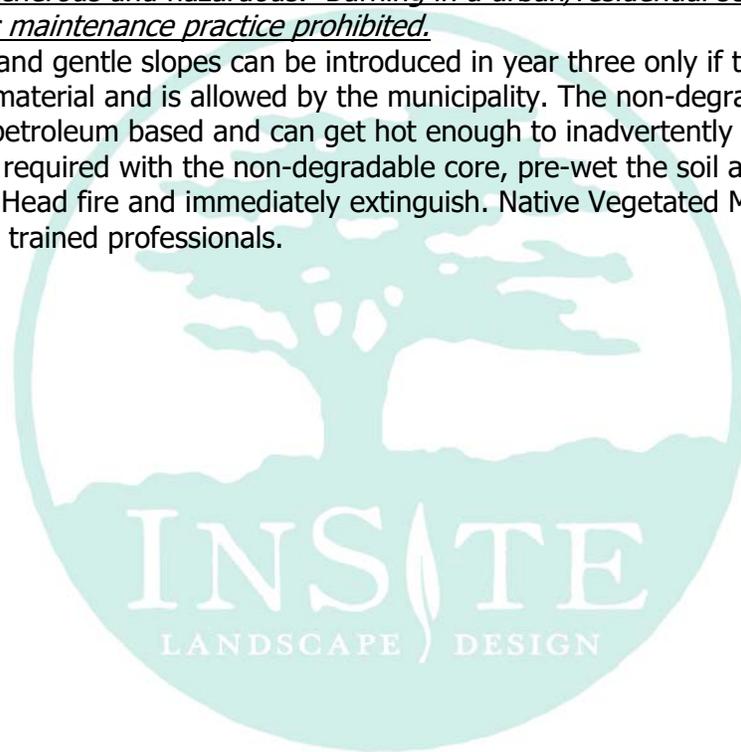
### Weed Control

The thick nature of Native Vegetated Mat coupled with the soil-less, weed free growing media will help prevent much of the weed seed bank from growing through. Eliminating all pre-existing perennial vegetation prior to installation will further reduce long term maintenance needs. If wind borne weeds are introduced to the site, simply hand weed or selectively use glyphosate herbicide. Do not spray weedy plants as the drift could eliminate other plants creating holes in the desirable vegetation.

### Burning

*Controlled burns of the severe slopes of the quarry edge more than likely will make a controlled burn impractical, treacherous and hazardous. Burning in a urban/residential setting may add the hazard cause this maintenance practice prohibited.*

Burning of flat areas and gentle slopes can be introduced in year three only if the NVM contains the degradable core material and is allowed by the municipality. The non-degradable, geosynthetic core is petroleum based and can get hot enough to inadvertently kill the crown of the plants. If a fire is required with the non-degradable core, pre-wet the soil and let the "one hour fuels" dry back. Head fire and immediately extinguish. Native Vegetated Mat burns should only be conducted by trained professionals.





# Reinders Grass Seed

## DELUXE 50 LAWN SEED MIX

### SEED TECHNOLOGY SHEET

#### Description

Reinders Deluxe 50 Lawn Seed Mix is formulated for areas where a predominant bluegrass turf is desired, yet where minimum maintenance is desired. Deluxe 50 will persist on non-irrigated sites that have wide variations in environmental conditions. Replicator and Fiesta 4 Perennial Ryegrass provide a quick ground cover and soil stabilization with quality and disease resistance that is vastly superior to unimproved perennial ryegrasses. The sod quality Kentucky Bluegrass and the named variety of Kentucky Bluegrass produce a well-knit sod and withstand moderately heavy traffic. Creeping Red Fescue provides shade tolerance, low fertility persistence and drought tolerance and disease resistance. This mixture combines good quality turf and long-term persistence with moderate maintenance requirements.

#### Formula

20% Kentucky Bluegrass (Sod Quality)  
15% Newport Kentucky Bluegrass  
15% SR 2100 Kentucky Bluegrass  
25% Creeping Red Fescue  
15% Replicator Perennial Ryegrass  
10% Fiesta 4 Perennial Ryegrass

#### Recommended Seeding Rate

New seeding    Rotary or Drop Spreader  
150-200 lbs/acre  
Overseeding Slicer/ seeder  
20% - 50% existing cover - 100-125 lbs/acre  
50%-75% existing cover – 75 – 100 lbs/acre  
Seeding Depth: 1/8" to 1/2"

#### Recommended Use

Deluxe 50 is designed for new seeding of large areas where initial cost must be kept low and where elite Bluegrass cultivars are not required. Major areas of use will include school grounds, parks, cemeteries, golf course roughs, home lawns, institutional grounds, and utility turf areas. Deluxe 50 is suited for sunny or shady areas and thrives in many different soil types.

#### Recommended Maintenance

Deluxe 50 will achieve adequate density and a medium dark green color with two to three fertilizations per season. It will do well under lower fertility programs, but to achieve a higher quality turf an increased fertility program is needed. A mowing height of 2 to 3 inches is recommended for maximum drought tolerance and weed resistance. This mixture should not be mowed below 1 1/2 inches.

Find a store location at [www.reinders.com](http://www.reinders.com) or call 800-785-3301



# Reinders Grass Seed

## REINDERS NO MOW / LOW GROW SEED MIX

### SEED TECHNOLOGY SHEET

#### Description

Reinders No Mow / Low Grow Seed Mix is a new blend developed for hard to mow areas or those areas where minimal up keep is desirable. Composed of Spartan II Hard Fescue, Quatro Sheep Fescue and TXR Annual Rye Grass, this blend needs to be irrigated only during germination (7 to 10 days), with a small amount of fertilizer at seeding. After it is established, it will require no fertilizer or irrigation. If unmowed, grass will grow to about a foot in height and bend over. If mowed, it should be cut at four inches occasionally. If unmowed, wild flowers could be seeded at the rate of  $\frac{1}{4}$  to  $\frac{1}{2}$  per 2500 square foot area (4 to 6 pounds per acre).

Spartan II hard fescue comprises 45% of this mix. Spartan II is a tough, vigorous and hardy variety that has good drought tolerance, excellent shade tolerance, and excellent cold tolerance. Spartan II is dark colored and fine-textured and will germinate in seven to ten days at soil temperatures over 65 degrees. Quatro sheep fescue has a very fine leaf texture and moderately dark blue-green color. It is outstanding for its low maintenance needs and slow growth rates. TXR Annual Ryegrass is a superior cultivar, which is quick starting with a slow rate of growth, but provides high turf quality and acts as a nursegrass for quick establishment.

#### Formula

45% Spartan II Hard Fescue  
40% Quatro Sheep Fescue  
15% TXR Annual Ryegrass

#### Recommended Seeding Rate

4 – 6 pounds per 1000 square feet  
175 / 250 pounds per acre

#### Recommended Use

No Mow / Low Grow Seed Mix is ideal for areas that will not be mowed regularly and will not need any special irrigation or fertilizer.

#### Recommended Maintenance

Mow once a year (spring) and it will grow to a height of 12 inches, then droop over. A small amount of fertilizer should be applied at seeding, and it should be watered until it has germinated. Cut at a height of four inches.

Find a store location at [www.reinders.com](http://www.reinders.com) or call 800-785-3301

## Specialty Seed Mixes



Well Field Seeding



Stream Bank Stabilization



*Sorghastrum nutans*, Indian Grass

For current pricing, availability, and information on our full installation and management services, visit [cardnonativeplantnursery.com](http://cardnonativeplantnursery.com)

## Slope Stabilization

This grass and sedge mix is best suited for sites with slopes where erosion control is needed. Applications include embankments, dams, and levees. Use this mix in conjunction with erosion control materials for best results. This seed mix includes 7 of 8 native permanent grass and sedge species. Apply at 59.5 PLS pounds per acre.

Botanical Name	Common Name	PLS Oz/Acre
<b>Permanent Grasses/Sedges</b>		
<i>Andropogon gerardii</i>	Big Bluestem	48.00
<i>Bouteloua curtipendula</i>	Side-Oats Grama	16.00
<i>Carex spp.</i>	Prairie Sedge Species	4.00
<i>Elymus canadensis</i>	Canada Wild Rye	32.00
<i>Elymus virginicus</i>	Virginia Wild Rye	24.00
<i>Panicum virgatum</i>	Switch Grass	12.00
<i>Schizachyrium scoparium</i>	Little Bluestem	32.00
<i>Sorghastrum nutans</i>	Indian Grass	32.00
	<b>Total</b>	<b>200.00</b>
<b>Temporary Cover</b>		
<i>Avena sativa</i>	Common Oat	512.00
<i>Lolium multiflorum</i>	Annual Rye	240.00
	<b>Total</b>	<b>752.00</b>



### Add a pollinator enhancement

To add a pollinator enhancement to the Slope Stabilization seed mix add our Native Wildflower seed mix (page 20) at a rate of 1/4 acre of Native Wildflower to 1 acre of the Slope Stabilization Seed Mix.

## Promote your organization | Promote native pollinators

Is your organization looking for a unique way to stand out? Build a promotional seed packet! Cardno's Native Plant Nursery can build promotional seed packets customized with your organization's logo and contact information. Cardno's seed packets make great handouts and conversation starters at conferences, tradeshows, and community events.

Advertise your organization and provide your audience with an opportunity to grow native plants that return year after year as a colorful reminder of your contribution. These plants help restore native landscape in your region and build habitat for butterflies, hummingbirds, and other pollinators.

Custom mixes can be specialized by region. Additional graphic services can be provided for an additional cost. Contact [nurserysales@cardno.com](mailto:nurserysales@cardno.com) for details and pricing.



1.5 – 2.0 grams of native plant seed of 5 species

## Prairie Seed Mixes



Established Economy Prairie Mix



*Asclepias tuberosa*, Butterfly Weed



*Ratibida pinnata*, Yellow Coneflower

For current pricing, availability, and information on our full installation and management services, visit [stantecnativeplantnursery.com](http://stantecnativeplantnursery.com)

### ECONOMY PRAIRIE

This prairie seed mix offers an economical way to establish a prairie. In addition to native prairie grasses, flowering species provide color throughout the growing season and food sources for birds and butterflies. Adding seed or plant plugs at a later date is a wonderful way to increase a prairie's richness and diversity. This seed mix includes at least 6 of 7 native permanent grass and sedge species and 10 of 13 native forb species. Apply at 41.16 PLS pounds per acre.

Botanical Name	Common Name	PLS Oz/Acre
<b>Permanent Grasses</b>		
<i>Andropogon gerardii</i>	Big Bluestem	12.00
<i>Bouteloua curtipendula</i>	Side-Oats Grama	16.00
<i>Carex spp.</i>	Prairie Sedge Species	3.00
<i>Elymus canadensis</i>	Canada Wild Rye	24.00
<i>Panicum virgatum</i>	Switch Grass	2.50
<i>Schizachyrium scoparium</i>	Little Bluestem	32.00
<i>Sorghastrum nutans</i>	Indian Grass	12.00
	<b>Total</b>	<b>101.50</b>
<b>Temporary Cover</b>		
<i>Avena sativa</i>	Common Oat	512.00
	<b>Total</b>	<b>512.00</b>
<b>Forbs</b>		
<i>Asclepias syriaca</i>	Common Milkweed	3.00
<i>Asclepias tuberosa</i>	Butterfly Weed	1.00
<i>Chamaecrista fasciculata</i>	Partridge Pea	10.00
<i>Coreopsis lanceolata</i>	Sand Coreopsis	6.00
<i>Echinacea purpurea</i>	Broad-Leaved Purple Coneflower	8.00
<i>Heliopsis helianthoides</i>	False Sunflower	0.50
<i>Monarda fistulosa</i>	Wild Bergamot	0.50
<i>Penstemon digitalis</i>	Foxglove Beard Tongue	2.00
<i>Ratibida pinnata</i>	Yellow Coneflower	4.00
<i>Rudbeckia hirta</i>	Black-Eyed Susan	8.00
<i>Solidago speciosa</i>	Showy Goldenrod	0.50
<i>Symphotrichum laeve</i>	Smooth Blue Aster	1.00
<i>Symphotrichum novae-angliae</i>	New England Aster	0.50
	<b>Total</b>	<b>45.00</b>

### Keys to seeding success

- Prepare the site adequately
- Choose the correct plant species for the site conditions
- Purchase quality PLS
- Ensure good seed-to-soil contact
- Prevent annual weeds from re-seeding
- Create and follow a maintenance plan; adapt as site conditions dictate

# Stormwater

A wetland seed mix for saturated soils in a detention pond or for seeding a saturated basin, this mix will tolerate highly fluctuating water levels and poor water quality associated with urban stormwater wetlands and ponds. For detention basins that experience long, dry periods, use the Economy Prairie seed mix in the upper third to half of the basin area in combination with this mix. This seed mix includes at least 10 of 12 native permanent grass and sedge species and 12 of 16 native forb species. Apply at 32.81 PLS pounds per acre.

Botanical Name	Common Name	PLS Oz/Acre
<b>Permanent Grasses/Sedges</b>		
<i>Bolboschoenus fluviatilis</i>	River Bulrush	0.25
<i>Carex cristatella</i>	Crested Oval Sedge	2.00
<i>Carex lurida</i>	Bottlebrush Sedge	3.00
<i>Carex vulpinoidea</i>	Brown Fox Sedge	6.00
<i>Elymus virginicus</i>	Virginia Wild Rye	13.50
<i>Glyceria striata</i>	Fowl Manna Grass	1.25
<i>Juncus effusus</i>	Common Rush	2.00
<i>Leersia oryzoides</i>	Rice Cut Grass	1.00
<i>Panicum virgatum</i>	Switch Grass	2.00
<i>Schoenoplectus tabernaemontani</i>	Softstem Bulrush	3.00
<i>Scirpus atrovirens</i>	Dark Green Rush	2.00
<i>Scirpus cyperinus</i>	Wool Grass	1.00
	<b>Total</b>	<b>37.00</b>
<b>Temporary Cover</b>		
<i>Avena sativa</i>	Common Oat	360.00
<i>Lolium multiflorum</i>	Annual Rye	100.00
	<b>Total</b>	<b>460.00</b>
<b>Forbs</b>		
<i>Alisma spp.</i>	Water Plantain Mix	4.25
<i>Asclepias incarnata</i>	Swamp Milkweed	1.50
<i>Bidens spp.</i>	Bidens Mix	2.00
<i>Helenium autumnale</i>	Sneezeweed	2.00
<i>Iris virginica</i>	Blue Flag	4.00
<i>Lycopus americanus</i>	Common Water Horehound	0.25
<i>Mimulus ringens</i>	Monkey Flower	1.00
<i>Oligoneuron riddellii</i>	Riddell's Goldenrod	0.50
<i>Penthorum sedoides</i>	Ditch Stonecrop	0.50
<i>Polygonum spp.</i>	Pinkweed Mix	4.00
<i>Rudbeckia subtomentosa</i>	Sweet Black-Eyed Susan	1.00
<i>Rudbeckia triloba</i>	Brown-Eyed Susan	1.50
<i>Sagittaria latifolia</i>	Common Arrowhead	1.00
<i>Senna hebecarpa</i>	Wild Senna	1.00
<i>Symphotrichum novae-angliae</i>	New England Aster	1.50
<i>Thalictrum dasycarpum</i>	Purple Meadow Rue	2.00
	<b>Total</b>	<b>28.00</b>

## Specialty Seed Mixes



*Carex cristatella*, Crested Oval Sedge



*Mimulus ringens*, Monkey Flower



*Rudbeckia subtomentosa*, Sweet Black-Eyed Susan

For current pricing, availability, and information on our full installation and management services, visit [cardnonativeplantnursery.com](http://cardnonativeplantnursery.com)

# Seed Aide - Aero - 50 LB BAG



SKU: SM-50

Availability: 1235 Available in Sussex

CHECK OTHER WAREHOUSES

**Your Price: \$25.84/EA**

~~List Price: \$35.40~~

1

 Add To Cart

- **Sold Individually. Manufacturer Pack Size = 40**

- Flexible application — apply aerially, hydraulically, with a high-volume drop spreader, large-opening broadcast spreader or by hand
- Better turf establishment
- Better ground coverage for dry and hydroseeding applications
- Faster loading and smooth shooting for hydroseeding applications
- Better soil bonding to prevent movement during rain or irrigation with included tackifier

#### ^ Long Description

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Seed Aide®

#### Application:

Apply with spreaders, hydrospray, or by hand. Do not exceed maximum slope length of 35' when slope gradients are steeper than 4H to 1V while hydroseeding. Do not exceed maximum slope length of 25' when slope gradients are steeper than 4H to 1V during broadcast spreading.

[DOWNLOAD SDS](#)

#### ∨ Product Literature

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There are no manuals for this product

#### ∨ Specifications

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Container Size	50 LBS BAG
Coverage	750 SQ FT
Weight (lbs)	50 lbs
Application	1,000-3,000 LBS/ACRE



## Specification Sheet – BioNet® S150BN™ Erosion Control Blanket

### DESCRIPTION

The short-term double net erosion control blanket shall be a machine-produced mat of 100% agricultural straw with a functional longevity of up to 12 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location and elevation). The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with a 100% biodegradable woven natural fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 0.50 x 1.0 in. (1.27 x 2.54 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The S150BN shall meet Type 2.D specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

### Material Content

<b>Matrix</b>	100% Straw Fiber	0.5 lbs/sq yd (0.27 kg/sm)
<b>Netting</b>	Top: Leno woven 100% biodegradable organic jute	9.35 lb/1000 sq ft (4.5 kg/100 sm)
	Bottom: 100% biodegradable organic jute	7.7 lb/1000 sq ft (3.76 kg/100 sm)
<b>Thread</b>	Degradable	

### Standard Roll Sizes

<b>Width</b>	6.67 ft (2.03 m)	8.0 ft (2.4 m)	15.5 ft (4.72 m)
<b>Length</b>	108 ft (32.92 m)	112 ft (34.14 m)	90 ft (27.43 m)
<b>Weight ± 10%</b>	52.22 lbs (23.69 kg)	65.28 lbs (29.61 kg)	101.2 lbs (45.9 kg)
<b>Area</b>	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	155 sq yd (129.6 sm)
	Leno weave top only	Leno top and bottom	Leno top and bottom

Index Property	Test Method	Typical
<b>Thickness</b>	ASTM D6525	0.23 in. (5.84 mm)
<b>Resiliency</b>	ECTC Guidelines	80.5%
<b>Water Absorbency</b>	ASTM D1117	428%
<b>Mass/Unit Area</b>	ASTM D6475	8.71 oz/sy (296 g/sm)
<b>Swell</b>	ECTC Guidelines	15%
<b>Smolder Resistance</b>	ECTC Guidelines	Yes
<b>Stiffness</b>	ASTM D1388	6.23 oz-in
<b>Light Penetration</b>	ASTM D6567	15.3%
<b>Tensile Strength - MD</b>	ASTM D6818	188.4 lbs/ft (2.79 kN/m)
<b>Elongation - MD</b>	ASTM D6818	11.2%
<b>Tensile Strength - TD</b>	ASTM D6818	157.2 lbs/ft (2.33 kN/m)
<b>Elongation - TD</b>	ASTM D6818	13.5%
<b>Biomass Improvement</b>	ASTM D7322	549%

### Design Permissible Shear Stress

<b>Unvegetated Shear Stress</b>	1.85 psf (88 Pa)
<b>Unvegetated Velocity</b>	6.00 fps (1.83 m/s)

### Slope Design Data: C Factors

	Slope Gradients (S)		
	≤ 3:1	3:1 - 2:1	≥ 2:1
<b>Slope Length (L)</b>			
≤ 20 ft (6 m)	0.00014	0.039	N/A
20-50 ft	0.01	0.070	N/A
≥ 50 ft (15.2 m)	0.02	0.100	N/A

### Roughness Coefficients – Unveg.

Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.055
0.50 - 2.0 ft	0.055-0.021
≥ 2.0 ft (0.60 m)	0.021

# **SLOPE INSPECTION CHECKLIST**

## Slope Inspection and Maintenance Checklist

Development Name: Hartland Apartments Date of Inspection: \_\_\_\_\_

Inspector Name: \_\_\_\_\_

Inspector Address: \_\_\_\_\_

Inspector Telephone Number: \_\_\_\_\_

Type of Inspection: Storm \_\_\_\_\_ Monthly \_\_\_\_\_ Annual \_\_\_\_\_ Other \_\_\_\_\_

**Evaluation Criteria**

N = Not investigated

0 = None observed

1 = Monitor - potential signs of instability

2 = Corrective action is necessary

\* = Use open space after each section to further explain as needed

**General Surface Erosion**

No visible signs of rills or gullies N 0 1 2

No excessive sediment deposits in swale areas N 0 1 2

No signs of bare spots in vegetated areas N 0 1 2

No signs of pipe discharge creating gully/rill erosion N 0 1 2

No signs of Freeze/Thaw erosion N 0 1 2

No signs of Dry-ravel N 0 1 2

**Global Stability Erosion**

No visible signs of shoulder/pavement separation or voids along the Hill Street or Palmer Drive frontages N 0 1 2

No visible signs of guardrail post rotation along Palmer Drive N 0 1 2

No visible signs of excessive slope deformation N 0 1 2

No visible signs of liquefaction or piping N 0 1 2

**Inspector's Summary** (please list general comments, corrective action to be taken with suggested time frame, and include photos and other documents as needed. Please attach additional pages if needed)


**Photo Log**

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## Indicators of Slope Instability

**Rill Erosion** – micro channels of erosion caused by water runoff on bare soil, generally becomes gully erosion if not treated.



Monitor: .5" to 4" in depth – Determine source of periodic runoff and divert.

Immediate Corrective Action: greater than 6" in depth – plant vegetation to minimize and protect the soil from future scouring.

**Gully Erosion** – “U” or “V” shaped channels with periodic flow that occur due to untreated rills. Typically occurring at concentrated flow areas. The product of rills that are deeper than 1'. If not corrected prior to, immediate action must be taken to determine the runoff source, divert and increase the amount of vegetation or trees in the area. In extreme cases, rolled erosion mat may be necessary.



**Vegetative Bare Spots** – areas that have been previously vegetated begin to develop open/dead areas; this can lead to increased erosion due to lack of root structure.



Monitor: Small area of vegetation is needed – plant vegetation as necessary to minimize erosion

Immediate Corrective Action: Area has continued to grow, and erosion is occurring – use Live Stakes (as shown below) to eliminate the erosion in the area.

**Freeze/Thaw Erosion** –Showing up primarily in ice formations on side slopes. Possible areas could be near concentrated snow storage areas on Hill Street and Palmer Drive.



Monitor: small area of ice formation on slope – monitor the area through the Spring

Immediate Corrective Action: the area has grown and large cracks have formed – determine the source and divert runoff.

**Rock/Slides (Dry-ravel)** – similar to that of a landslide, in this slope failure, material, ranging from large boulders to small gravel marbles, will be found breaking from the top of the slope towards the toe of the slope



Monitor: Small marbles and gravel – seed, fertilize and mulch the area

Immediate Corrective Action: large boulders have broken away from the slope – determine if a rip-rap/rock blanket is necessary, extreme cases may require a retaining wall to hold the slope.

**Excessive sediment in swales** – dry-ravel erosion cause slides from top of slope to toe, many times to the swale basin.

Monitor: determine the source of the sediment

Immediate Corrective Action: Remove sediment from swale to ensure proper drainage is occurring

## Corrective Actions

Rilling & Gullies – The first step is always to determine the source of the runoff and divert it. Vegetation would be the next step so root structures can grow and hold the soil together. The most serious would be to apply a rolled erosion product.



Vegetative Bare Spots – Vegetative re-planting is the earliest step that can be taken to decrease the size/amount of bare spots. Live Stakes, mentioned above, have shown their ability to minimize erosion due to their strong roots.

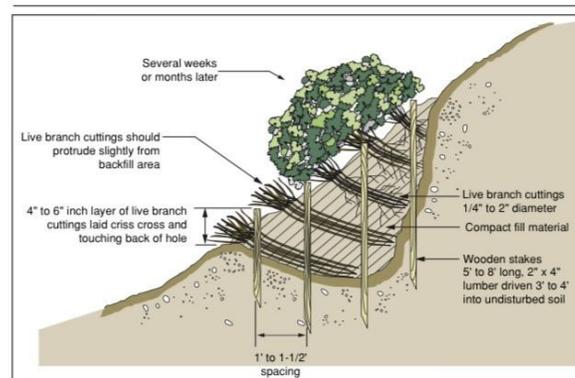


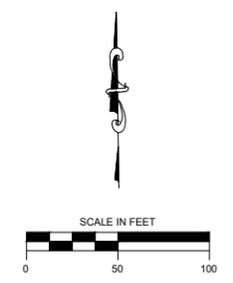
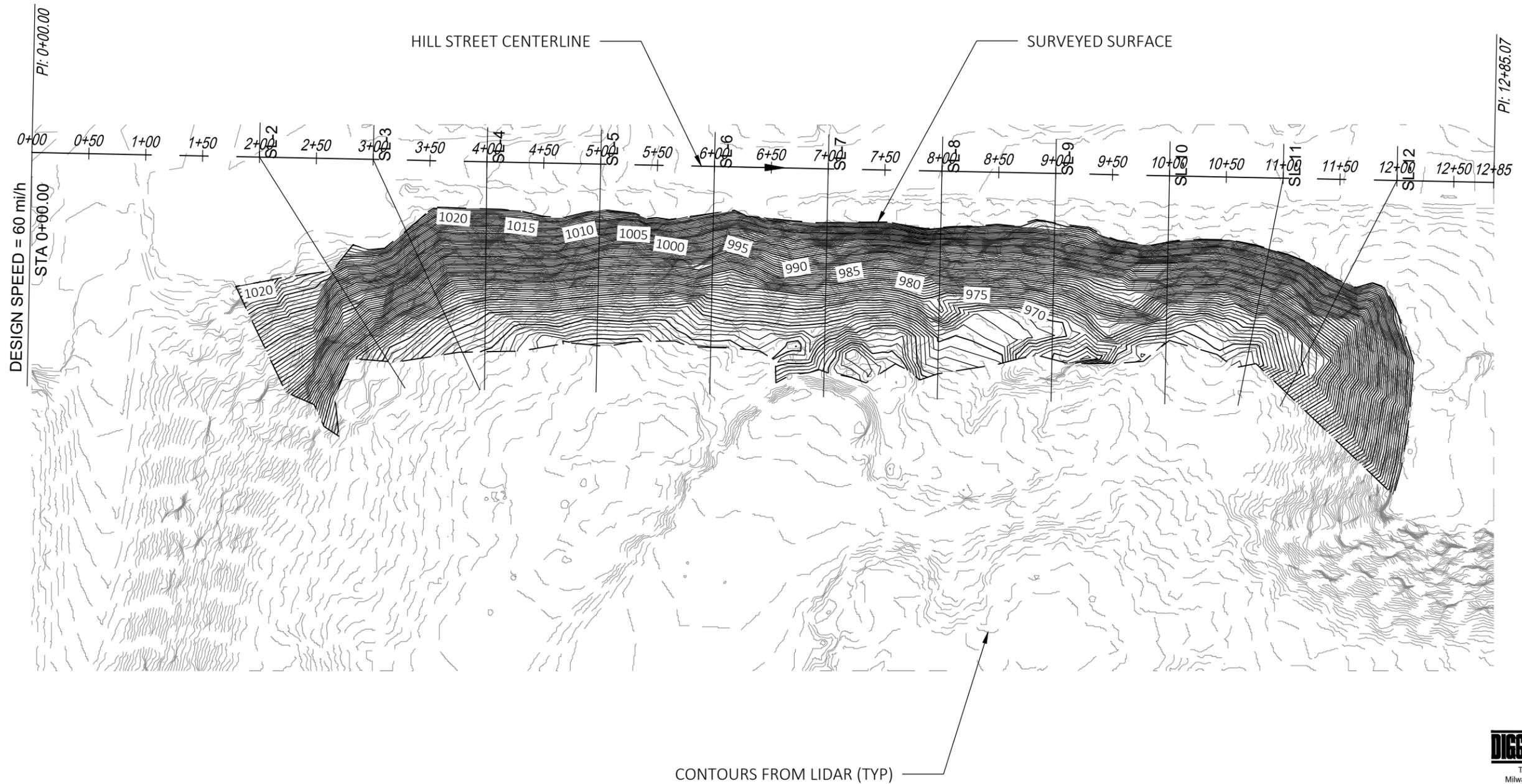
Figure 17—Typical branchpacking. (Lewis 2000)

Pipe Discharge areas causing rilling/gullies – rip rap may be necessary to treat this area

Dry-ravel – treatments include, seed, fertilizer and mulch, rip rap/rock blankets, bioengineered soil or in extreme cases a retaining wall may be needed.

# **HILL STREET SLOPE ANALYSIS**

Jan 09, 2024 - 12:07pm  
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**HARTLAND APARTMENTS  
 HILL STREET SLOPE ANALYSIS**

**DIGGERS HOTLINE**  
 Toll Free (800) 242-8511  
 Milwaukee Area (414) 259-1181  
 Hearing Impaired TDD (800) 542-2289  
 www.DiggersHotline.com

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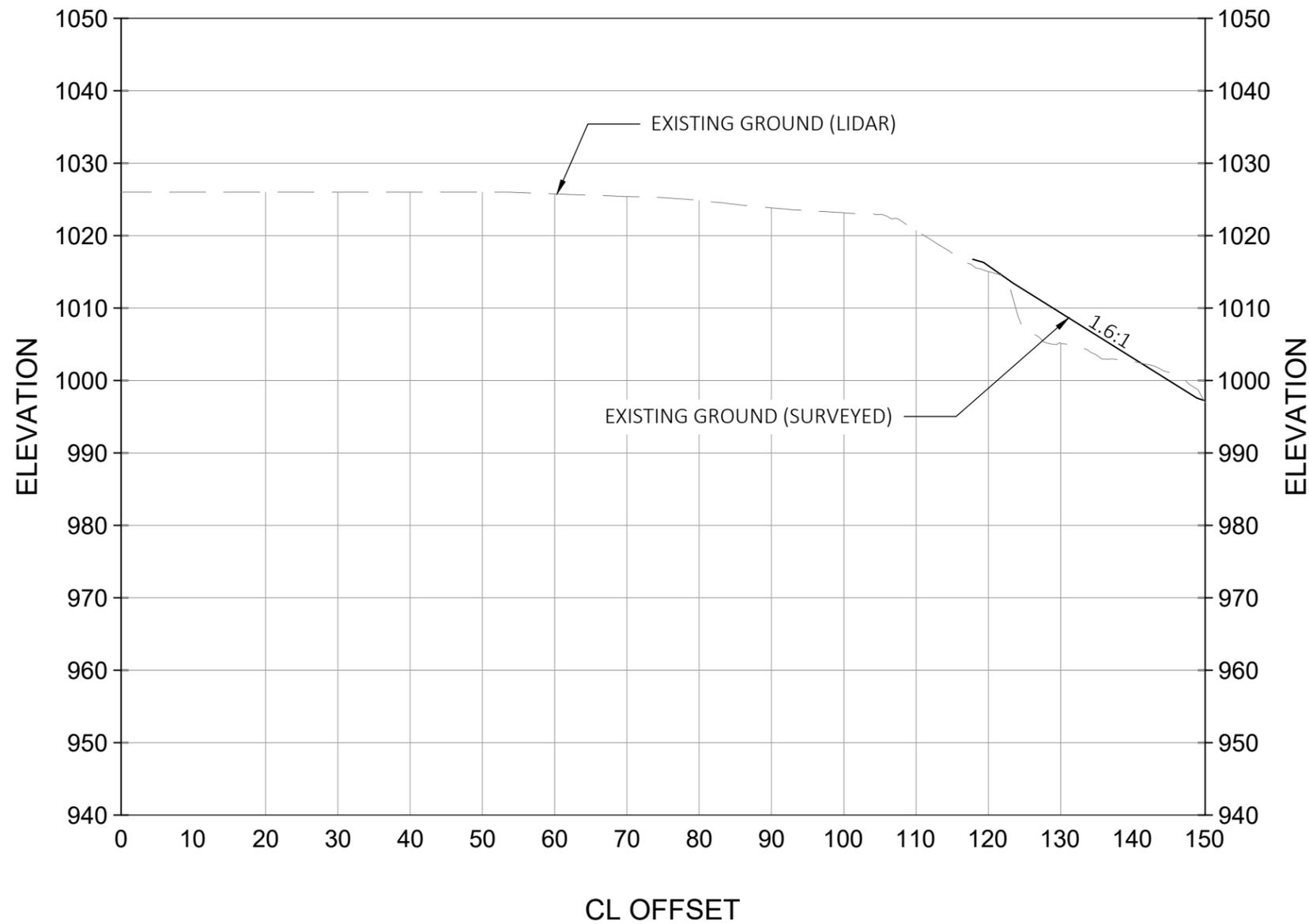
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STATION 2+00



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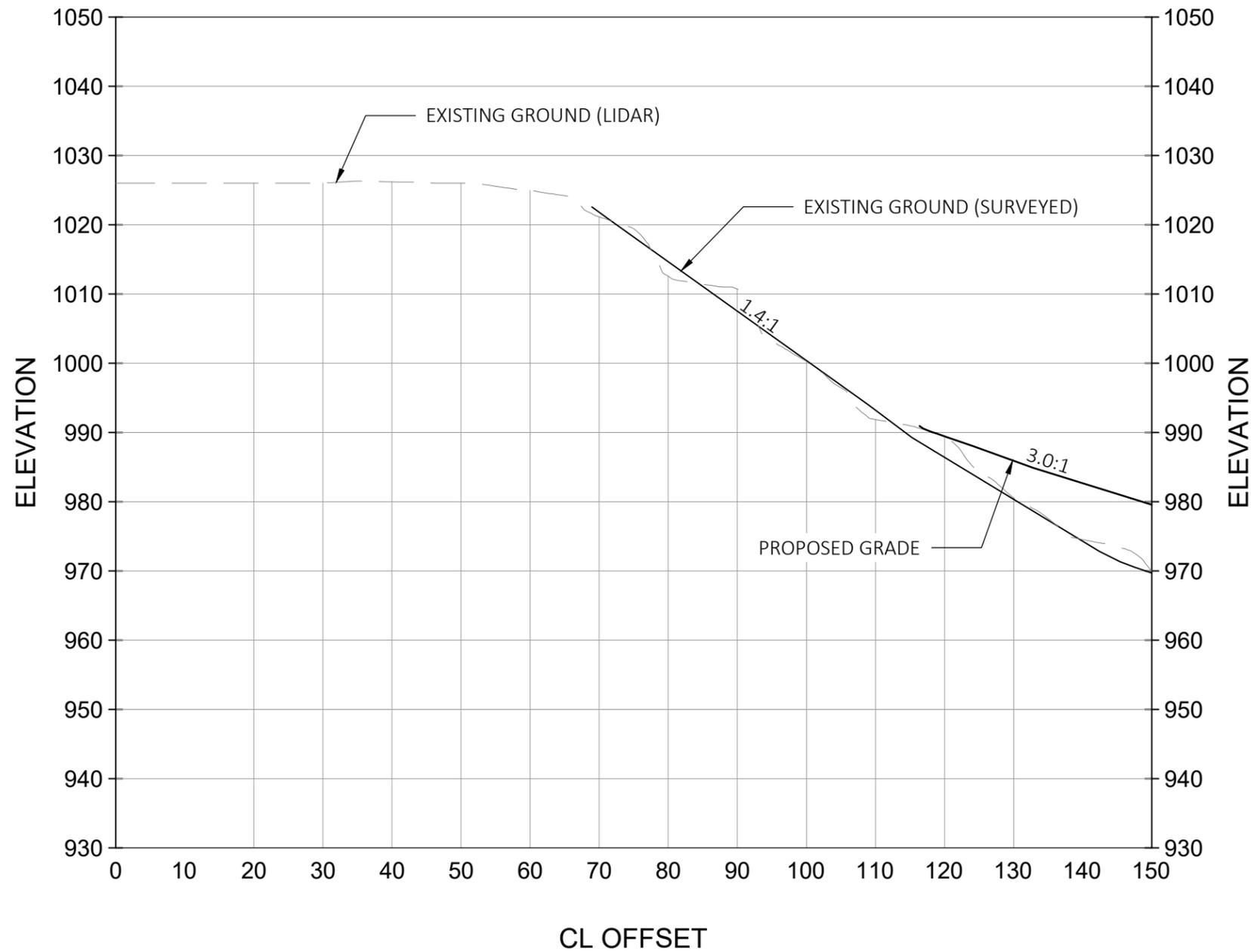
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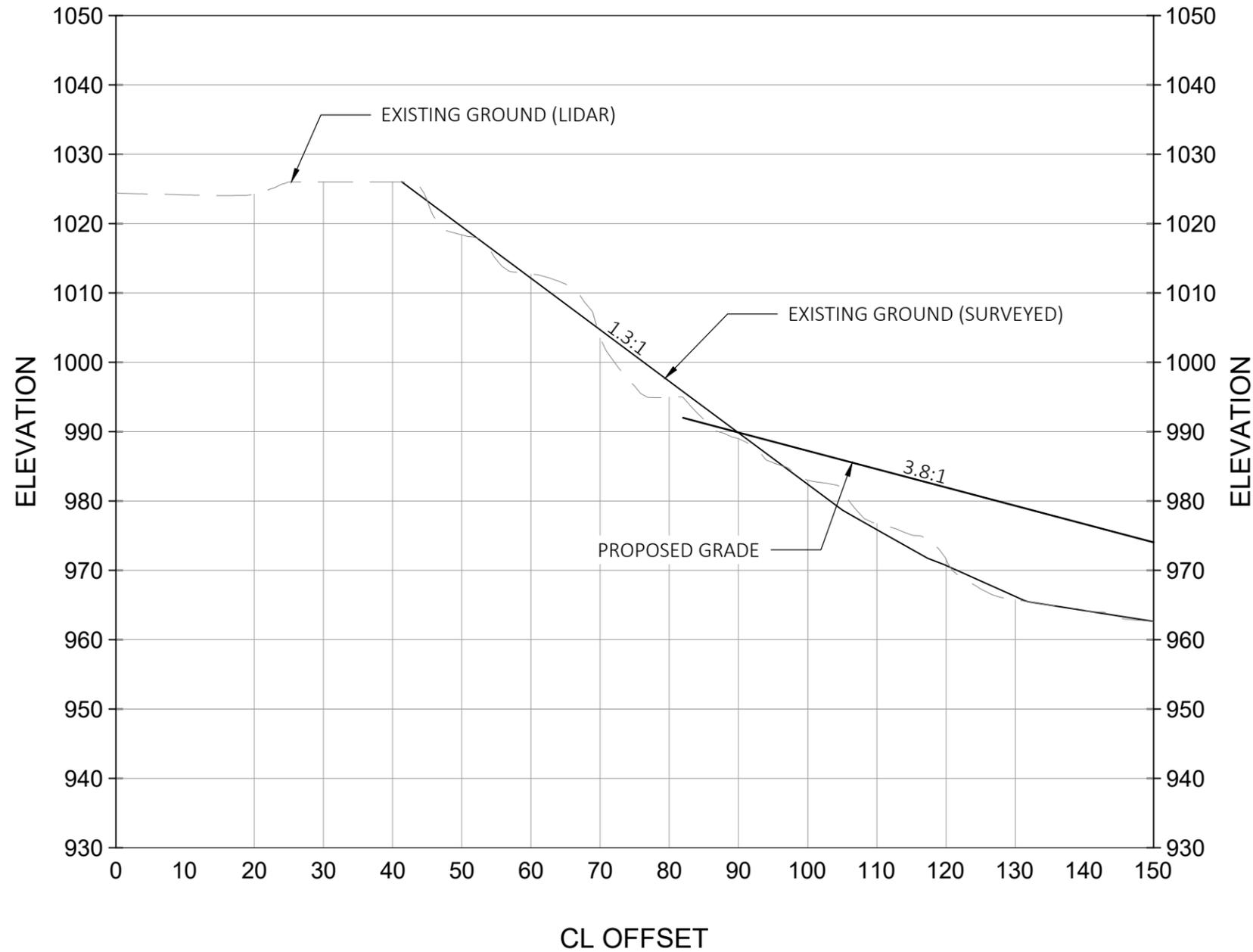
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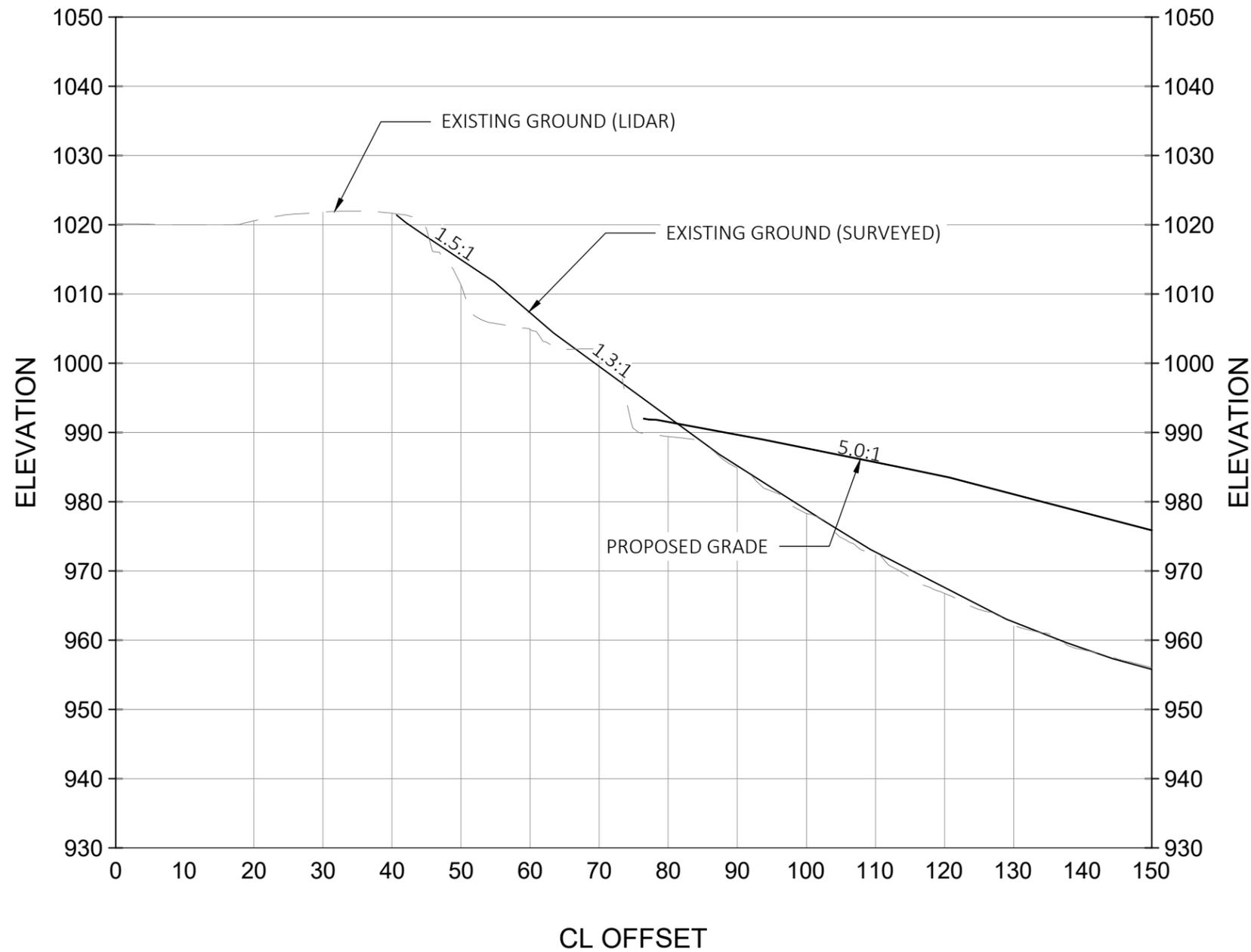
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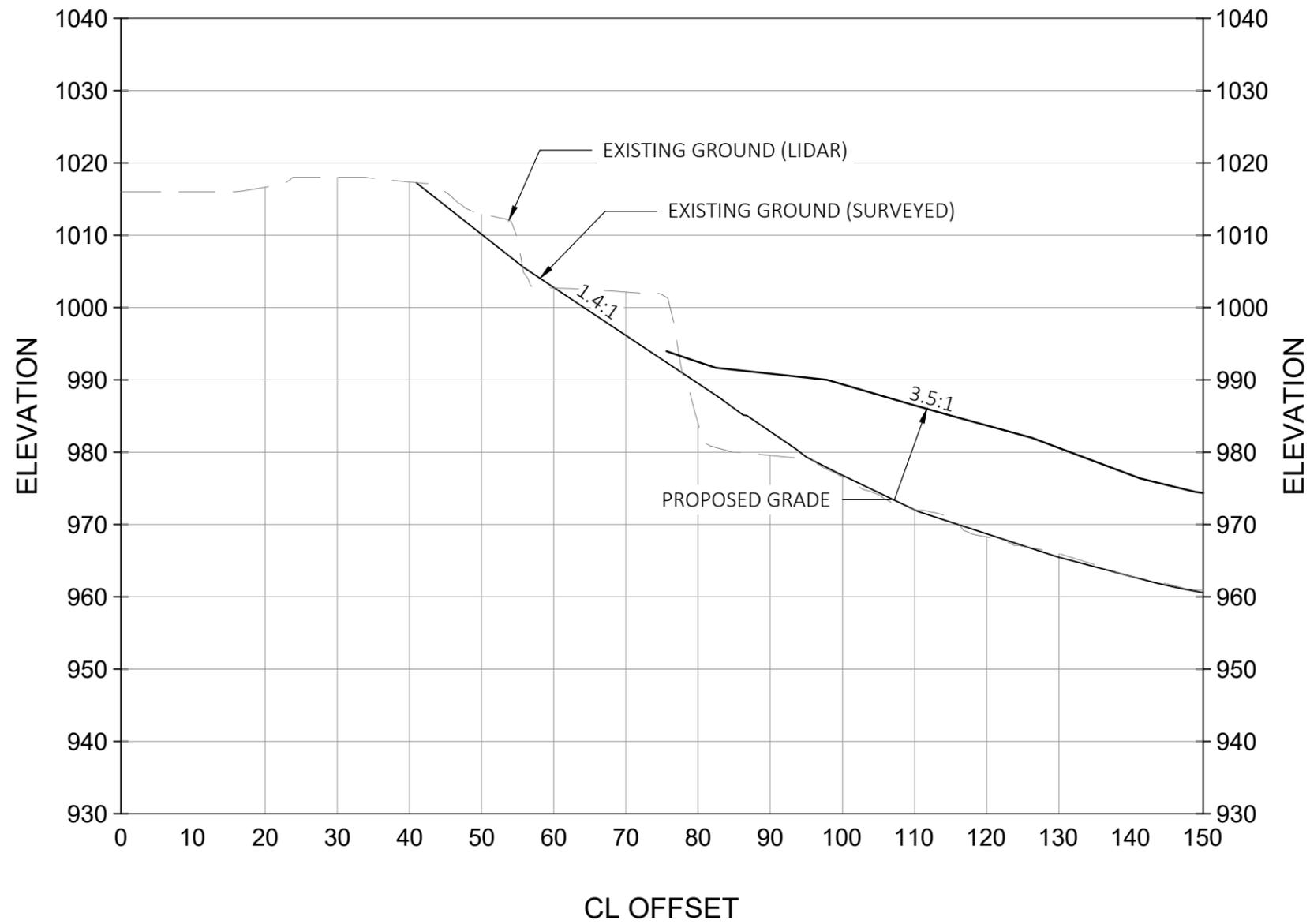
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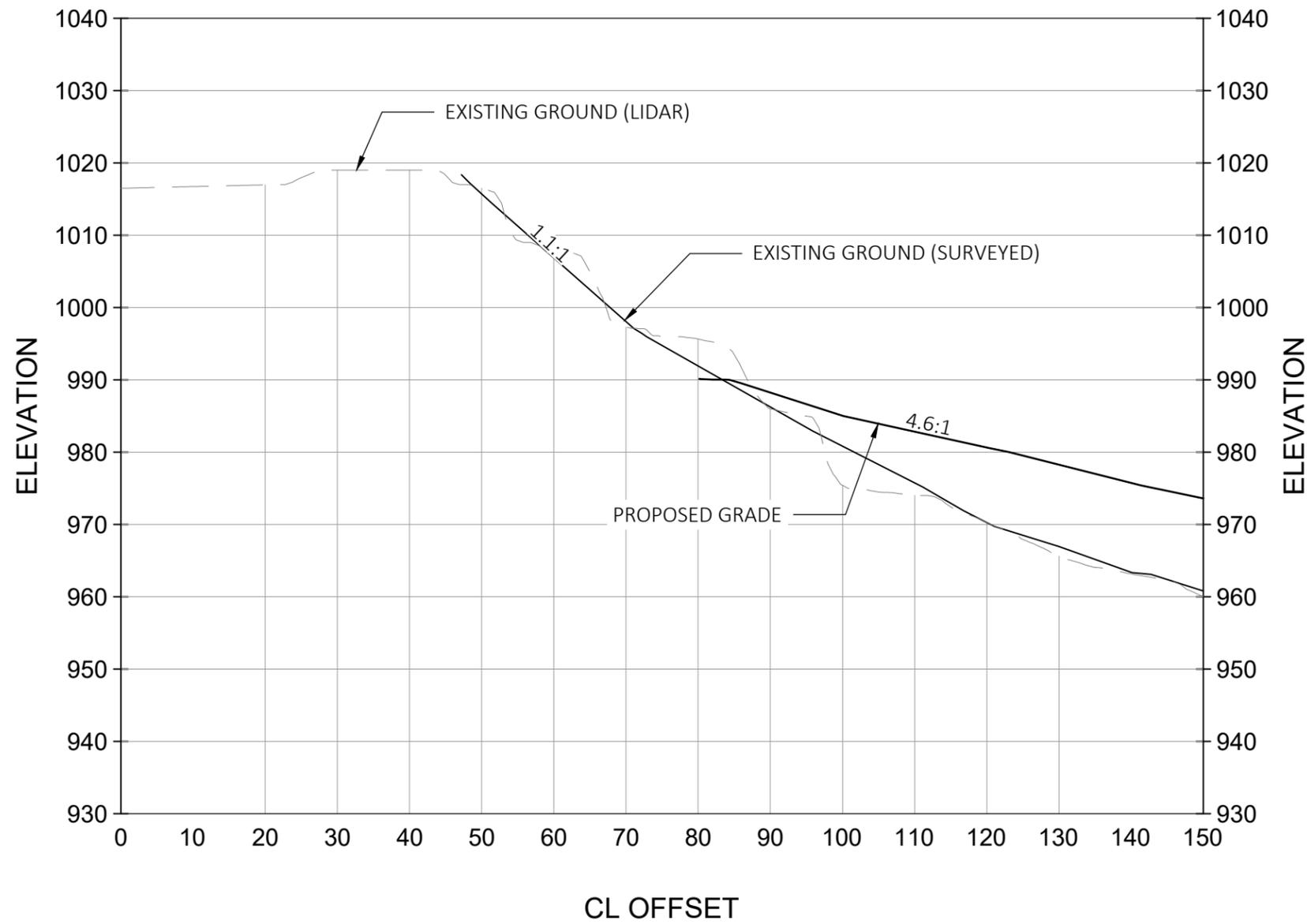
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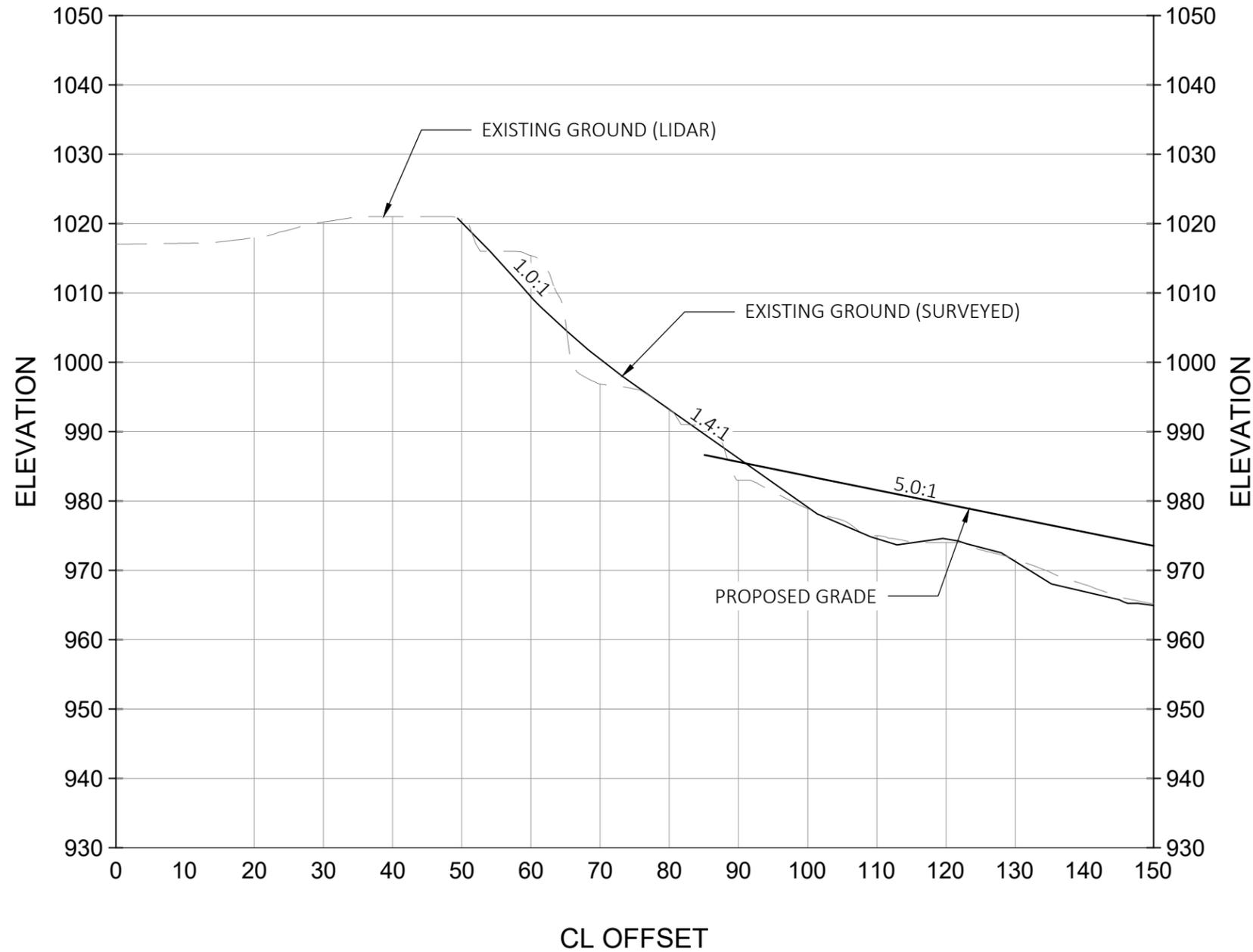
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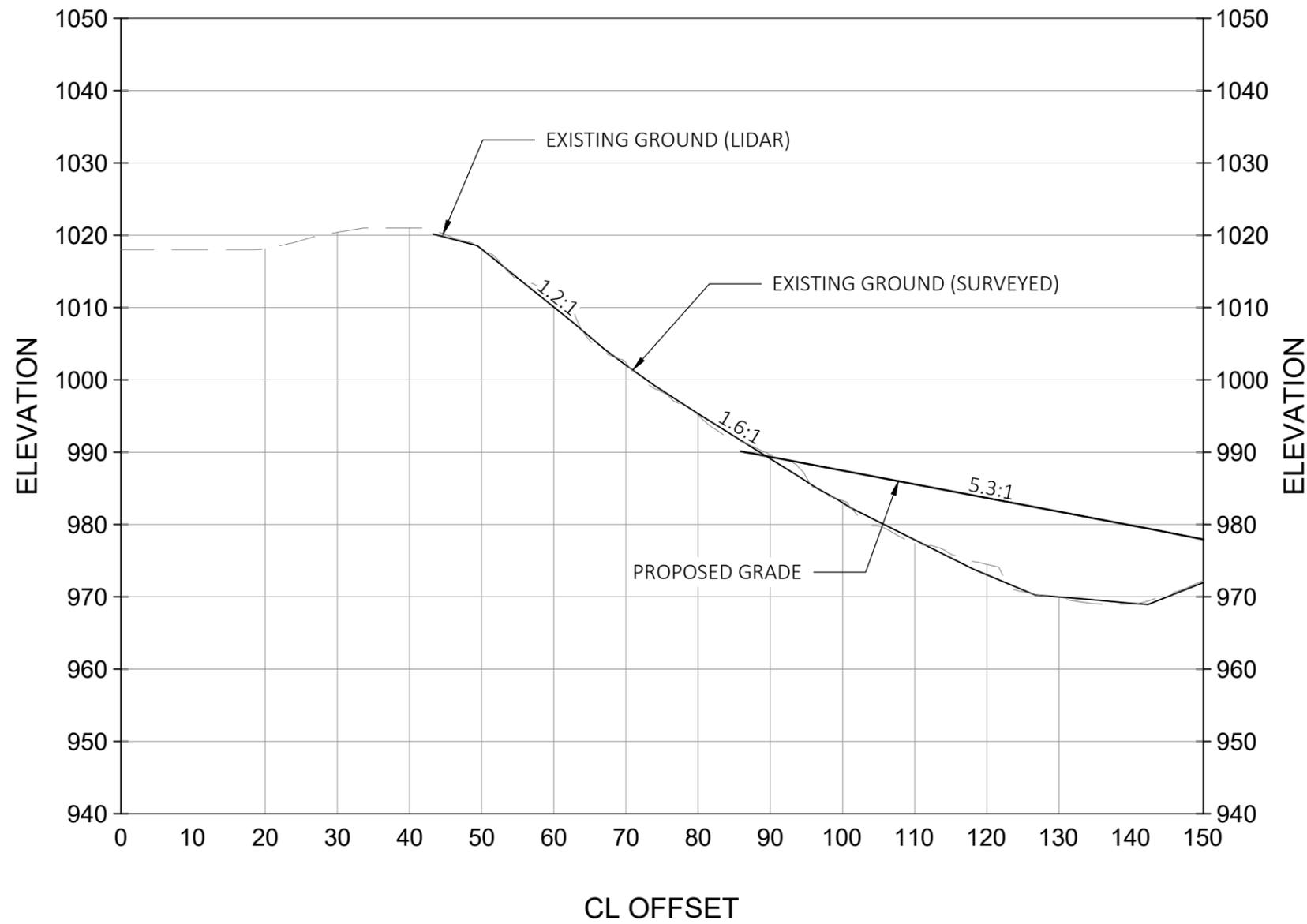
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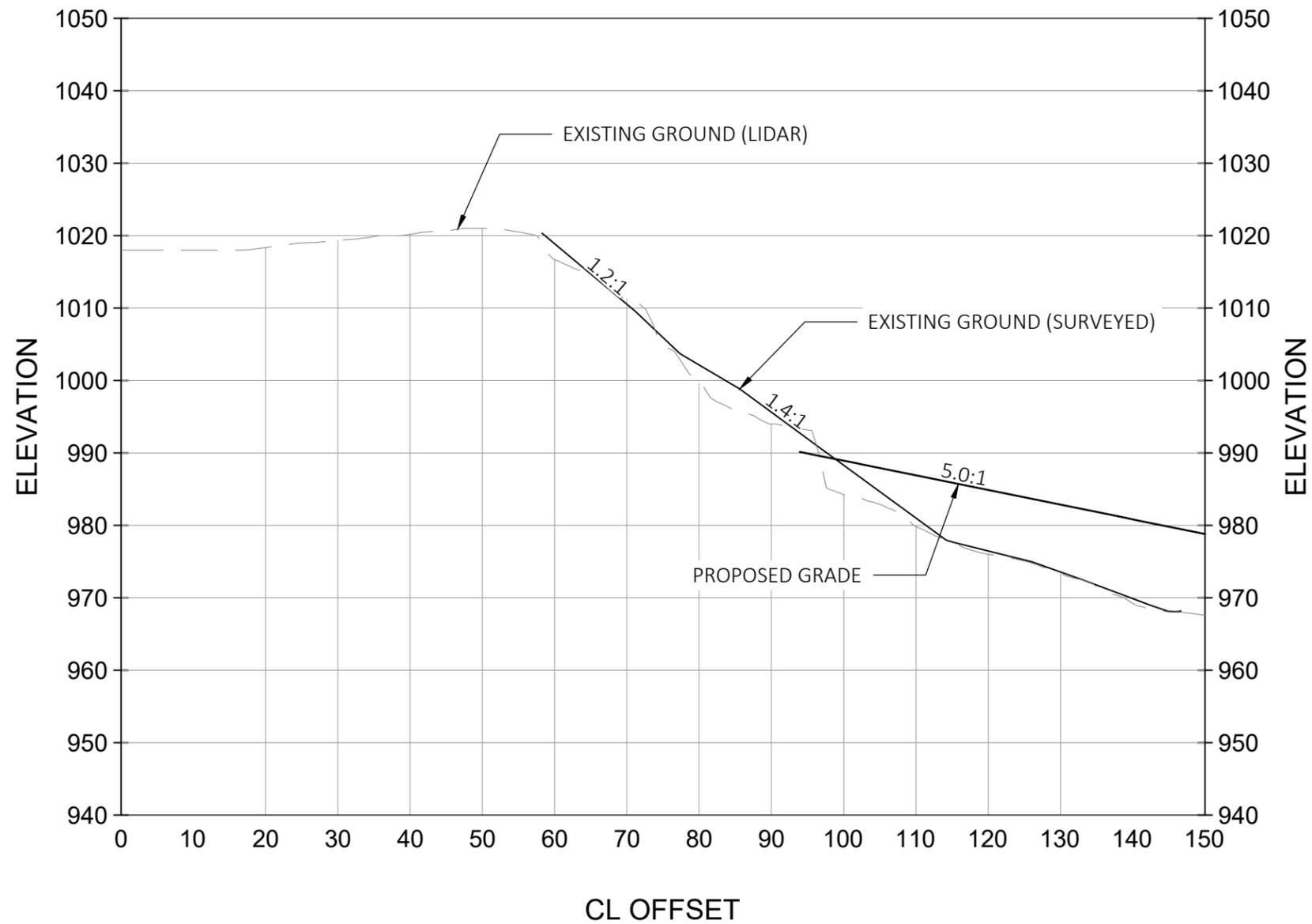
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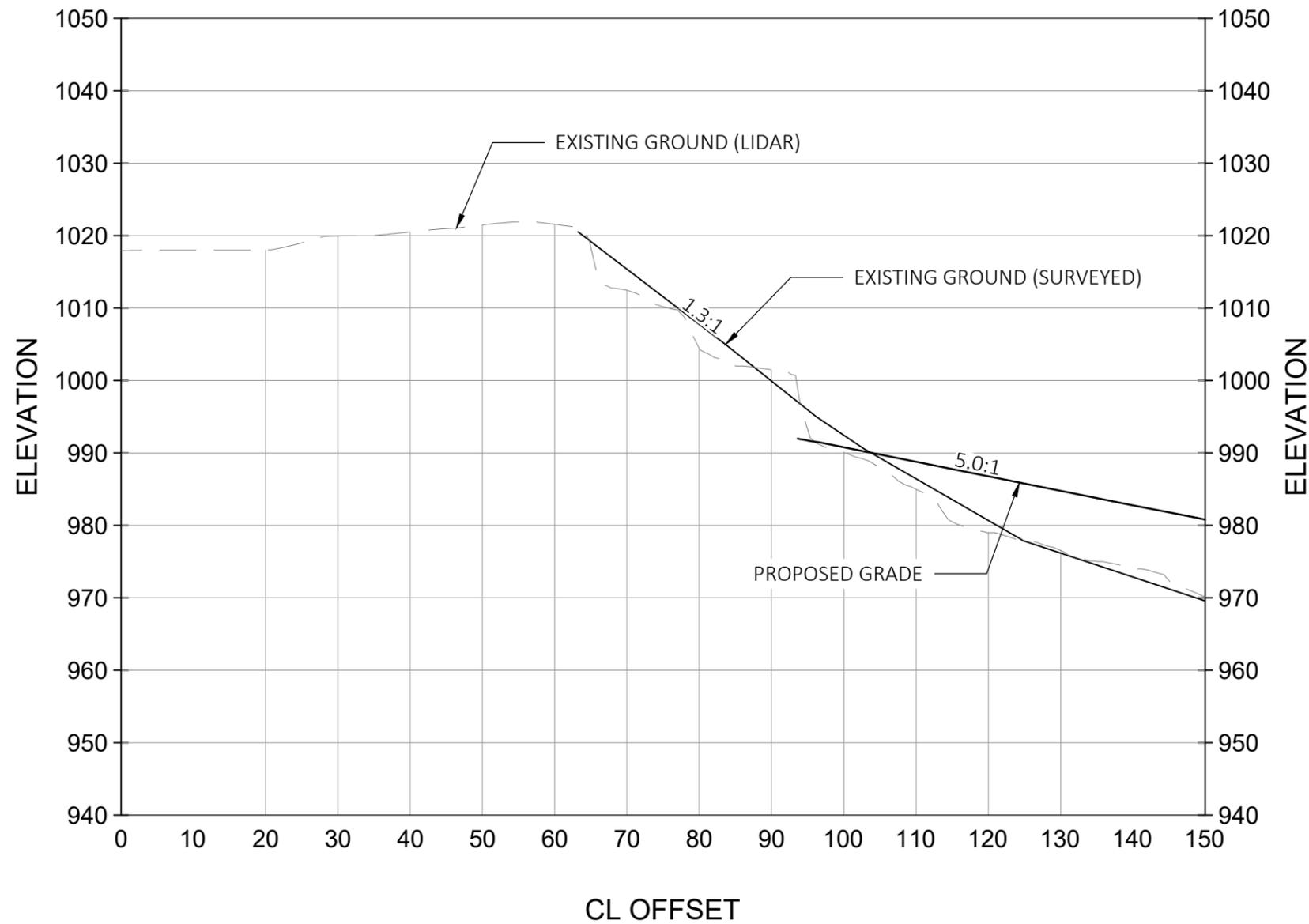
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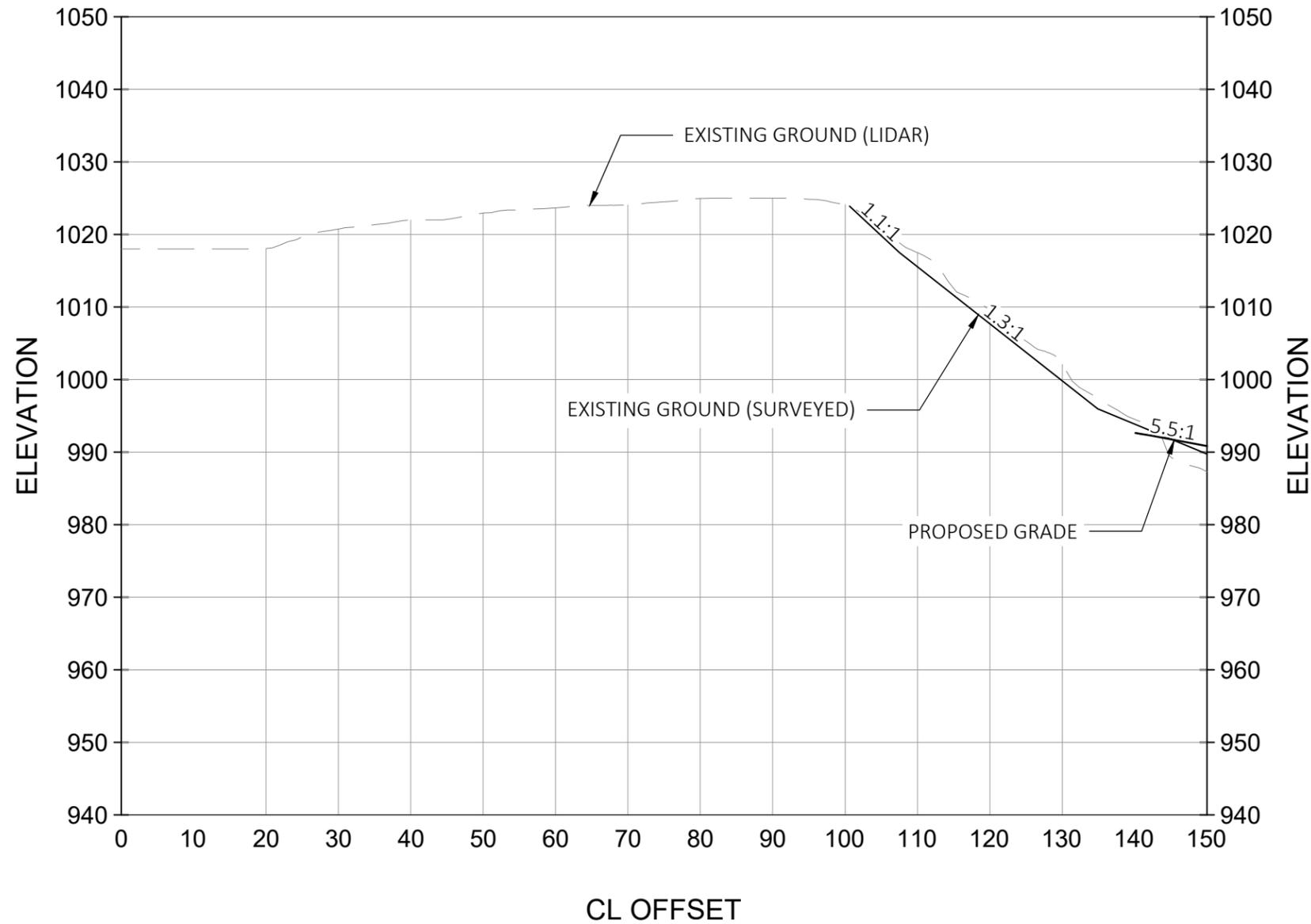
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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

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This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2 - Sta 200.sl4d  
Name of output file : Hartland Quarry - Section 2 - Sta 200.sl4o  
Name of plot output file : Hartland Quarry - Section 2 - Sta 200.sl4p

-----  
Time and Date of Analysis  
-----

Date: January 16, 2024 Time: 10:01:23

1

PROBLEM DESCRIPTION Section 2 - Sta 2+00

BOUNDARY COORDINATES

5 Top Boundaries  
11 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
-----------------	---------------	---------------	----------------	----------------	------------------------

1	0.00	997.00	50.00	997.00	4
2	50.00	997.00	77.00	1012.00	4
3	77.00	1012.00	94.00	1023.00	1
4	94.00	1023.00	120.00	1026.00	1
5	120.00	1026.00	180.00	1026.00	1
6	77.00	1012.00	180.00	1012.00	4
7	0.00	994.00	180.00	994.00	2
8	0.00	983.00	180.00	983.00	4
9	0.00	973.00	180.00	973.00	4
10	0.00	968.00	180.00	968.00	3
11	0.00	955.00	180.00	955.00	4

1

#### ISOTROPIC SOIL PARAMETERS

##### 4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	37.0	0.00	0.0	0
2	135.0	0.0	0.0	40.0	0.00	0.0	0
3	140.0	0.0	0.0	43.0	0.00	0.0	0
4	145.0	0.0	0.0	46.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 50.00 ft.  
and X = 70.00 ft.

Each Surface Terminates Between X = 70.00 ft.  
and X = 100.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

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

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

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	70.00	1008.11
2	74.98	1007.65
3	79.96	1008.11
4	84.77	1009.46
5	89.25	1011.68
6	93.26	1014.67
7	96.65	1018.34
8	99.31	1022.58
9	99.75	1023.66

Circle Center At X = 75.0 ; Y = 1034.9 and Radius, 27.3

\*\*\* 1.9 \*\*\*

Individual data on the 11 slices

	Water Force	Water Force	Tie Force	Tie Force	Earthquake Force
Surcharge					

Slice No.	Width Ft	Weight Lbs	Top Lbs	Bot Lbs	Norm Lbs	Tan Lbs	Hor Lbs	Ver Lbs	Load Lbs
1	5.0	0.12E+04	0.00E+00						
2	2.0	0.11E+04	0.00E+00						
3	3.0	0.21E+04	0.00E+00						
4	4.8	0.44E+04	0.00E+00						
5	4.5	0.47E+04	0.00E+00						
6	0.4	0.46E+03	0.00E+00						
7	3.6	0.37E+04	0.00E+00						
8	0.7	0.74E+03	0.00E+00						
9	2.7	0.22E+04	0.00E+00						
10	2.7	0.10E+04	0.00E+00						
11	0.4	0.29E+02	0.00E+00						

-----  
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	70.00	1008.11
2	74.96	1007.47
3	79.95	1007.85
4	84.75	1009.22
5	89.18	1011.54
6	93.05	1014.71
7	96.19	1018.60
8	98.49	1023.04
9	98.62	1023.53

Circle Center At X = 75.6 ; Y = 1032.0 and Radius, 24.6

\*\*\* 1.930 \*\*\*

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	65.00	1005.33
2	69.98	1004.91
3	74.97	1005.27
4	79.84	1006.39
5	84.48	1008.26
6	88.78	1010.82
7	92.63	1014.01
8	95.94	1017.76
9	98.62	1021.97
10	99.35	1023.62

Circle Center At X = 70.2 ; Y = 1037.1 and Radius, 32.2

\*\*\* 1.935 \*\*\*

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	60.00	1002.56
2	65.00	1002.48
3	69.90	1003.45
4	74.49	1005.43
5	78.57	1008.33
6	81.94	1012.02
7	84.46	1016.34
8	84.66	1016.96

Circle Center At X = 62.9 ; Y = 1026.1 and Radius, 23.7

\*\*\* 1.993 \*\*\*

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	55.00	999.78
2	59.97	999.22
3	64.97	999.28
4	69.92	999.96
5	74.75	1001.25
6	79.39	1003.13
7	83.75	1005.56
8	87.78	1008.52
9	91.42	1011.96
10	94.60	1015.82
11	97.28	1020.04
12	98.94	1023.57

Circle Center At X = 62.0 ; Y = 1039.5 and Radius, 40.3

\*\*\* 2.004 \*\*\*

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	997.00
2	54.98	996.54
3	59.98	996.61
4	64.94	997.21
5	69.82	998.33
6	74.54	999.96
7	79.07	1002.08
8	83.35	1004.67
9	87.32	1007.70
10	90.96	1011.14
11	94.21	1014.93
12	97.04	1019.06
13	99.42	1023.46
14	99.49	1023.63

Circle Center At X = 56.8 ; Y = 1043.6 and Radius, 47.1

\*\*\* 2.004 \*\*\*

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	65.00	1005.33
2	69.89	1004.31
3	74.89	1004.32
4	79.79	1005.35
5	84.37	1007.36
6	88.43	1010.27
7	91.82	1013.95
8	94.37	1018.24
9	95.99	1022.97
10	96.03	1023.23

Circle Center At X = 72.4 ; Y = 1028.4 and Radius, 24.2

\*\*\* 2.023 \*\*\*

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	55.00	999.78
2	59.93	998.93
3	64.92	998.76
4	69.90	999.28
5	74.75	1000.49
6	79.39	1002.34
7	83.74	1004.82
8	87.70	1007.87
9	91.21	1011.43
10	94.19	1015.45
11	96.59	1019.83
12	97.97	1023.46

Circle Center At X = 63.6 ; Y = 1035.0 and Radius, 36.3

\*\*\* 2.055 \*\*\*

## Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	60.00	1002.56
2	64.87	1001.44
3	69.87	1001.23
4	74.82	1001.93
5	79.56	1003.51
6	83.93	1005.94
7	87.79	1009.12
8	91.01	1012.94
9	93.48	1017.29
10	95.12	1022.02
11	95.29	1023.15

Circle Center At X = 68.5 ; Y = 1028.6 and Radius, 27.4

\*\*\* 2.075 \*\*\*

## Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	70.00	1008.11
2	74.81	1006.75
3	79.81	1006.83
4	84.58	1008.34
5	88.72	1011.15
6	91.87	1015.02
7	93.79	1019.64
8	94.14	1023.02

Circle Center At X = 77.0 ; Y = 1023.9 and Radius, 17.3

\*\*\* 2.099 \*\*\*



F 1580.04 +  
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-  
-  
-  
-  
T 1805.76 +



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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2 - Sta 300.sl4d  
Name of output file : Hartland Quarry - Section 2 - Sta 300.sl4o  
Name of plot output file : Hartland Quarry - Section 2 - Sta 300.sl4p

-----  
Time and Date of Analysis  
-----

Date: January 16, 2024 Time: 09:22:50

1

PROBLEM DESCRIPTION Section 2 - Sta 3+00

BOUNDARY COORDINATES

6 Top Boundaries  
12 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
--------------	------------	------------	-------------	-------------	---------------------

1	0.00	980.00	50.00	980.00	4
2	50.00	980.00	62.00	983.00	4
3	62.00	983.00	90.00	994.00	2
4	90.00	994.00	117.00	1012.00	4
5	117.00	1012.00	138.00	1026.00	1
6	138.00	1026.00	180.00	1026.00	1
7	117.00	1012.00	180.00	1012.00	4
8	90.00	994.00	180.00	994.00	2
9	62.00	983.00	180.00	983.00	4
10	0.00	973.00	180.00	973.00	4
11	0.00	968.00	180.00	968.00	3
12	0.00	955.00	180.00	955.00	4

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	37.0	0.00	0.0	0
2	135.0	0.0	0.0	40.0	0.00	0.0	0
3	140.0	0.0	0.0	43.0	0.00	0.0	0
4	145.0	0.0	0.0	46.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 90.00 ft. and X = 120.00 ft.

Each Surface Terminates Between X = 120.00 ft. and X = 160.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation



0.00E+00  
 2 3.7 0.15E+04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
 0.00E+00  
 3 0.2 0.35E+02 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00  
 0.00E+00

-----  
 Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	994.00
2	94.98	993.60
3	99.97	993.92
4	104.87	994.96
5	109.56	996.69
6	113.95	999.08
7	117.95	1002.08
8	121.48	1005.62
9	124.47	1009.63
10	126.84	1014.03
11	128.56	1018.72
12	128.80	1019.86

Circle Center At X = 95.3 ; Y = 1028.2 and Radius, 34.6

\*\*\* 1.770 \*\*\*

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	97.50	999.00
2	102.49	998.76
3	107.47	999.27
4	112.32	1000.50
5	116.93	1002.43
6	121.20	1005.02
7	125.05	1008.22
8	128.38	1011.95
9	131.12	1016.13
10	133.22	1020.67

11            134.00        1023.33

Circle Center At X = 101.6 ; Y = 1032.5 and Radius, 33.8

\*\*\*        1.775        \*\*\*

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	105.00	1004.00
2	110.00	1003.90
3	114.97	1004.44
4	119.83	1005.60
5	124.51	1007.37
6	128.92	1009.73
7	133.00	1012.62
8	136.67	1016.01
9	139.89	1019.84
10	142.59	1024.04
11	143.52	1026.00

Circle Center At X = 108.3 ; Y = 1043.1 and Radius, 39.3

\*\*\*        1.776        \*\*\*

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	112.50	1009.00
2	117.47	1008.42
3	122.40	1009.24
4	126.90	1011.41
5	130.63	1014.75
6	133.28	1018.99
7	134.62	1023.75

Circle Center At X = 117.0 ; Y = 1026.2 and Radius, 17.8

\*\*\* 1.781 \*\*\*

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	994.00
2	94.98	993.51
3	99.96	993.89
4	104.81	995.13
5	109.37	997.18
6	113.50	1000.00
7	117.09	1003.48
8	120.02	1007.53
9	122.20	1012.03
10	123.42	1016.28

Circle Center At X = 95.3 ; Y = 1022.3 and Radius, 28.8

\*\*\* 1.789 \*\*\*

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	994.00
2	94.88	992.92
3	99.87	992.54
4	104.86	992.88
5	109.75	993.92
6	114.44	995.65
7	118.84	998.02
8	122.86	1001.00
9	126.41	1004.52
10	129.43	1008.51
11	131.84	1012.88
12	133.62	1017.56
13	134.71	1022.44

14            134.82        1023.88

Circle Center At X = 100.0 ; Y = 1027.6 and Radius, 35.1

\*\*\*        1.822        \*\*\*

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	112.50	1009.00
2	117.45	1008.29
3	122.36	1009.24
4	126.67	1011.77
5	129.92	1015.57
6	131.72	1020.24
7	131.77	1021.85

Circle Center At X = 117.1 ; Y = 1023.2 and Radius, 14.9

\*\*\*        1.881        \*\*\*

1

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	994.00
2	94.61	992.06
3	99.44	990.76
4	104.39	990.12
5	109.39	990.15
6	114.34	990.85
7	119.15	992.22
8	123.74	994.21
9	128.01	996.81
10	131.89	999.96
11	135.32	1003.60
12	138.22	1007.67
13	140.55	1012.10

14	142.26	1016.80
15	143.33	1021.68
16	143.67	1026.00

Circle Center At X = 106.7 ; Y = 1027.1 and Radius, 37.1

\*\*\* 2.025 \*\*\*

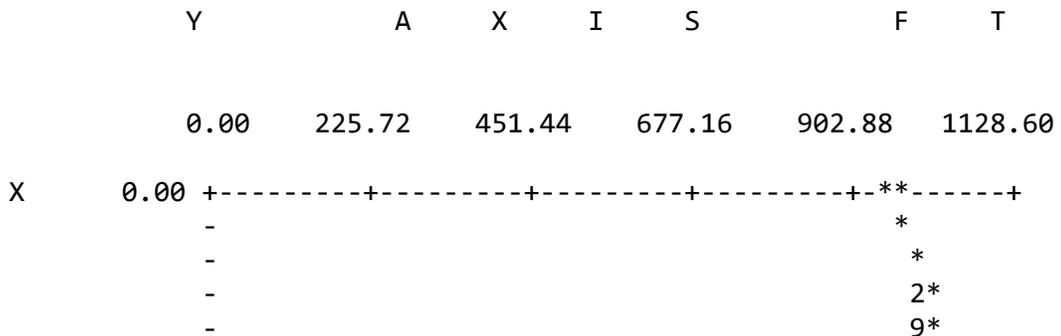
Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	97.50	999.00
2	102.32	997.67
3	107.29	997.11
4	112.28	997.34
5	117.18	998.36
6	121.85	1000.14
7	126.19	1002.63
8	130.08	1005.77
9	133.42	1009.48
10	136.14	1013.68
11	138.17	1018.25
12	139.44	1023.09
13	139.74	1026.00

Circle Center At X = 108.3 ; Y = 1028.7 and Radius, 31.6

\*\*\* 2.026 \*\*\*

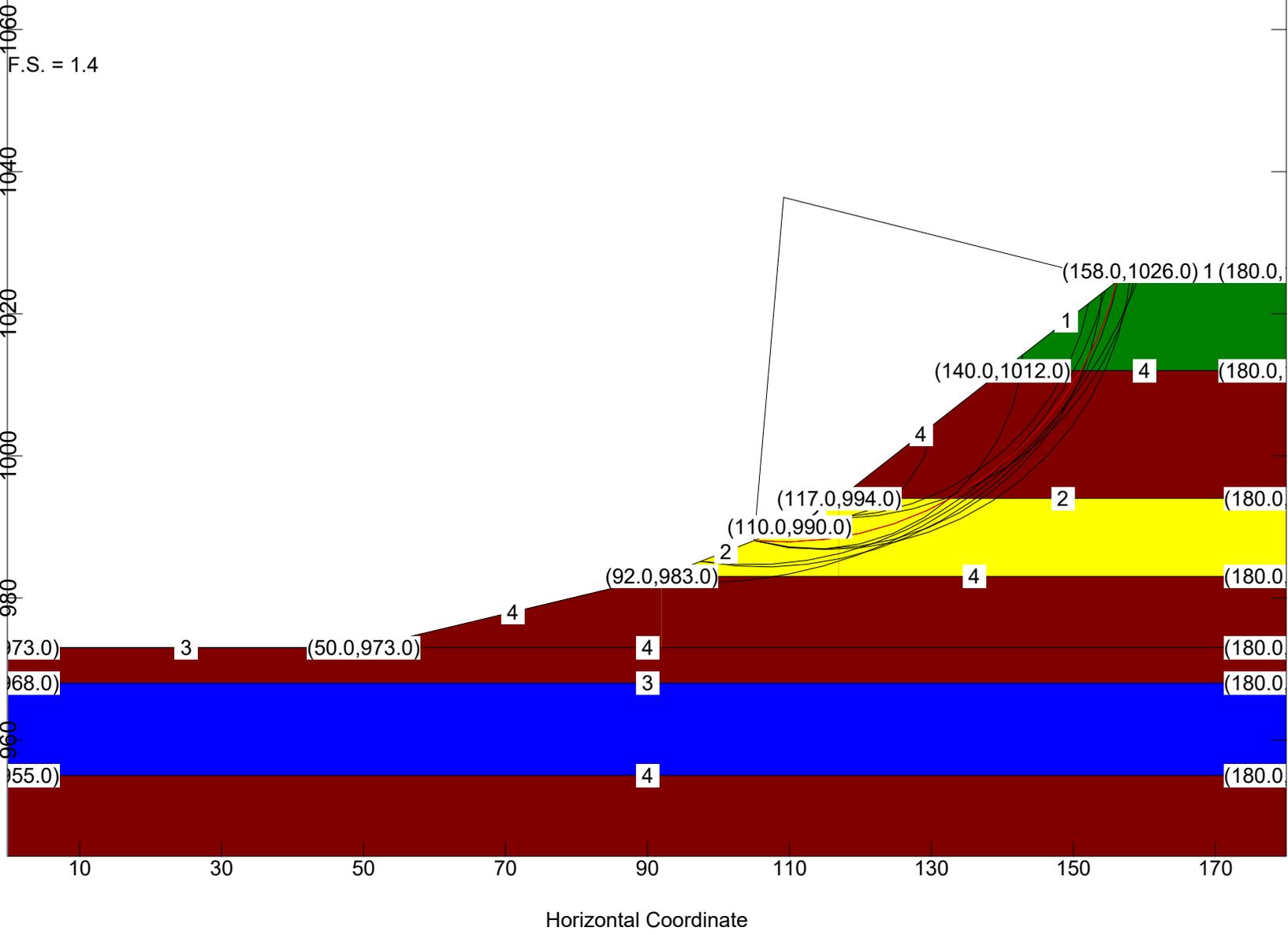
1



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T 1805.76 +

Factor of Safety = 1.4, X = 109.16, Y = 1036.37, R = 48.49



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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

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West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2 - Sta 400.sl4d  
Name of output file : Hartland Quarry - Section 2 - Sta 400.sl4o  
Name of plot output file : Hartland Quarry - Section 2 - Sta 400.sl4p

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Time and Date of Analysis

-----

Date: January 16, 2024 Time: 11:22:31

1

PROBLEM DESCRIPTION Section 2 - Sta 4+00

BOUNDARY COORDINATES

7 Top Boundaries  
13 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
--------------	------------	------------	-------------	-------------	---------------------

1	0.00	973.00	50.00	973.00	3
2	50.00	973.00	92.00	983.00	4
3	92.00	983.00	110.00	990.00	2
4	110.00	990.00	117.00	994.00	2
5	117.00	994.00	140.00	1012.00	4
6	140.00	1012.00	158.00	1026.00	1
7	158.00	1026.00	180.00	1026.00	1
8	140.00	1012.00	180.00	1012.00	4
9	117.00	994.00	180.00	994.00	2
10	92.00	983.00	180.00	983.00	4
11	0.00	973.00	180.00	973.00	4
12	0.00	968.00	180.00	968.00	3
13	0.00	955.00	180.00	955.00	4

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	37.0	0.00	0.0	0
2	135.0	0.0	0.0	40.0	0.00	0.0	0
3	140.0	0.0	0.0	43.0	0.00	0.0	0
4	145.0	0.0	0.0	46.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 90.00 ft. and X = 120.00 ft.

Each Surface Terminates Between X = 120.00 ft. and X = 160.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is  $Y = 900.00$  ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of  $-45.0$  And  $0.0$  deg.

1

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

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

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	105.00	988.06
2	110.00	987.88
3	114.99	988.23
4	119.91	989.08
5	124.72	990.44
6	129.37	992.29
7	133.80	994.60
8	137.97	997.36
9	141.84	1000.54
10	145.35	1004.09
11	148.48	1007.99
12	151.20	1012.19
13	153.46	1016.64
14	155.26	1021.31
15	156.14	1024.55

Circle Center At  $X = 109.2$  ;  $Y = 1036.4$  and Radius, 48.5

\*\*\* 1.4 \*\*\*

Individual data on the 19 slices

Surcharge			Water	Water	Tie	Tie	Earthquake		
Slice	Width	Weight	Force	Force	Force	Force	Hor	Ver	Load
No.	Ft	Lbs	Top	Bot	Norm	Tan	Lbs	Lbs	Lbs
			Lbs	Lbs	Lbs	Lbs			
1	5.0	0.71E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	0.0	0.70E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	5.0	0.23E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	2.0	0.14E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	2.9	0.25E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	4.8	0.57E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	4.6	0.70E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	3.3	0.56E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9	1.2	0.21E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	4.2	0.77E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	2.0	0.38E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	1.8	0.34E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	3.5	0.62E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
14	3.1	0.49E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	2.6	0.33E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16	0.1	0.14E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
17	2.3	0.21E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	1.8	0.98E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
19	0.9	0.15E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	97.50	985.14
2	102.48	984.71
3	107.48	984.75
4	112.45	985.29
5	117.35	986.30
6	122.13	987.77
7	126.74	989.71
8	131.14	992.08
9	135.30	994.86
10	139.16	998.03
11	142.70	1001.56
12	145.89	1005.42
13	148.68	1009.56
14	151.06	1013.96
15	153.01	1018.56
16	154.48	1023.27

Circle Center At X = 104.5 ; Y = 1036.4 and Radius, 51.7

\*\*\* 1.446 \*\*\*

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	97.50	985.14
2	102.46	984.51
3	107.46	984.37
4	112.45	984.72
5	117.38	985.55
6	122.20	986.87
7	126.87	988.65
8	131.35	990.87
9	135.59	993.53
10	139.54	996.59
11	143.18	1000.02
12	146.47	1003.79

13	149.37	1007.86
14	151.85	1012.20
15	153.90	1016.76
16	155.50	1021.49
17	156.22	1024.62

Circle Center At X = 106.4 ; Y = 1035.4 and Radius, 51.0

\*\*\* 1.461 \*\*\*

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	112.50	991.43
2	117.50	991.39
3	122.46	992.01
4	127.30	993.28
5	131.92	995.18
6	136.25	997.69
7	140.21	1000.74
8	143.73	1004.29
9	146.75	1008.28
10	149.21	1012.63
11	151.07	1017.27
12	152.13	1021.43

Circle Center At X = 115.3 ; Y = 1028.9 and Radius, 37.6

\*\*\* 1.473 \*\*\*

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	112.50	991.43
2	117.50	991.21
3	122.48	991.58
4	127.39	992.53

5	132.16	994.04
6	136.71	996.10
7	140.99	998.68
8	144.95	1001.75
9	148.51	1005.25
10	151.65	1009.14
11	154.31	1013.38
12	156.45	1017.90
13	158.05	1022.63
14	158.76	1026.00

Circle Center At X = 116.9 ; Y = 1033.9 and Radius, 42.7

\*\*\* 1.483 \*\*\*

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	982.52
2	94.99	982.17
3	99.99	982.19
4	104.97	982.58
5	109.91	983.36
6	114.78	984.50
7	119.55	986.01
8	124.19	987.87
9	128.67	990.08
10	132.98	992.62
11	137.08	995.48
12	140.96	998.64
13	144.58	1002.08
14	147.94	1005.79
15	151.00	1009.74
16	153.76	1013.91
17	156.19	1018.28
18	158.29	1022.82
19	159.48	1026.00

Circle Center At X = 97.2 ; Y = 1048.3 and Radius, 66.2

\*\*\* 1.483 \*\*\*

## Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	105.00	988.06
2	109.92	987.17
3	114.91	986.91
4	119.90	987.28
5	124.80	988.27
6	129.54	989.87
7	134.04	992.05
8	138.23	994.78
9	142.05	998.01
10	145.43	1001.69
11	148.32	1005.77
12	150.68	1010.18
13	152.46	1014.85
14	153.65	1019.71
15	154.01	1022.90

Circle Center At X = 114.5 ; Y = 1026.7 and Radius, 39.8

\*\*\* 1.500 \*\*\*

## Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	105.00	988.06
2	109.92	987.14
3	114.90	986.80
4	119.90	987.05
5	124.83	987.87
6	129.63	989.26
7	134.24	991.20
8	138.59	993.66
9	142.63	996.61
10	146.30	1000.01
11	149.55	1003.81
12	152.33	1007.96
13	154.61	1012.41

14	156.36	1017.10
15	157.56	1021.95
16	158.06	1026.00

Circle Center At X = 115.3 ; Y = 1029.8 and Radius, 43.0

\*\*\* 1.501 \*\*\*

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	112.50	991.43
2	117.50	991.22
3	122.27	992.70
4	126.26	995.71
5	129.01	999.89
6	130.06	1004.22

Circle Center At X = 115.6 ; Y = 1005.7 and Radius, 14.6

\*\*\* 1.504 \*\*\*

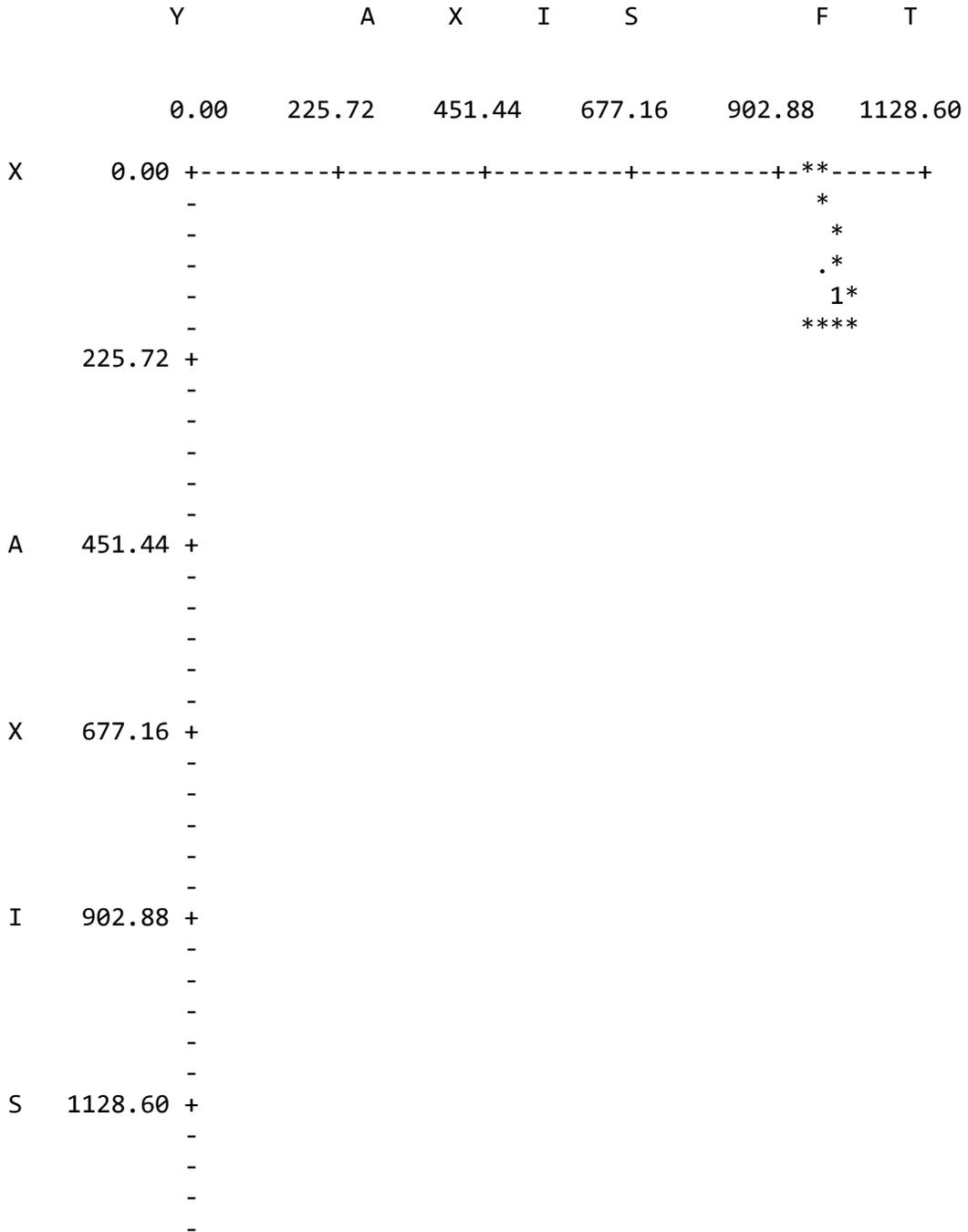
Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	105.00	988.06
2	109.90	987.06
3	114.90	986.90
4	119.85	987.58
5	124.62	989.08
6	129.07	991.37
7	133.07	994.36
8	136.51	997.99
9	139.30	1002.14
10	141.35	1006.70
11	142.60	1011.54
12	142.83	1014.20

Circle Center At X = 113.3 ; Y = 1016.5 and Radius, 29.7

\*\*\* 1.516 \*\*\*

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T 1805.76 +



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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

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West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2 - Sta 500.sl4d  
Name of output file : Hartland Quarry - Section 2 - Sta 500.sl4o  
Name of plot output file : Hartland Quarry - Section 2 - Sta 500.sl4p

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Time and Date of Analysis

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Date: January 16, 2024 Time: 10:44:17

1

PROBLEM DESCRIPTION Section 2 - Sta 5+00

BOUNDARY COORDINATES

7 Top Boundaries  
13 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
--------------	------------	------------	-------------	-------------	---------------------

1	0.00	975.00	50.00	975.00	4
2	50.00	975.00	90.00	983.00	4
3	90.00	983.00	118.00	992.00	2
4	118.00	992.00	125.00	994.00	2
5	125.00	994.00	147.00	1012.00	4
6	147.00	1012.00	159.00	1022.00	1
7	159.00	1022.00	180.00	1022.00	1
8	147.00	1012.00	180.00	1012.00	4
9	125.00	994.00	180.00	994.00	2
10	90.00	983.00	180.00	983.00	4
11	0.00	973.00	180.00	973.00	4
12	0.00	968.00	180.00	968.00	3
13	0.00	955.00	180.00	955.00	4

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	37.0	0.00	0.0	0
2	135.0	0.0	0.0	40.0	0.00	0.0	0
3	140.0	0.0	0.0	43.0	0.00	0.0	0
4	145.0	0.0	0.0	46.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 110.00 ft. and X = 140.00 ft.

Each Surface Terminates Between X = 140.00 ft. and X = 170.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -45.0 And 0.0 deg.

1

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

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

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	117.50	991.84
2	122.47	991.28
3	127.46	991.58
4	132.33	992.73
5	136.92	994.70
6	141.11	997.43
7	144.77	1000.84
8	147.78	1004.83
9	150.07	1009.27
10	151.56	1014.05
11	151.81	1016.01

Circle Center At X = 123.2 ; Y = 1020.3 and Radius, 29.0

\*\*\* 1.5 \*\*\*

Individual data on the 15 slices

Surcharge			Water Force	Water Force	Tie Force	Tie Force	Earthquake Force		Load
Slice No.	Width Ft	Weight Lbs	Top Lbs	Bot Lbs	Norm Lbs	Tan Lbs	Hor Lbs	Ver Lbs	Lbs
1	0.5	0.73E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	4.5	0.67E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	2.5	0.78E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	2.5	0.12E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	4.9	0.40E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	3.0	0.34E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	1.6	0.21E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	4.2	0.57E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9	3.7	0.51E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	2.2	0.28E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.8	0.91E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	2.3	0.21E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	0.9	0.49E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
14	0.6	0.21E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	0.3	0.29E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	117.50	991.84
2	122.44	991.08
3	127.42	991.52
4	132.16	993.12
5	136.38	995.80

6	139.85	999.40
7	142.36	1003.73
8	143.77	1008.52
9	143.82	1009.39

Circle Center At X = 123.1 ; Y = 1012.0 and Radius, 20.9

\*\*\* 1.514 \*\*\*

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	110.00	989.43
2	114.92	988.51
3	119.91	988.29
4	124.89	988.78
5	129.74	989.97
6	134.38	991.84
7	138.71	994.34
8	142.64	997.43
9	146.10	1001.04
10	149.01	1005.11
11	151.32	1009.54
12	152.98	1014.26
13	153.62	1017.52

Circle Center At X = 118.9 ; Y = 1023.6 and Radius, 35.3

\*\*\* 1.526 \*\*\*

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	110.00	989.43
2	114.99	989.04
3	119.97	989.39
4	124.86	990.45

5	129.54	992.21
6	133.92	994.63
7	137.89	997.66
8	141.39	1001.23
9	144.33	1005.27
10	146.65	1009.70
11	147.65	1012.54

Circle Center At X = 115.1 ; Y = 1023.4 and Radius, 34.4

\*\*\* 1.526 \*\*\*

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	110.00	989.43
2	114.89	988.38
3	119.88	988.08
4	124.86	988.54
5	129.72	989.73
6	134.34	991.64
7	138.62	994.21
8	142.47	997.41
9	145.80	1001.14
10	148.53	1005.33
11	150.60	1009.88
12	151.97	1014.69
13	152.17	1016.31

Circle Center At X = 119.4 ; Y = 1021.3 and Radius, 33.3

\*\*\* 1.548 \*\*\*

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	117.50	991.84

2	122.45	991.16
3	127.45	991.08
4	132.43	991.58
5	137.31	992.66
6	142.03	994.31
7	146.52	996.51
8	150.73	999.22
9	154.58	1002.40
10	158.03	1006.02
11	161.04	1010.01
12	163.55	1014.33
13	165.54	1018.92
14	166.46	1022.00

Circle Center At X = 125.7 ; Y = 1033.4 and Radius, 42.4

\*\*\* 1.593 \*\*\*

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	110.00	989.43
2	114.99	989.07
3	119.97	989.53
4	124.80	990.79
5	129.36	992.84
6	133.53	995.61
7	137.19	999.02
8	140.23	1002.98
9	142.59	1007.39
10	143.05	1008.77

Circle Center At X = 114.7 ; Y = 1019.5 and Radius, 30.4

\*\*\* 1.595 \*\*\*

Failure Surface Specified By 9 Coordinate Points

Point	X-Surf	Y-Surf
-------	--------	--------

No.	ft.	ft.
1	125.00	994.00
2	129.99	993.67
3	134.93	994.46
4	139.56	996.33
5	143.67	999.18
6	147.03	1002.88
7	149.48	1007.24
8	150.90	1012.04
9	151.11	1015.42

Circle Center At X = 129.0 ; Y = 1015.9 and Radius, 22.3

\*\*\* 1.600 \*\*\*

1

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	125.00	994.00
2	129.98	993.51
3	134.93	994.17
4	139.61	995.95
5	143.76	998.74
6	147.16	1002.40
7	149.64	1006.75
8	151.06	1011.54
9	151.29	1015.58

Circle Center At X = 129.6 ; Y = 1015.3 and Radius, 21.8

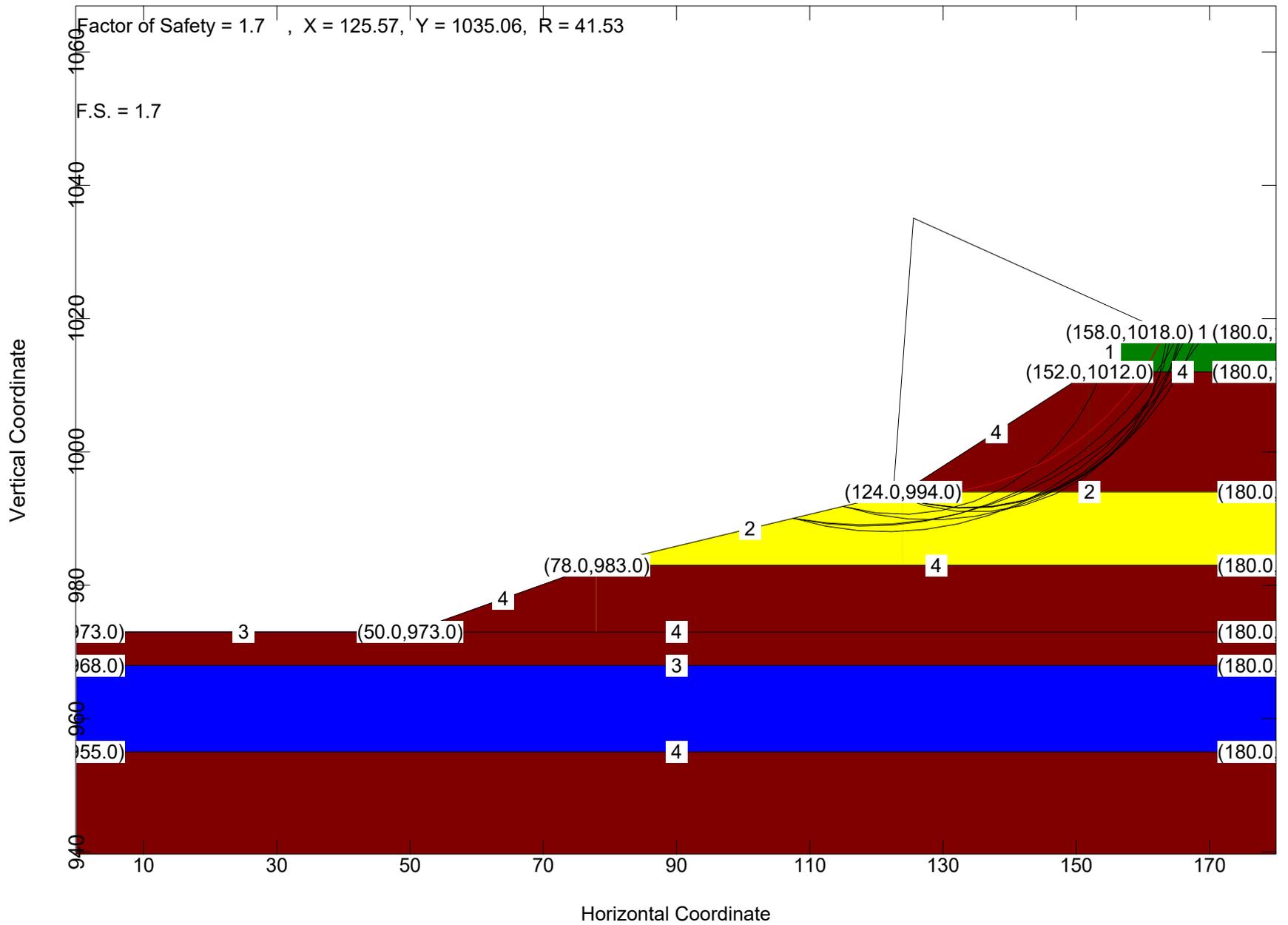
\*\*\* 1.617 \*\*\*

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	110.00	989.43



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I 899.36 +  
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S 1124.20 +  
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F 1573.88 +  
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T 1798.72 +



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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

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West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2 - Sta 600.sl4d  
Name of output file : Hartland Quarry - Section 2 - Sta 600.sl4o  
Name of plot output file : Hartland Quarry - Section 2 - Sta 600.sl4p

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Time and Date of Analysis

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Date: January 16, 2024 Time: 10:57:57

1

PROBLEM DESCRIPTION Section 2 - Sta 6+00

BOUNDARY COORDINATES

6 Top Boundaries  
12 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
-----------------	---------------	---------------	----------------	----------------	------------------------

1	0.00	973.00	50.00	973.00	3
2	50.00	973.00	78.00	983.00	4
3	78.00	983.00	124.00	994.00	2
4	124.00	994.00	152.00	1012.00	4
5	152.00	1012.00	158.00	1018.00	1
6	158.00	1018.00	180.00	1018.00	1
7	152.00	1012.00	180.00	1012.00	4
8	124.00	994.00	180.00	994.00	2
9	78.00	983.00	180.00	983.00	4
10	0.00	973.00	180.00	973.00	4
11	0.00	968.00	180.00	968.00	3
12	0.00	955.00	180.00	955.00	4

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	37.0	0.00	0.0	0
2	135.0	0.0	0.0	40.0	0.00	0.0	0
3	140.0	0.0	0.0	43.0	0.00	0.0	0
4	145.0	0.0	0.0	46.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 100.00 ft. and X = 130.00 ft.

Each Surface Terminates Between X = 130.00 ft. and X = 170.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y =900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

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

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

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	122.50	993.64
2	127.50	993.57
3	132.47	994.11
4	137.34	995.23
5	142.04	996.94
6	146.51	999.19
7	150.66	1001.97
8	154.46	1005.22
9	157.83	1008.91
10	160.74	1012.98
11	163.14	1017.37
12	163.39	1018.00

Circle Center At X = 125.6 ; Y = 1035.1 and Radius, 41.5

\*\*\* 1.7 \*\*\*

Individual data on the 16 slices

Surcharge			Water Force	Water Force	Tie Force	Tie Force	Earthquake Force		Load
Slice No.	Width Ft	Weight Lbs	Top Lbs	Bot Lbs	Norm Lbs	Tan Lbs	Hor Lbs	Ver Lbs	Lbs
1	1.5	0.38E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	3.5	0.76E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	4.0	0.22E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	1.0	0.73E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	4.9	0.45E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	4.7	0.55E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	4.5	0.58E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	4.2	0.56E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9	1.3	0.17E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	2.5	0.32E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	3.4	0.42E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	0.2	0.20E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	2.0	0.20E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
14	0.7	0.50E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	2.4	0.88E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16	0.3	0.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	115.00	991.85
2	119.90	990.87
3	124.90	990.67

4	129.87	991.25
5	134.68	992.60
6	139.22	994.69
7	143.38	997.47
8	147.06	1000.86
9	150.15	1004.78
10	152.60	1009.14
11	154.34	1013.83
12	154.46	1014.46

Circle Center At X = 123.7 ; Y = 1022.5 and Radius, 31.9

\*\*\* 1.761 \*\*\*

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	107.50	990.05
2	112.43	989.24
3	117.42	988.90
4	122.42	989.04
5	127.38	989.64
6	132.27	990.72
7	137.03	992.25
8	141.62	994.23
9	146.00	996.63
10	150.14	999.44
11	153.99	1002.63
12	157.52	1006.17
13	160.70	1010.03
14	163.50	1014.17
15	165.59	1018.00

Circle Center At X = 118.5 ; Y = 1041.6 and Radius, 52.7

\*\*\* 1.791 \*\*\*

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	107.50	990.05
2	112.36	988.88
3	117.32	988.21
4	122.31	988.04
5	127.30	988.38
6	132.23	989.22
7	137.05	990.56
8	141.70	992.37
9	146.15	994.66
10	150.35	997.38
11	154.24	1000.51
12	157.80	1004.02
13	160.99	1007.88
14	163.77	1012.03
15	166.11	1016.45
16	166.74	1018.00

Circle Center At X = 121.5 ; Y = 1037.3 and Radius, 49.3

\*\*\* 1.845 \*\*\*

1

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	107.50	990.05
2	112.45	989.36
3	117.44	989.08
4	122.44	989.21
5	127.41	989.77
6	132.32	990.74
7	137.12	992.12
8	141.80	993.89
9	146.30	996.06
10	150.62	998.59
11	154.70	1001.47
12	158.53	1004.69
13	162.08	1008.21
14	165.32	1012.02
15	168.22	1016.09
16	169.36	1018.00

Circle Center At X = 118.3 ; Y = 1048.7 and Radius, 59.6

\*\*\* 1.878 \*\*\*

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	115.00	991.85
2	119.85	990.61
3	124.80	989.95
4	129.80	989.86
5	134.78	990.36
6	139.66	991.43
7	144.38	993.07
8	148.89	995.24
9	153.11	997.92
10	156.98	1001.08
11	160.47	1004.66
12	163.51	1008.63
13	166.08	1012.92
14	168.12	1017.49
15	168.28	1018.00

Circle Center At X = 128.0 ; Y = 1032.7 and Radius, 42.9

\*\*\* 1.886 \*\*\*

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	122.50	993.64
2	127.30	992.23
3	132.26	991.61
4	137.26	991.79
5	142.16	992.77
6	146.84	994.53

7	151.18	997.01
8	155.07	1000.16
9	158.40	1003.88
10	161.09	1008.10
11	163.07	1012.69
12	164.29	1017.54
13	164.33	1018.00

Circle Center At X = 133.6 ; Y = 1022.7 and Radius, 31.1

\*\*\* 1.887 \*\*\*

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	122.50	993.64
2	127.31	992.28
3	132.28	991.68
4	137.27	991.84
5	142.19	992.76
6	146.90	994.43
7	151.30	996.80
8	155.29	999.82
9	158.77	1003.41
10	161.66	1007.49
11	163.88	1011.97
12	165.40	1016.73
13	165.60	1018.00

Circle Center At X = 133.7 ; Y = 1024.2 and Radius, 32.5

\*\*\* 1.913 \*\*\*

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	122.50	993.64

2	127.21	991.96
3	132.14	991.11
4	137.14	991.11
5	142.06	991.97
6	146.77	993.66
7	151.12	996.13
8	154.98	999.30
9	158.25	1003.09
10	160.81	1007.38
11	162.61	1012.04
12	163.58	1016.95
13	163.61	1018.00

Circle Center At X = 134.6 ; Y = 1020.2 and Radius, 29.1

\*\*\* 1.917 \*\*\*

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	122.50	993.64
2	127.30	992.24
3	132.26	991.60
4	137.26	991.72
5	142.18	992.62
6	146.90	994.25
7	151.32	996.59
8	155.33	999.58
9	158.83	1003.16
10	161.74	1007.22
11	163.99	1011.69
12	165.52	1016.44
13	165.77	1018.00

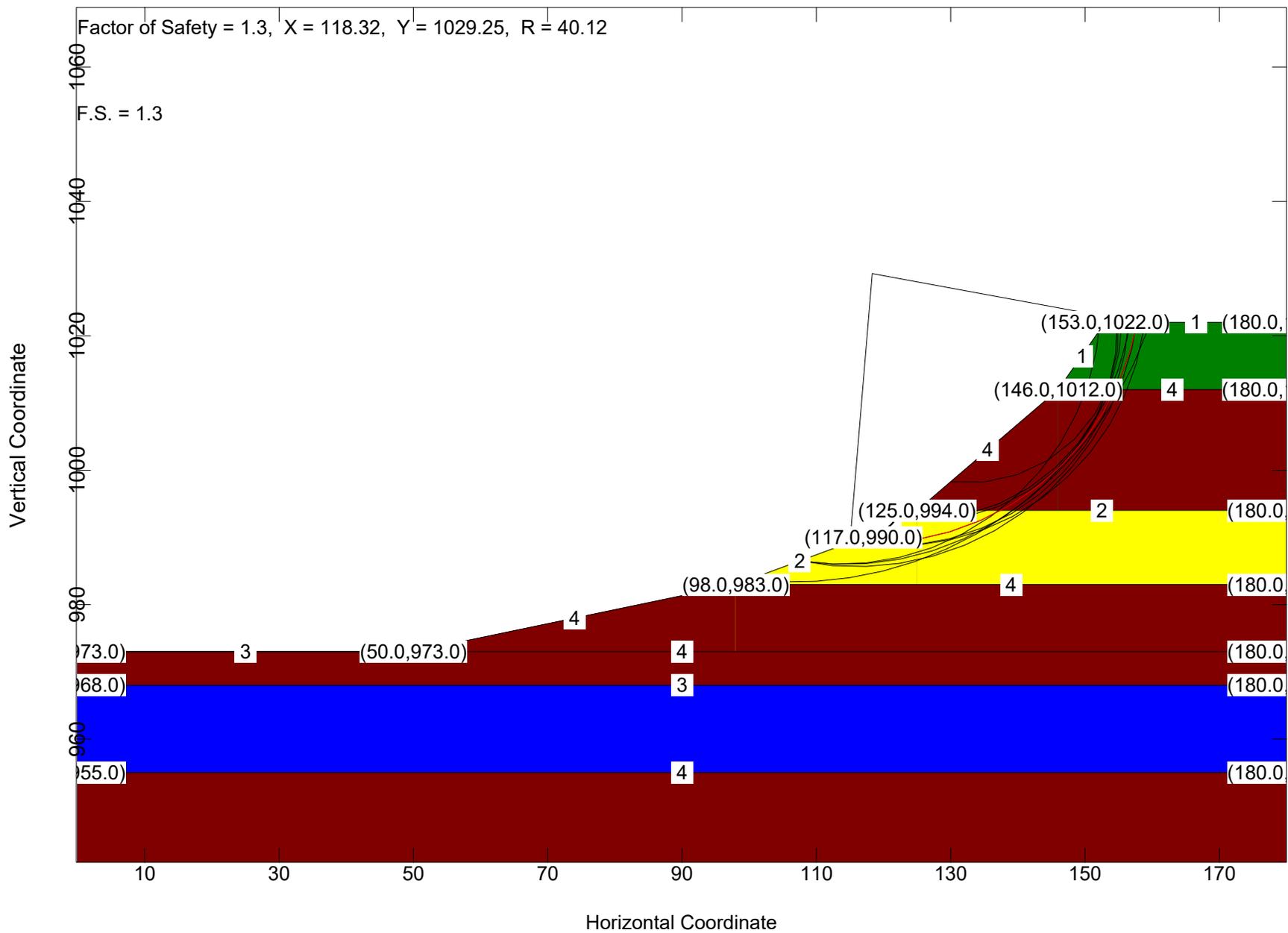
Circle Center At X = 133.9 ; Y = 1024.0 and Radius, 32.5

\*\*\* 1.923 \*\*\*

0.00      223.96      447.92      671.88      895.84      1119.80

X	0.00	+	-----+	-----+	-----+	-----+	*	-----+
		-					*	
		-					*	
		-					*.	
		-					1*	
		-					***	
	223.96	+						
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A	447.92	+						
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X	671.88	+						
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		-						
		-						
I	895.84	+						
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		-						
S	1119.80	+						
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		-						
		-						
	1343.76	+						
		-						
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		-						
		-						
F	1567.72	+						
		-						
		-						
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T 1791.68 +



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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2 - Sta 700.sl4d  
Name of output file : Hartland Quarry - Section 2 - Sta 700.sl4o  
Name of plot output file : Hartland Quarry - Section 2 - Sta 700.sl4p

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Time and Date of Analysis

-----

Date: January 16, 2024 Time: 11:50:42

1

PROBLEM DESCRIPTION Section 2 - Sta 7+00

BOUNDARY COORDINATES

7 Top Boundaries  
13 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
--------------	------------	------------	-------------	-------------	---------------------

1	0.00	973.00	50.00	973.00	3
2	50.00	973.00	98.00	983.00	4
3	98.00	983.00	117.00	990.00	2
4	117.00	990.00	125.00	994.00	2
5	125.00	994.00	146.00	1012.00	4
6	146.00	1012.00	153.00	1022.00	1
7	153.00	1022.00	180.00	1022.00	1
8	146.00	1012.00	180.00	1012.00	4
9	125.00	994.00	180.00	994.00	2
10	98.00	983.00	180.00	983.00	4
11	0.00	973.00	180.00	973.00	4
12	0.00	968.00	180.00	968.00	3
13	0.00	955.00	180.00	955.00	4

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	37.0	0.00	0.0	0
2	135.0	0.0	0.0	40.0	0.00	0.0	0
3	140.0	0.0	0.0	43.0	0.00	0.0	0
4	145.0	0.0	0.0	46.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 100.00 ft. and X = 130.00 ft.

Each Surface Terminates Between X = 130.00 ft. and X = 160.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is  $Y = 900.00$  ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of  $-45.0$  And  $0.0$  deg.

1

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

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

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	115.00	989.26
2	120.00	989.16
3	124.97	989.68
4	129.84	990.81
5	134.53	992.55
6	138.97	994.85
7	143.09	997.68
8	146.82	1001.01
9	150.11	1004.77
10	152.91	1008.92
11	155.17	1013.38
12	156.86	1018.08
13	157.73	1022.00

Circle Center At  $X = 118.3$  ;  $Y = 1029.2$  and Radius,  $40.1$

\*\*\* 1.3 \*\*\*

Individual data on the 18 slices

Surcharge Slice No.	Width Ft	Weight Lbs	Water	Water	Tie	Tie	Earthquake		Load Lbs
			Force Top Lbs	Force Bot Lbs	Force Norm Lbs	Force Tan Lbs	Force Hor Lbs	Force Ver Lbs	
1	2.0	0.10E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	3.0	0.63E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	5.0	0.22E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	0.0	0.16E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	4.8	0.39E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	4.7	0.57E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	2.8	0.41E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	1.6	0.26E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9	4.1	0.69E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	2.9	0.50E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.8	0.14E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	3.3	0.59E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	2.8	0.50E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
14	0.1	0.15E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	1.5	0.22E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16	0.7	0.84E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
17	1.7	0.14E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	0.9	0.22E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	107.50	986.50
2	112.48	986.01
3	117.48	986.10
4	122.43	986.76
5	127.28	988.00
6	131.95	989.79
7	136.38	992.10
8	140.51	994.92
9	144.29	998.19
10	147.67	1001.88
11	150.59	1005.93
12	153.03	1010.30
13	154.94	1014.92
14	156.31	1019.73
15	156.68	1022.00

Circle Center At X = 114.2 ; Y = 1029.1 and Radius, 43.1

\*\*\* 1.312 \*\*\*

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	115.00	989.26
2	119.97	988.74
3	124.97	988.92
4	129.89	989.81
5	134.64	991.38
6	139.12	993.60
7	143.24	996.43
8	146.92	999.82
9	150.08	1003.69
10	152.67	1007.97
11	154.63	1012.57
12	155.92	1017.40
13	156.48	1022.00

Circle Center At X = 121.2 ; Y = 1024.1 and Radius, 35.4

\*\*\* 1.321 \*\*\*

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	122.50	992.75
2	127.50	992.68
3	132.44	993.45
4	137.19	995.01
5	141.61	997.35
6	145.59	1000.38
7	149.01	1004.03
8	151.78	1008.19
9	153.82	1012.75
10	155.08	1017.59
11	155.47	1022.00

Circle Center At X = 125.4 ; Y = 1022.7 and Radius, 30.1

\*\*\* 1.326 \*\*\*

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	107.50	986.50
2	112.48	986.03
3	117.48	986.21
4	122.41	987.02
5	127.19	988.47
6	131.75	990.52
7	136.01	993.14
8	139.89	996.29
9	143.34	999.92
10	146.29	1003.95
11	148.69	1008.34
12	150.51	1012.99
13	151.72	1017.85
14	152.04	1020.62

Circle Center At X = 113.6 ; Y = 1024.7 and Radius, 38.7

\*\*\* 1.339 \*\*\*

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	107.50	986.50
2	112.45	985.79
3	117.45	985.67
4	122.43	986.14
5	127.31	987.20
6	132.04	988.83
7	136.54	991.01
8	140.75	993.70
9	144.61	996.88
10	148.07	1000.49
11	151.08	1004.48
12	153.59	1008.81
13	155.57	1013.40
14	157.00	1018.19
15	157.65	1022.00

Circle Center At X = 116.0 ; Y = 1027.8 and Radius, 42.1

\*\*\* 1.348 \*\*\*

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	122.50	992.75
2	127.49	992.51
3	132.45	993.14
4	137.22	994.64
5	141.66	996.95
6	145.62	1000.00

7	148.99	1003.70
8	151.65	1007.93
9	153.53	1012.56
10	154.58	1017.45
11	154.73	1022.00

Circle Center At X = 126.4 ; Y = 1020.9 and Radius, 28.4

\*\*\* 1.350 \*\*\*

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	115.00	989.26
2	119.97	988.72
3	124.97	988.84
4	129.91	989.63
5	134.70	991.07
6	139.25	993.12
7	143.50	995.77
8	147.35	998.96
9	150.75	1002.62
10	153.63	1006.71
11	155.94	1011.15
12	157.64	1015.85
13	158.70	1020.73
14	158.80	1022.00

Circle Center At X = 121.5 ; Y = 1026.2 and Radius, 37.6

\*\*\* 1.357 \*\*\*

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	100.00	983.74
2	104.99	983.38

3	109.99	983.47
4	114.96	984.01
5	119.86	984.99
6	124.66	986.40
7	129.31	988.23
8	133.78	990.48
9	138.03	993.11
10	142.03	996.11
11	145.74	999.46
12	149.15	1003.12
13	152.21	1007.07
14	154.90	1011.28
15	157.21	1015.72
16	159.12	1020.34
17	159.64	1022.00

Circle Center At X = 106.5 ; Y = 1039.3 and Radius, 56.0

\*\*\* 1.361 \*\*\*

Failure Surface Specified By 9 Coordinate Points

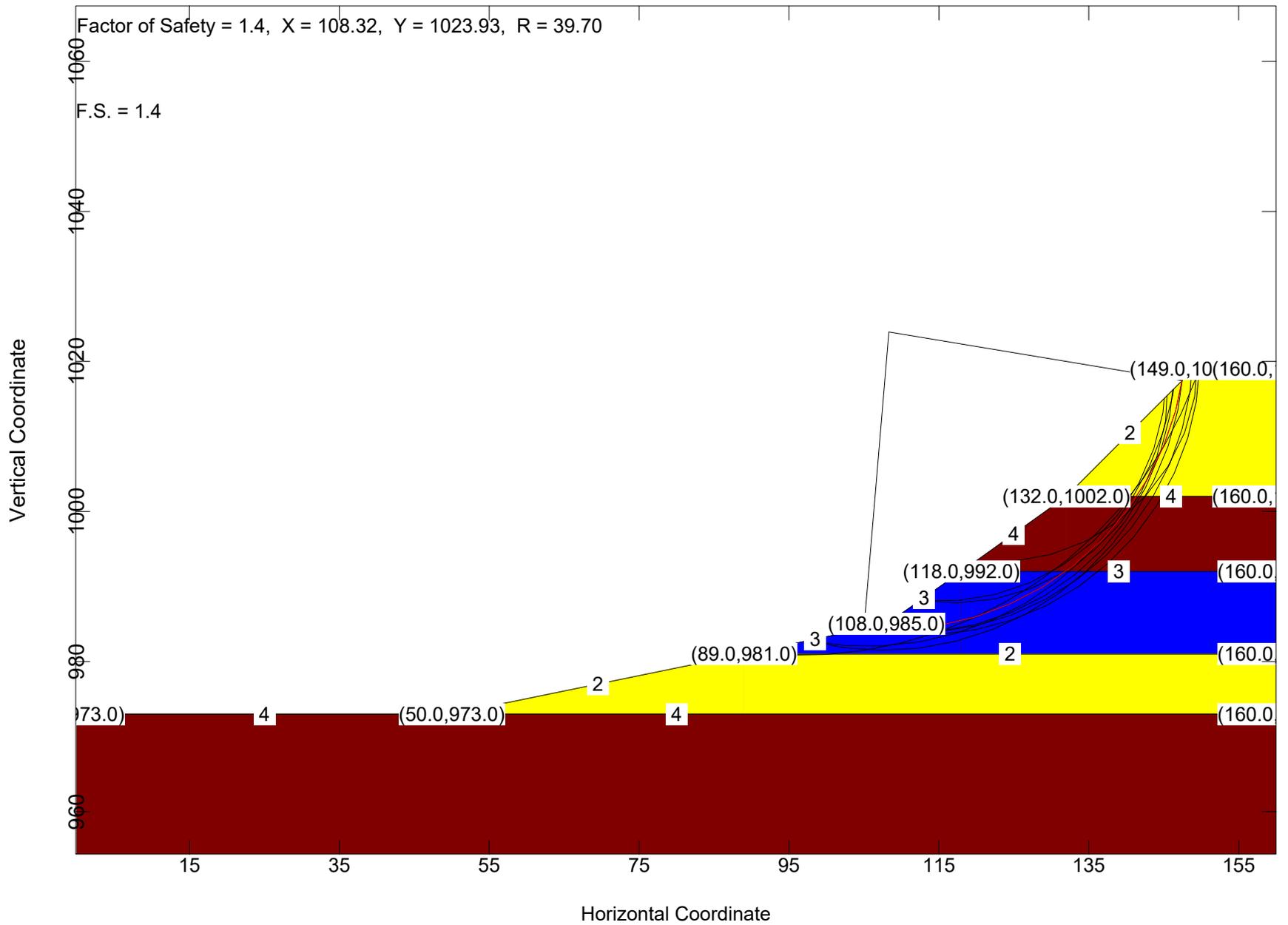
Point No.	X-Surf ft.	Y-Surf ft.
1	130.00	998.29
2	135.00	998.24
3	139.88	999.31
4	144.41	1001.44
5	148.34	1004.53
6	151.49	1008.41
7	153.69	1012.90
8	154.84	1017.77
9	154.87	1022.00

Circle Center At X = 132.7 ; Y = 1020.4 and Radius, 22.3

\*\*\* 1.393 \*\*\*



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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2 - Sta 1100.sl4d  
Name of output file : Hartland Quarry - Section 2 - Sta 1100.sl4o  
Name of plot output file : Hartland Quarry - Section 2 - Sta 1100.sl4p

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Time and Date of Analysis

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Date: January 16, 2024 Time: 14:28:46

1

PROBLEM DESCRIPTION Section 2 - Sta 8+00

BOUNDARY COORDINATES

7 Top Boundaries  
11 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
--------------	------------	------------	-------------	-------------	---------------------

1	0.00	973.00	50.00	973.00	4
2	50.00	973.00	89.00	981.00	2
3	89.00	981.00	108.00	985.00	3
4	108.00	985.00	118.00	992.00	3
5	118.00	992.00	132.00	1002.00	4
6	132.00	1002.00	149.00	1019.00	2
7	149.00	1019.00	160.00	1019.00	2
8	132.00	1002.00	160.00	1002.00	4
9	118.00	992.00	160.00	992.00	3
10	89.00	981.00	160.00	981.00	2
11	0.00	973.00	160.00	973.00	4

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	37.0	0.00	0.0	0
2	135.0	0.0	0.0	40.0	0.00	0.0	0
3	140.0	0.0	0.0	43.0	0.00	0.0	0
4	145.0	0.0	0.0	46.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 90.00 ft. and X = 120.00 ft.

Each Surface Terminates Between X = 120.00 ft. and X = 150.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

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

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

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	105.00	984.37
2	110.00	984.26
3	114.97	984.79
4	119.84	985.94
5	124.52	987.68
6	128.95	990.01
7	133.05	992.87
8	136.76	996.22
9	140.01	1000.02
10	142.77	1004.19
11	144.98	1008.68
12	146.60	1013.41
13	147.44	1017.44

Circle Center At X = 108.3 ; Y = 1023.9 and Radius, 39.7

\*\*\* 1.4 \*\*\*

Individual data on the 17 slices

Surcharge Slice No.	Width Ft	Weight Lbs	Water	Water	Tie	Tie	Earthquake		Load Lbs
			Force Top Lbs	Force Bot Lbs	Force Norm Lbs	Force Tan Lbs	Force Hor Lbs	Force Ver Lbs	
1	3.0	0.15E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	2.0	0.40E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	5.0	0.25E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	3.0	0.25E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	1.8	0.18E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	4.7	0.54E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	4.4	0.60E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	2.9	0.41E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9	0.2	0.28E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.1	0.15E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	3.7	0.55E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	3.3	0.46E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	1.3	0.17E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
14	1.4	0.17E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	2.2	0.22E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16	1.6	0.10E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
17	0.8	0.18E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

-----  
Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	120.00	993.43

2	125.00	993.38
3	129.92	994.26
4	134.59	996.04
5	138.85	998.66
6	142.55	1002.02
7	145.56	1006.01
8	147.78	1010.50
9	149.12	1015.31
10	149.43	1019.00

Circle Center At X = 122.8 ; Y = 1020.1 and Radius, 26.8

\*\*\* 1.377 \*\*\*

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	112.50	988.15
2	117.50	988.12
3	122.44	988.92
4	127.17	990.52
5	131.58	992.89
6	135.53	995.94
7	138.93	999.61
8	141.67	1003.80
9	143.69	1008.37
10	144.92	1013.22
11	145.07	1015.07

Circle Center At X = 115.2 ; Y = 1018.2 and Radius, 30.2

\*\*\* 1.414 \*\*\*

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	981.21

2	94.99	980.85
3	99.99	980.94
4	104.96	981.47
5	109.86	982.44
6	114.66	983.84
7	119.32	985.67
8	123.79	987.90
9	128.05	990.52
10	132.06	993.50
11	135.79	996.84
12	139.21	1000.49
13	142.29	1004.43
14	145.00	1008.62
15	147.34	1013.05
16	149.27	1017.66
17	149.69	1019.00

Circle Center At X = 96.5 ; Y = 1037.0 and Radius, 56.2

\*\*\* 1.418 \*\*\*

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	105.00	984.37
2	109.97	983.83
3	114.97	983.97
4	119.91	984.76
5	124.69	986.21
6	129.24	988.29
7	133.47	990.95
8	137.31	994.15
9	140.69	997.84
10	143.55	1001.94
11	145.83	1006.39
12	147.50	1011.10
13	148.52	1016.00
14	148.72	1018.72

Circle Center At X = 111.5 ; Y = 1021.2 and Radius, 37.4

\*\*\* 1.427 \*\*\*

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	105.00	984.37
2	109.97	983.85
3	114.97	984.04
4	119.89	984.94
5	124.63	986.52
6	129.10	988.76
7	133.21	991.61
8	136.88	995.01
9	140.02	998.90
10	142.59	1003.19
11	144.52	1007.80
12	145.78	1012.64
13	146.18	1016.18

Circle Center At X = 111.1 ; Y = 1019.1 and Radius, 35.2

\*\*\* 1.449 \*\*\*

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	105.00	984.37
2	109.95	983.66
3	114.95	983.62
4	119.91	984.25
5	124.74	985.54
6	129.35	987.47
7	133.66	990.01
8	137.59	993.10
9	141.07	996.70
10	144.03	1000.72
11	146.42	1005.11
12	148.20	1009.79
13	149.34	1014.65

14            149.75        1019.00

Circle Center At X = 112.7 ; Y = 1020.6 and Radius, 37.1

\*\*\*        1.452        \*\*\*

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	97.50	982.79
2	102.46	982.14
3	107.46	982.08
4	112.43	982.63
5	117.30	983.77
6	121.99	985.48
7	126.45	987.74
8	130.60	990.53
9	134.39	993.79
10	137.77	997.48
11	140.67	1001.55
12	143.06	1005.94
13	144.91	1010.59
14	146.19	1015.42
15	146.32	1016.32

Circle Center At X = 105.4 ; Y = 1023.6 and Radius, 41.6

\*\*\*        1.461        \*\*\*

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	112.50	988.15
2	117.49	987.81
3	122.46	988.34
4	127.26	989.73
5	131.75	991.93

6	135.79	994.88
7	139.25	998.48
8	142.03	1002.64
9	144.05	1007.22
10	145.24	1012.07
11	145.46	1015.46

Circle Center At X = 117.0 ; Y = 1016.4 and Radius, 28.6

\*\*\* 1.461 \*\*\*

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	97.50	982.79
2	102.41	981.84
3	107.40	981.51
4	112.39	981.81
5	117.31	982.72
6	122.07	984.23
7	126.61	986.32
8	130.86	988.96
9	134.74	992.11
10	138.21	995.72
11	141.20	999.73
12	143.66	1004.08
13	145.57	1008.70
14	146.89	1013.52
15	147.46	1017.46

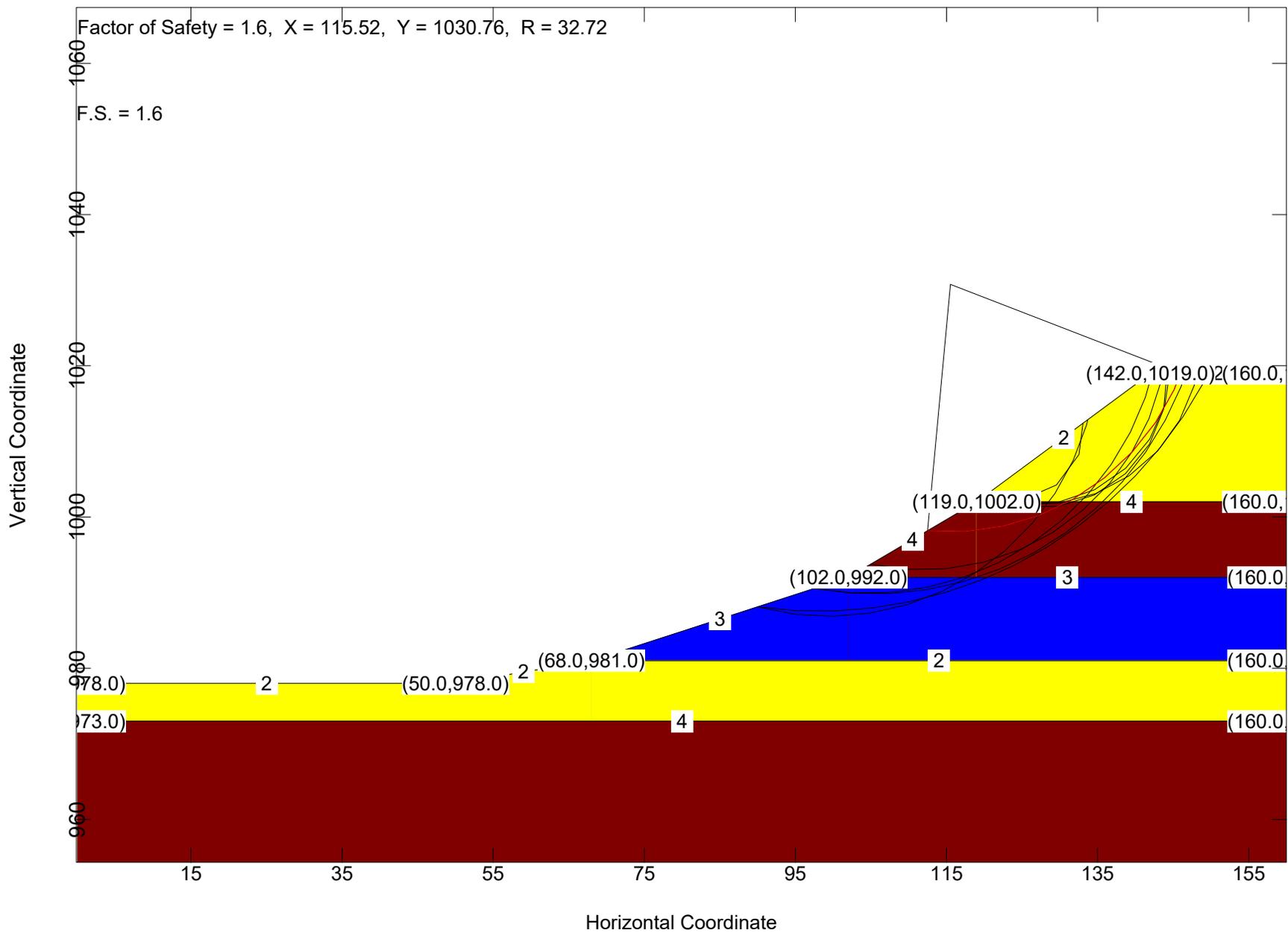
Circle Center At X = 107.5 ; Y = 1021.7 and Radius, 40.2

\*\*\* 1.496 \*\*\*

1

Y	A	X	I	S	F	T
0.00	224.18	448.36	672.54	896.72	1120.90	





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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

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West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2 - Sta 900.sl4d  
Name of output file : Hartland Quarry - Section 2 - Sta 900.sl4o  
Name of plot output file : Hartland Quarry - Section 2 - Sta 900.sl4p

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Time and Date of Analysis

-----

Date: January 16, 2024 Time: 14:14:22

1

PROBLEM DESCRIPTION Section 2 - Sta 9+00

BOUNDARY COORDINATES

6 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	978.00	50.00	978.00	2
2	50.00	978.00	68.00	981.00	2
3	68.00	981.00	102.00	992.00	3
4	102.00	992.00	119.00	1002.00	4
5	119.00	1002.00	142.00	1019.00	2
6	142.00	1019.00	160.00	1019.00	2
7	119.00	1002.00	160.00	1002.00	4
8	102.00	992.00	160.00	992.00	3
9	68.00	981.00	160.00	981.00	2
10	0.00	973.00	160.00	973.00	4

1

#### ISOTROPIC SOIL PARAMETERS

##### 4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	37.0	0.00	0.0	0
2	135.0	0.0	0.0	40.0	0.00	0.0	0
3	140.0	0.0	0.0	43.0	0.00	0.0	0
4	145.0	0.0	0.0	46.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 90.00 ft.  
and X = 120.00 ft.

Each Surface Terminates Between X = 120.00 ft.  
and X = 150.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

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

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

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	112.50	998.18
2	117.50	998.10
3	122.45	998.78
4	127.24	1000.21
5	131.76	1002.35
6	135.90	1005.16
7	139.56	1008.56
8	142.66	1012.49
9	145.13	1016.84
10	145.95	1019.00

Circle Center At X = 115.5 ; Y = 1030.8 and Radius, 32.7

\*\*\* 1.6 \*\*\*

Individual data on the 12 slices

	Water Force	Water Force	Tie Force	Tie Force	Earthquake Force
Surcharge					

Slice No.	Width Ft	Weight Lbs	Top Lbs	Bot Lbs	Norm Lbs	Tan Lbs	Hor Lbs	Ver Lbs	Load Lbs
1	5.0	0.11E+04	0.00E+00						
2	1.5	0.73E+03	0.00E+00						
3	3.5	0.23E+04	0.00E+00						
4	4.8	0.45E+04	0.00E+00						
5	3.8	0.43E+04	0.00E+00						
6	0.7	0.90E+03	0.00E+00						
7	4.1	0.51E+04	0.00E+00						
8	3.7	0.44E+04	0.00E+00						
9	2.4	0.26E+04	0.00E+00						
10	0.7	0.62E+03	0.00E+00						
11	2.5	0.14E+04	0.00E+00						
12	0.8	0.12E+03	0.00E+00						

-----  
Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	120.00	1002.74
2	124.97	1002.23
3	129.55	1004.24
4	132.55	1008.25
5	133.07	1012.40

Circle Center At X = 123.5 ; Y = 1011.9 and Radius, 9.8

\*\*\* 1.622 \*\*\*

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	97.50	990.54
2	102.47	989.96
3	107.47	990.01
4	112.42	990.71
5	117.24	992.03
6	121.85	993.95
7	126.19	996.45
8	130.16	999.48
9	133.72	1003.00
10	136.80	1006.94
11	139.34	1011.24
12	141.32	1015.83
13	142.23	1019.00

Circle Center At X = 104.5 ; Y = 1029.0 and Radius, 39.1

\*\*\* 1.675 \*\*\*

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	120.00	1002.74
2	124.89	1001.68
3	129.88	1001.97
4	134.60	1003.60
5	138.71	1006.45
6	141.90	1010.30
7	143.93	1014.87
8	144.53	1019.00

Circle Center At X = 126.3 ; Y = 1020.0 and Radius, 18.3

\*\*\* 1.704 \*\*\*

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	97.50	990.54
2	102.46	989.93
3	107.46	989.88
4	112.43	990.40
5	117.32	991.48
6	122.04	993.11
7	126.55	995.27
8	130.79	997.92
9	134.69	1001.05
10	138.22	1004.59
11	141.32	1008.52
12	143.95	1012.77
13	146.08	1017.29
14	146.66	1019.00

Circle Center At X = 105.4 ; Y = 1033.7 and Radius, 43.9

\*\*\* 1.716 \*\*\*

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	105.00	993.77
2	109.95	993.08
3	114.95	993.17
4	119.88	994.02
5	124.61	995.63
6	129.05	997.94
7	133.07	1000.91
8	136.59	1004.47
9	139.51	1008.52
10	141.78	1012.97
11	143.34	1017.73
12	143.55	1019.00

Circle Center At X = 111.9 ; Y = 1025.4 and Radius, 32.4

\*\*\* 1.740 \*\*\*

1

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	988.12
2	94.98	987.63
3	99.98	987.57
4	104.96	987.95
5	109.90	988.75
6	114.75	989.97
7	119.47	991.61
8	124.03	993.65
9	128.41	996.08
10	132.55	998.87
11	136.44	1002.01
12	140.05	1005.48
13	143.34	1009.24
14	146.30	1013.27
15	148.89	1017.55
16	149.61	1019.00

Circle Center At X = 98.1 ; Y = 1045.5 and Radius, 57.9

\*\*\* 1.757 \*\*\*

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	120.00	1002.74
2	124.89	1001.72
3	129.89	1001.84
4	134.73	1003.10
5	139.15	1005.43
6	142.93	1008.71
7	145.85	1012.77
8	147.77	1017.38
9	148.03	1019.00

Circle Center At X = 126.9 ; Y = 1023.4 and Radius, 21.7

\*\*\* 1.807 \*\*\*

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	120.00	1002.74
2	124.81	1001.36
3	129.80	1001.42
4	134.57	1002.92
5	138.71	1005.73
6	141.85	1009.62
7	143.74	1014.25
8	144.20	1019.00

Circle Center At X = 127.1 ; Y = 1018.3 and Radius, 17.1

\*\*\* 1.828 \*\*\*

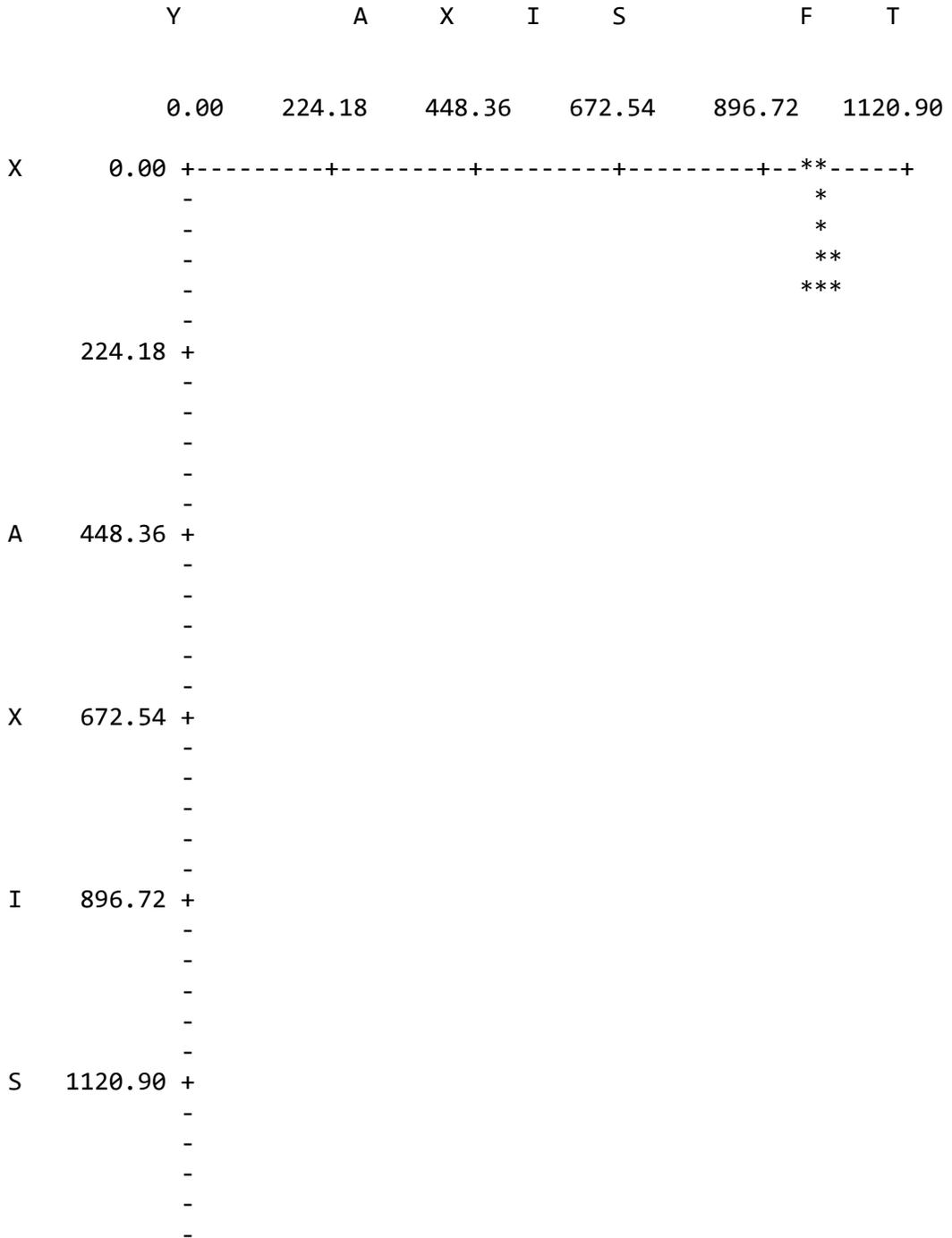
Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	988.12
2	94.90	987.14
3	99.90	986.86
4	104.88	987.28
5	109.75	988.39
6	114.43	990.18
7	118.80	992.59
8	122.80	995.60
9	126.34	999.13
10	129.34	1003.13
11	131.76	1007.50
12	133.55	1012.17
13	133.71	1012.87

Circle Center At X = 99.4 ; Y = 1022.6 and Radius, 35.7

\*\*\* 1.859 \*\*\*

1



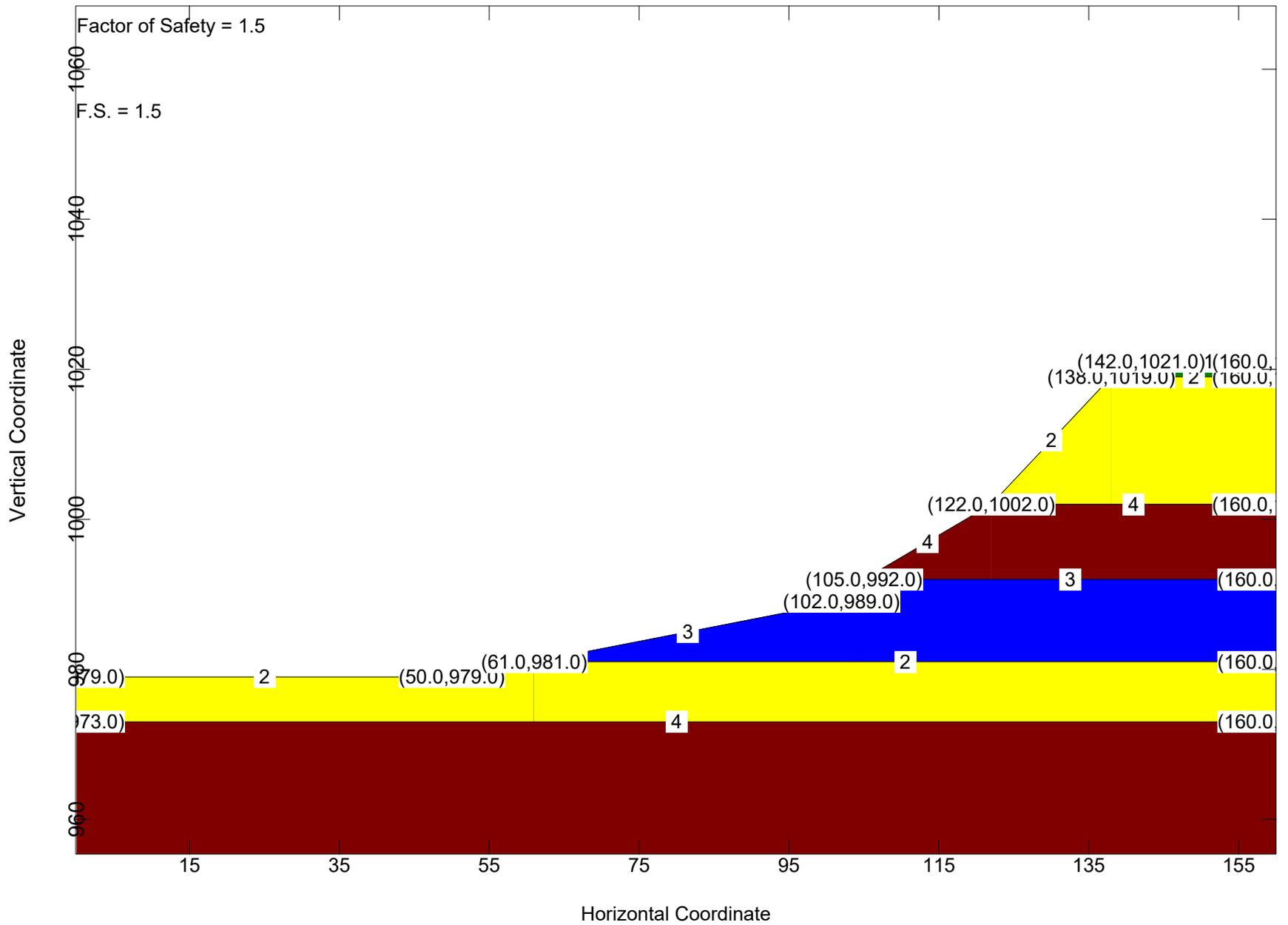
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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2 - Sta 1000.sl4d  
Name of output file : Hartland Quarry - Section 2 - Sta 1000.sl4o  
Name of plot output file : Hartland Quarry - Section 2 - Sta 1000.sl4p

-----

Time and Date of Analysis

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Date: January 16, 2024 Time: 14:02:21

1

PROBLEM DESCRIPTION Section 2 - Sta 10+00

BOUNDARY COORDINATES

8 Top Boundaries  
13 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
--------------	------------	------------	-------------	-------------	---------------------

1	0.00	979.00	50.00	979.00	2
2	50.00	979.00	61.00	981.00	2
3	61.00	981.00	102.00	989.00	3
4	102.00	989.00	105.00	992.00	3
5	105.00	992.00	122.00	1002.00	4
6	122.00	1002.00	138.00	1019.00	2
7	138.00	1019.00	142.00	1021.00	1
8	142.00	1021.00	160.00	1021.00	1
9	138.00	1019.00	160.00	1019.00	2
10	122.00	1002.00	160.00	1002.00	4
11	105.00	992.00	160.00	992.00	3
12	61.00	981.00	160.00	981.00	2
13	0.00	973.00	160.00	973.00	4

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	37.0	0.00	0.0	0
2	135.0	0.0	0.0	40.0	0.00	0.0	0
3	140.0	0.0	0.0	43.0	0.00	0.0	0
4	145.0	0.0	0.0	46.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 100.00 ft. and X = 120.00 ft.

Each Surface Terminates Between X = 120.00 ft. and X = 140.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation  
At Which A Surface Extends Is  $Y = 900.00$  ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

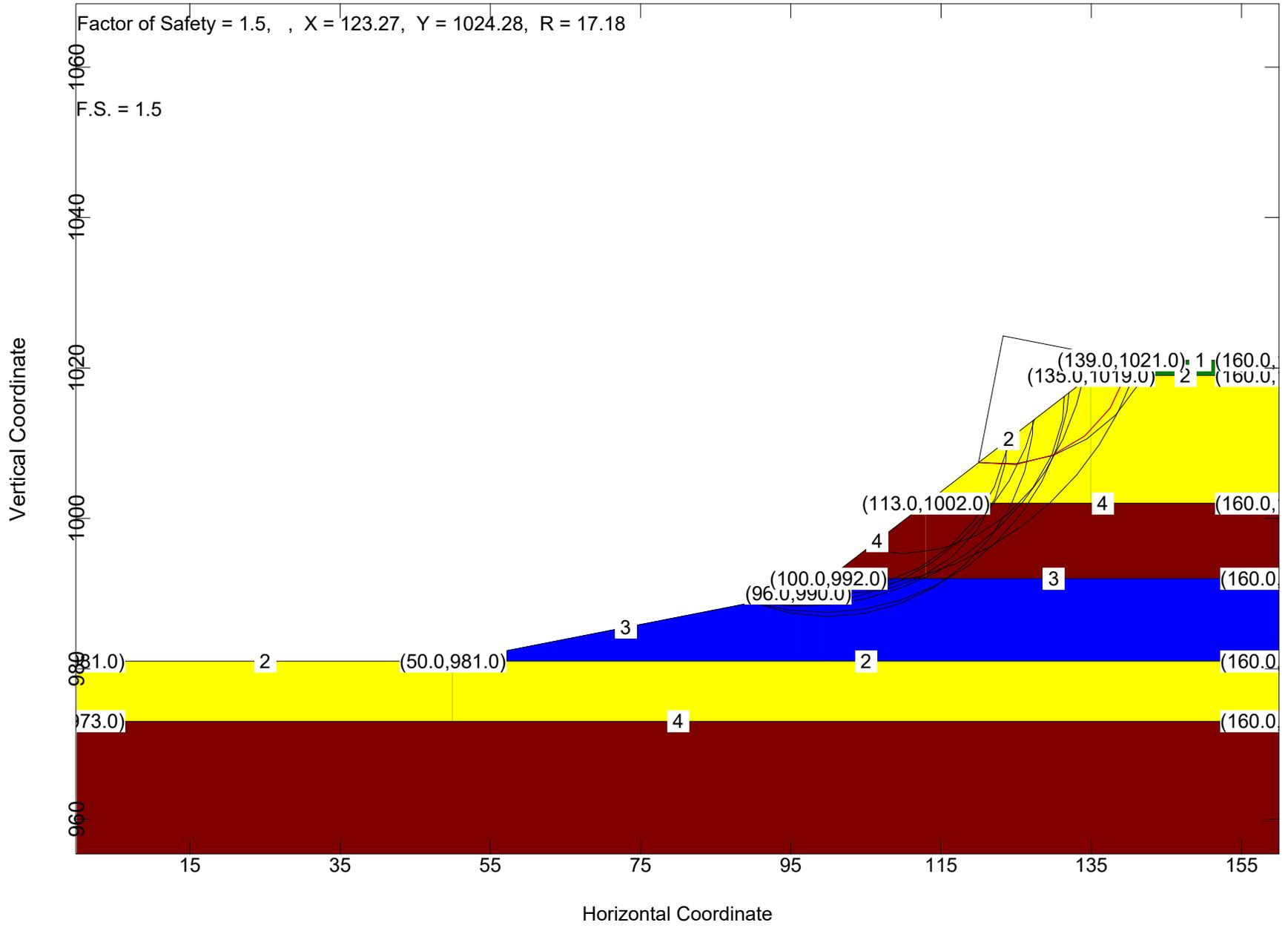
Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of  $-45.0$   
And  $0.0$  deg.

\*\*\*\* ERROR - RC10 \*\*\*\*

```
*****  
***** EXECUTION OF STABL ABORTED *****  
*****
```

Factor of Safety = 1.5, , X = 123.27, Y = 1024.28, R = 17.18

F.S. = 1.5



=====

STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

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Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2 - Sta 1100.sl4d  
Name of output file : Hartland Quarry - Section 2 - Sta 1100.sl4o  
Name of plot output file : Hartland Quarry - Section 2 - Sta 1100.sl4p

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Time and Date of Analysis

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Date: January 16, 2024 Time: 12:49:55

1

PROBLEM DESCRIPTION Section 2 - Sta 11+00

BOUNDARY COORDINATES

7 Top Boundaries  
12 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
--------------	------------	------------	-------------	-------------	---------------------

1	0.00	981.00	50.00	981.00	2
2	50.00	981.00	96.00	990.00	3
3	96.00	990.00	100.00	992.00	3
4	100.00	992.00	113.00	1002.00	4
5	113.00	1002.00	135.00	1019.00	2
6	135.00	1019.00	139.00	1021.00	1
7	139.00	1021.00	160.00	1021.00	1
8	135.00	1019.00	160.00	1019.00	2
9	113.00	1002.00	160.00	1002.00	4
10	100.00	992.00	160.00	992.00	3
11	50.00	981.00	160.00	981.00	2
12	0.00	973.00	160.00	973.00	4

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	37.0	0.00	0.0	0
2	135.0	0.0	0.0	40.0	0.00	0.0	0
3	140.0	0.0	0.0	43.0	0.00	0.0	0
4	145.0	0.0	0.0	46.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 90.00 ft. and X = 120.00 ft.

Each Surface Terminates Between X = 120.00 ft. and X = 150.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y =900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

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

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

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	120.00	1007.41
2	125.00	1007.18
3	129.84	1008.40
4	134.14	1010.97
5	137.51	1014.66
6	139.68	1019.16
7	139.96	1021.00

Circle Center At X = 123.3 ; Y = 1024.3 and Radius, 17.2

\*\*\* 1.5 \*\*\*

Individual data on the 9 slices

Surcharge	Water Force	Water Force	Tie Force	Tie Force	Earthquake Force			
Slice Width	Weight	Top	Bot	Norm	Tan	Hor	Ver	Load

No.	Ft	Lbs	
1	5.0	0.14E+04	0.00E+00
2	4.8	0.35E+04	0.00E+00
3	4.3	0.41E+04	0.00E+00
4	0.9	0.84E+03	0.00E+00
5	2.5	0.21E+04	0.00E+00
6	1.5	0.88E+03	0.00E+00
7	0.6	0.21E+03	0.00E+00
8	0.1	0.20E+02	0.00E+00
9	0.3	0.35E+02	0.00E+00

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Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	988.83
2	94.98	988.34
3	99.97	988.50
4	104.91	989.31
5	109.70	990.74
6	114.26	992.78
7	118.53	995.40
8	122.42	998.54
9	125.87	1002.15
10	128.83	1006.19
11	131.24	1010.56
12	133.07	1015.22
13	133.78	1018.05

Circle Center At X = 96.2 ; Y = 1027.0 and Radius, 38.7

\*\*\* 1.510 \*\*\*

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	988.83
2	94.99	988.44
3	99.97	988.80
4	104.85	989.89
5	109.52	991.69
6	113.86	994.17
7	117.79	997.26
8	121.22	1000.90
9	124.07	1005.01
10	126.28	1009.49
11	127.46	1013.17

Circle Center At X = 95.1 ; Y = 1022.1 and Radius, 33.7

\*\*\* 1.519 \*\*\*

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	97.50	990.75
2	102.50	990.70
3	107.47	991.24
4	112.35	992.35
5	117.06	994.02
6	121.54	996.23
7	125.74	998.95
8	129.59	1002.15
9	133.04	1005.77
10	136.04	1009.76
11	138.55	1014.08
12	140.55	1018.67
13	141.25	1021.00

Circle Center At X = 100.4 ; Y = 1033.4 and Radius, 42.7

\*\*\* 1.528 \*\*\*

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	120.00	1007.41
2	125.00	1007.29
3	129.88	1008.35
4	134.38	1010.54
5	138.23	1013.72
6	141.22	1017.73
7	142.61	1021.00

Circle Center At X = 123.0 ; Y = 1028.2 and Radius, 21.0

\*\*\* 1.551 \*\*\*

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	97.50	990.75
2	102.50	990.58
3	107.42	991.47
4	112.04	993.39
5	116.14	996.24
6	119.55	999.90
7	122.11	1004.20
8	123.70	1008.94
9	123.86	1010.39

Circle Center At X = 100.8 ; Y = 1014.0 and Radius, 23.5

\*\*\* 1.572 \*\*\*

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	988.83
2	94.89	987.78
3	99.88	987.49
4	104.86	987.95
5	109.71	989.16
6	114.33	991.09
7	118.59	993.69
8	122.42	996.91
9	125.72	1000.66
10	128.41	1004.88
11	130.44	1009.45
12	131.75	1014.27
13	132.03	1016.70

Circle Center At X = 99.3 ; Y = 1020.5 and Radius, 33.0

\*\*\* 1.610 \*\*\*

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	105.00	995.85
2	109.97	995.32
3	114.93	995.94
4	119.62	997.67
5	123.79	1000.43
6	127.23	1004.07
7	129.74	1008.39
8	131.20	1013.17
9	131.40	1016.22

Circle Center At X = 109.8 ; Y = 1017.1 and Radius, 21.8

\*\*\* 1.669 \*\*\*

Point No.	X-Surf ft.	Y-Surf ft.
1	97.50	990.75
2	102.45	990.01
3	107.42	990.47
4	112.15	992.10
5	116.36	994.80
6	119.79	998.43
7	122.27	1002.78
8	123.64	1007.59
9	123.74	1010.30

Circle Center At X = 103.0 ; Y = 1010.9 and Radius, 20.9

\*\*\* 1.677 \*\*\*

Failure Surface Specified By 12 Coordinate Points

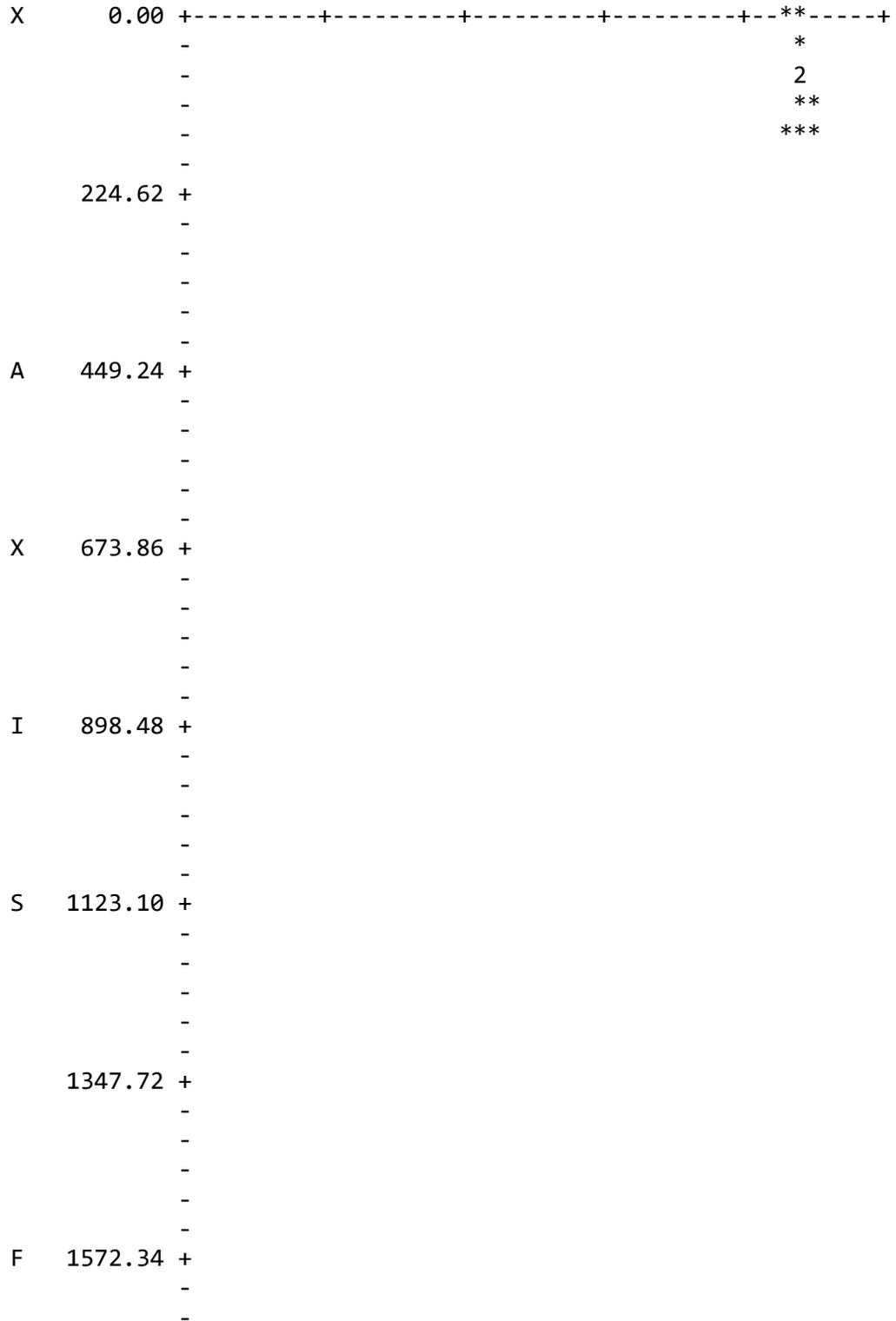
Point No.	X-Surf ft.	Y-Surf ft.
1	90.00	988.83
2	94.80	987.44
3	99.78	986.94
4	104.76	987.36
5	109.58	988.68
6	114.09	990.85
7	118.12	993.81
8	121.55	997.45
9	124.25	1001.66
10	126.15	1006.28
11	127.18	1011.18
12	127.22	1012.99

Circle Center At X = 100.0 ; Y = 1014.3 and Radius, 27.4

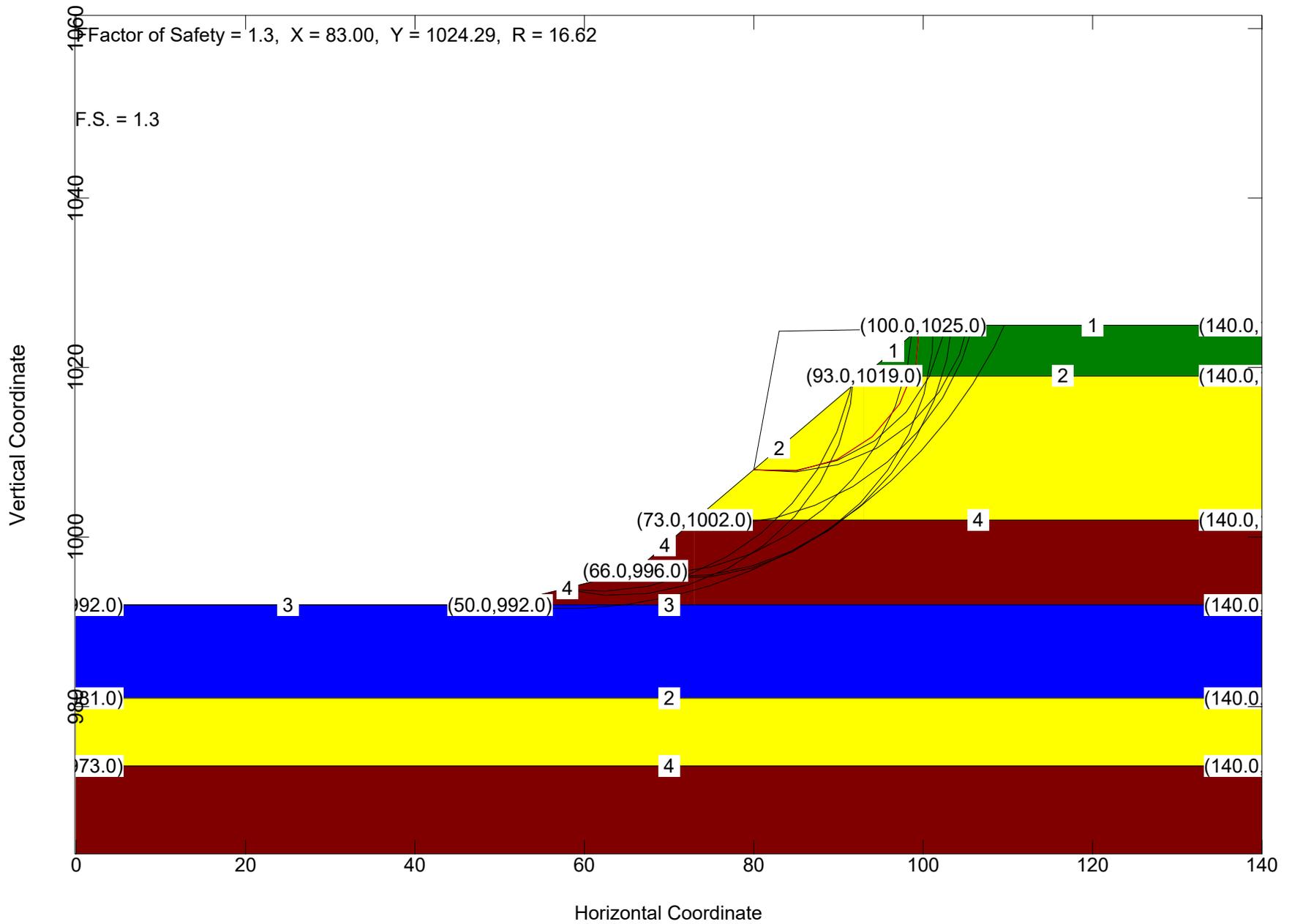
\*\*\* 1.700 \*\*\*

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STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

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

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2 - Sta 1200.sl4d  
Name of output file : Hartland Quarry - Section 2 - Sta 1200.sl4o  
Name of plot output file : Hartland Quarry - Section 2 - Sta 1200.sl4p

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Time and Date of Analysis

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Date: January 16, 2024 Time: 12:20:15

1

PROBLEM DESCRIPTION Section 2 - Sta 12+00

BOUNDARY COORDINATES

6 Top Boundaries  
11 Total Boundaries

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
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1	0.00	992.00	50.00	992.00	3
2	50.00	992.00	66.00	996.00	4
3	66.00	996.00	73.00	1002.00	4
4	73.00	1002.00	93.00	1019.00	2
5	93.00	1019.00	100.00	1025.00	1
6	100.00	1025.00	140.00	1025.00	1
7	93.00	1019.00	140.00	1019.00	2
8	73.00	1002.00	140.00	1002.00	4
9	0.00	992.00	140.00	992.00	3
10	0.00	981.00	140.00	981.00	2
11	0.00	973.00	140.00	973.00	4

1

#### ISOTROPIC SOIL PARAMETERS

##### 4 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	130.0	0.0	0.0	37.0	0.00	0.0	0
2	135.0	0.0	0.0	40.0	0.00	0.0	0
3	140.0	0.0	0.0	43.0	0.00	0.0	0
4	145.0	0.0	0.0	46.0	0.00	0.0	0

1

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

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 50.00 ft.  
and X = 80.00 ft.

Each Surface Terminates Between X = 80.00 ft.  
and X = 110.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

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

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

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	80.00	1007.95
2	85.00	1007.80
3	89.81	1009.14
4	94.01	1011.85
5	97.22	1015.69
6	99.13	1020.31
7	99.52	1024.59

Circle Center At X = 83.0 ; Y = 1024.3 and Radius, 16.6

\*\*\* 1.3 \*\*\*

Individual data on the 8 slices

Surcharge		Water Force	Water Force	Tie Force	Tie Force	Earthquake Force		Load
Slice No.	Width Ft	Top Lbs	Bot Lbs	Norm Lbs	Tan Lbs	Hor Lbs	Ver Lbs	Lbs

1	5.0	0.15E+04	0.00E+00						
0.00E+00									
2	4.8	0.38E+04	0.00E+00						
0.00E+00									
3	3.2	0.32E+04	0.00E+00						
0.00E+00									
4	1.0	0.11E+04	0.00E+00						
0.00E+00									
5	3.2	0.32E+04	0.00E+00						
0.00E+00									
6	1.4	0.11E+04	0.00E+00						
0.00E+00									
7	0.5	0.31E+03	0.00E+00						
0.00E+00									
8	0.4	0.10E+03	0.00E+00						
0.00E+00									

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Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	80.00	1007.95
2	85.00	1007.87
3	89.86	1009.03
4	94.28	1011.37
5	97.98	1014.74
6	100.72	1018.93
7	102.33	1023.66
8	102.43	1025.00

Circle Center At X = 82.8 ; Y = 1027.7 and Radius, 19.9

\*\*\* 1.320 \*\*\*

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	72.50	1001.57
2	77.50	1001.51

3	82.45	1002.24
4	87.22	1003.74
5	91.69	1005.97
6	95.76	1008.87
7	99.32	1012.39
8	102.28	1016.42
9	104.56	1020.86
10	105.92	1025.00

Circle Center At X = 75.4 ; Y = 1033.1 and Radius, 31.6

\*\*\* 1.384 \*\*\*

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	65.00	995.75
2	70.00	995.71
3	74.94	996.48
4	79.70	998.02
5	84.14	1000.31
6	88.17	1003.28
7	91.66	1006.85
8	94.54	1010.94
9	96.73	1015.44
10	98.16	1020.23
11	98.64	1023.83

Circle Center At X = 67.7 ; Y = 1026.7 and Radius, 31.1

\*\*\* 1.394 \*\*\*

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	57.50	993.88
2	62.49	993.62

3	67.46	994.19
4	72.27	995.55
5	76.80	997.68
6	80.92	1000.51
7	84.52	1003.97
8	87.52	1007.98
9	89.82	1012.41
10	91.37	1017.17
11	91.45	1017.69

Circle Center At X = 61.5 ; Y = 1024.3 and Radius, 30.7

\*\*\* 1.422 \*\*\*

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	80.00	1007.95
2	84.99	1007.69
3	89.92	1008.55
4	94.53	1010.49
5	98.59	1013.40
6	101.90	1017.15
7	104.29	1021.54
8	105.27	1025.00

Circle Center At X = 83.6 ; Y = 1029.9 and Radius, 22.3

\*\*\* 1.440 \*\*\*

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	65.00	995.75
2	69.98	995.28
3	74.97	995.57
4	79.86	996.61

5	84.54	998.37
6	88.90	1000.82
7	92.84	1003.90
8	96.27	1007.54
9	99.11	1011.66
10	101.30	1016.15
11	102.78	1020.93
12	103.40	1025.00

Circle Center At X = 70.6 ; Y = 1028.3 and Radius, 33.0

\*\*\* 1.504 \*\*\*

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	65.00	995.75
2	69.96	995.13
3	74.96	995.35
4	79.85	996.38
5	84.50	998.21
6	88.79	1000.79
7	92.58	1004.04
8	95.79	1007.88
9	98.32	1012.19
10	100.10	1016.87
11	101.08	1021.77
12	101.18	1025.00

Circle Center At X = 71.2 ; Y = 1025.2 and Radius, 30.1

\*\*\* 1.524 \*\*\*

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	57.50	993.88

2	62.45	993.15
3	67.45	993.33
4	72.33	994.38
5	76.95	996.30
6	81.16	999.00
7	84.81	1002.41
8	87.80	1006.42
9	90.03	1010.90
10	91.43	1015.70
11	91.65	1017.85

Circle Center At X = 64.0 ; Y = 1021.1 and Radius, 28.0

\*\*\* 1.526 \*\*\*

Failure Surface Specified By 16 Coordinate Points

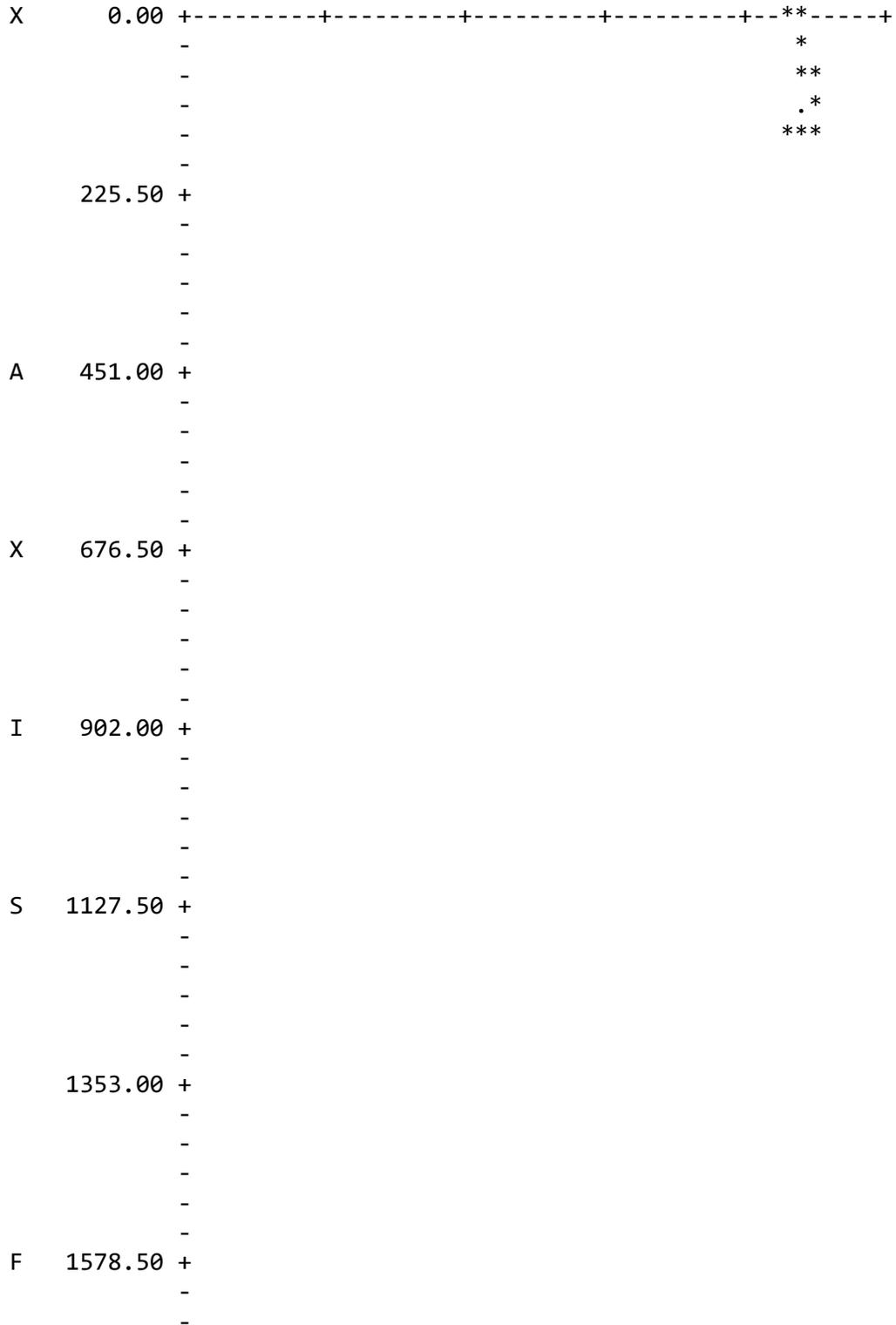
Point No.	X-Surf ft.	Y-Surf ft.
1	50.00	992.00
2	54.98	991.58
3	59.98	991.60
4	64.96	992.05
5	69.89	992.93
6	74.71	994.23
7	79.41	995.94
8	83.94	998.06
9	88.27	1000.55
10	92.37	1003.42
11	96.20	1006.63
12	99.75	1010.16
13	102.97	1013.98
14	105.85	1018.07
15	108.37	1022.39
16	109.60	1025.00

Circle Center At X = 57.3 ; Y = 1049.2 and Radius, 57.7

\*\*\* 1.552 \*\*\*

Y A X I S F T

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# **PSI SUMMARY**

## Hartland Quarry Development - Slope Stability PSI Project No. 00523202

### Slope Stability Evaluation – September 2023

A previous global stability evaluation was performed by PSI with Slide2 software from Rocscience, using the input parameters/geometry provided by GeoTest in their Geotechnical Slope Stability Analysis dated September 8, 2023. For the minimum considered failure surface at a depth of 5 feet, the results indicated minimum factors of safety of 1.1, 1.1, and 0.8 at Cross Sections 2, 3, and 4, respectively. In this evaluation, the factors of safety generally increased with depth. For the failure surfaces at a depth of about 10 feet, the factors of safety at Cross Sections 2, 3, and 4 were 1.3, 1.3, and 1.0, respectively.

### Slope Stability Evaluation – Hill Street– January 2024

In January of 2024, the grading plan of the development along Hill Street was updated as elected by GeoTest using LiDAR technology. Using the new slope geometry along Hill Street at stations 2+00 to 12+00 (general area of Cross Section 2), and the new soil parameters provided by Geotest in their slope stability evaluation performed January 16<sup>th</sup>, 2024, the slope stability at each of these sections was evaluated by PSI, again using the Slide 2 software by Rocscience. The table below indicates the minimum factors of safety calculated by GeoTest and the minimum factors of safety calculated by PSI at each of these stations. As shown, the minimum factors of safety calculated by PSI ranged from about 1.3 to 2.1, with the minimum factors of safety calculated by GeoTest ranging from about 1.3 to 1.9.

**Hartland Quarry - Hill Street Slope Stability Summary**

Station along Hill Street (Cross Section 2)	Minimum Factor of Safety	
	GeoTest (using STABLPro for Windows software)	PSI (using Slide 2 software and limiting failure surfaces to a minimum depth of 10 feet)
2+00	1.9	2.1
3+00	1.7	1.7
4+00	1.4	1.5
5+00	1.5	1.6
6+00	1.7	1.9
7+00	1.3	1.3
8+00	1.4	1.4
9+00	1.6	1.8
10+00	1.5	1.3
11+00	1.5	1.5
12+00	1.3	1.3

### PSI Slope Stability Statement

In generally accepted engineering practice, required factors of safety of 1.3 to 1.5 are commonly utilized for slope stability evaluations. In some cases, a required safety factor of 1.3 is referenced where a slope is adjacent to but does not support a structure, or where geotechnical parameters are well defined. For cases where a slope supports a structure, or where geotechnical information is limited, a minimum safety factor of 1.5 is typically required. Chapter 6 (Geotechnical) of the Federal Highway Administration Project Development and Design Manual references safety factors of 1.3 to 1.5, dependent upon levels of importance and risk, and upon the uncertainty of input parameters. One of the sources cited in Chapter 6 of the FHWA manual is the United States Army Corp of Engineers (USACE) Slope Stability Engineer Manual (EM 1110-2-1902 – dated October 31, 2003), which we have previously referenced. Table 3-1, which is in

Chapter 3 (Design Criteria) of the USACE Manual, provides minimum required factors of safety for new earth and rock-fill dams. Factors of safety of 1.5 and 1.3 are shown in this Table for long term and end-of-construction conditions, respectively. While the Manual does not provide specific safety factors for other slope types, it does indicate within a general discussion of all slopes, that when both the uncertainty and consequences of a slope failure are low, a minimum factor of safety of 1.3 or lower may be considered. Additionally, it is noted in Section 3-1 of the USACE Manual that “an acceptable factor of safety should reflect the difference between a new slope, where stability must be forecast, and existing slopes, where information regarding past performance is available. A history free of signs of slope movements provides firm evidence that a slope has been stable under the conditions it has experienced”, and as such “values of factors of safety that are lower than those required for new slopes can often be justified for existing slopes”.

In summary, although a factor of safety of 1.5 is generally desirable, a lower acceptable minimum factor of safety may be justified when considering additional criteria, such as noted above. For an existing slope (such as the subject site), historical performance of the slope can be considered, which would include evaluating the slope for any signs of prior failure. Where the slope has performed satisfactorily over a period of time without signs of shear failure, surface sloughing, or excessive deformation, a lower factor of safety can be considered.

When a suitable minimum safety factor has been established for the quarry development project, any areas displaying lesser factors of safety must be improved to meet the minimum value. Improvement can include grading to reduce the steepness of the slope; incorporating retaining walls; or installing elements such as drilled piers, micropiles, or tie-backs to improve the overall stability of the slope.