November 4, 2024
ES-0593.05

Earth Solutions NW LLC
Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

RM Homes, LLC
2913 – 5th Avenue Northeast, Suite 201
Puyallup, Washington 98372

Attention: James Kerby

Subject: Response to Comments
Normandy Heights
2007 Shaw Road
Puyallup, Washington

Greetings:

As requested by Barghausen Consulting Engineers, Inc. (BCE), Earth Solutions NW, LLC (ESNW) has prepared this response to comments letter for the proposed Normandy Heights residential project. Third party review comments were provided to ESNW via the referenced peer letter. Our responses are provided in the following section.

Response to Comments

Comment 1: ESNW Response – The attached Plate 1 (Plate 2 within the referenced geotechnical engineering study) has been updated to show the basic features of the site development (lots, critical areas buffers, etc.) as requested. Please note that this plan should only be used for referencing purposes.

Comment 2: ESNW Response – Based on our review of the referenced site plans, it appears that the Tract A and Tract D critical area buffers meet the intent of Puyallup Municipal Code (PMC) 21.06.1240.1.a(iii). The tallest, non-broken slope with a 40 percent gradient within the Tract A critical area appears to be about 22 feet. Likewise, the tallest slope within the Tract D critical area is about 10 feet. As such, buffer widths of 11 feet and 5 feet for Tract A and D are considered adequate, pursuant to PMC 12.06.1240.1.a(iii).

Grading within Tract A appears to consist of larger cuts along the eastern edge of the tract and around the steep slope buffer. Other grading within the Tract A area appears to be relatively minor (a few feet or less). Grading within Tract D appears to be relatively minor and consist of minor grade cuts and fills. A tiered wall is proposed in the area and adjacent to the access road servicing the Tract E vault. Each tier will be about four feet tall. Based on our review, no grading is proposed within the steep slope areas or associated buffers of Tract A and D. As such, and based on our understanding of the proposed project, the proposed site layout meets the intent of PMC 21.06.1240.1.a(iii).

Comment 3: ESNW Response –A slope stability and evaluation of the development standards provided in PMC 21.06.1230(2) is provided in the following.

To evaluate global stability, slope stability analyses were completed using GeoStudio 2024 Slope/W software. The intent of the evaluation was to determine if the post-construction condition of the depicted cross sections in the Tract A and D areas of the site that are subject to grading activities will maintain or exceed minimum target factor of safety (FOS) values. The modeled cross section can be seen on the attached Plate 1.

Soil strength parameters were selected based on our experience with similar deposits and the conditions encountered during our subsurface explorations. Soil characterizations and "materials" in the model are intended to provide a general depiction of the soil characteristics and represent in-situ soil density and overall strength characterizations. It is our opinion that the model presents a general, comprehensive depiction of slope stability characteristics on site.

Two conditions were evaluated with our slope stability modeling: static and pseudo-static (or seismic). For the pseudo-static condition, a horizontal seismic coefficient (K_h) of 0.275 was used, which equates to approximately one-half of the site-modified peak ground acceleration (PGA_M). For this evaluation, a minimum acceptable FOS of 1.5 for a static condition and 1.2 for a pseudo-static condition was assumed, in accordance with the PMC development standards. The critical slip surfaces (for each condition) are highlighted on the model outputs, and the calculated numerical FOS values are provided in the following table:

Model	**Condition**	**Minimum Calculated FOS Value**
A-A'	Static	3.02
	Pseudo-static	1.24
B-B'	Static	2.22
	Pseudo-Static	1.24

Based on our representative modeling, the minimum target FOS values have been achieved for all modeled conditions. The SlopeW computer output is attached.

In accordance with the request of the reviewer, the following PMC 21.06.1230(2) criteria and our response in how these are achieved with the proposed development are provided below.

PMC 21.06.1230.2(a) – The proposed development shall not decrease the factor of safety for landslide occurrences below the limits of 1.5 for static conditions and 1.2 for dynamic conditions. Analysis of dynamic conditions shall be based on a minimum horizontal acceleration as established by the current version of the International Building Code.

ESNW Response – The minimum target FOS for static and pseudo-static conditions have been satisfied, as indicated on the representative cross sections.

PMC 21.06.1230.2(b) – The alteration will not increase the threat of the geological hazard to the project site or adjacent properties beyond predevelopment conditions, nor shall it result in a need for increased buffers on neighboring properties.

ESNW Response – From a geotechnical standpoint, the proposed development will not increase the threat of the geological hazard on the subject site or adjacent properties. This consideration is based on results of our slope stability modeling.

PMC 21.06.1230.2(c) – The development will not increase or concentrate surface water discharge or sedimentation to adjacent sites beyond predevelopment conditions. Drainage plans have been designed in accordance with current Puyallup drainage code requirements and focused on minimizing adverse impacts to the site and surrounding properties.

ESNW Response – We understand that detention (via a vault) will be used for the main stormwater management. The vault outfall will direct water towards the existing wetland feature located at the northeastern extent of the property. It is anticipated that the vault will provide adequate flow control for post-construction site runoff. Sedimentation discharge across property boundaries is anticipated to be equal to or less than the pre-developed site condition.

PMC 21.06.1230.2(d) – Structures and improvements shall be located to minimize alterations to the natural contour of the slope and foundations shall be tiered where possible to conform to existing topography.

ESNW Response – Acknowledged. Based on a review of the site plan, various walls have been proposed along property and lot boundaries.

PMC 21.06.1230.2(e) – The use of engineered retaining walls that allow the maintenance of existing natural slope area is preferred over graded artificial slopes. Engineered retaining walls shall not exceed 15 feet in height and preferably should be less than eight feet in height. Riprap retaining walls should not exceed eight feet in height. Wherever possible, retaining walls should be designed as structural elements of the building foundation.

ESNW Response – Acknowledged. Various wall conditions and configurations (including tiered configurations) are proposed across the site area. Each individual wall appears to not be more than six feet in exposed height. It is noted that many walls are sperate from the proposed home structures and are independent features. In general, ESNW takes no exception to this design approach, from a geotechnical standpoint.

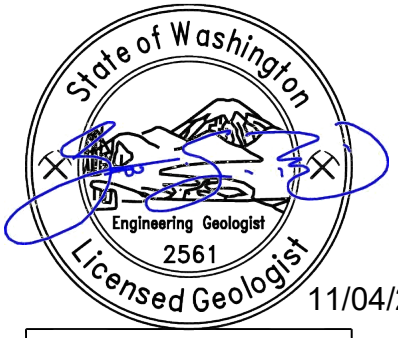
PMC 21.06.1230.2(f) – Development shall be designed to minimize impervious lot coverage. Use of common access drives and utility corridors is encouraged.

ESNW Response – Acknowledged. Shared access drive aisles (such as Tract B and Tract C) are proposed. However, site layout designs (outside of restrictions associated with geologically hazardous areas) are outside of the expertise and purview of ESNW.

We trust this letter meets your current needs. Should you have any questions, or if additional information is required, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC



11/04/2024

Scott S. Riegel

Chase G. Halsen, L.G., L.E.G.
Project Manager

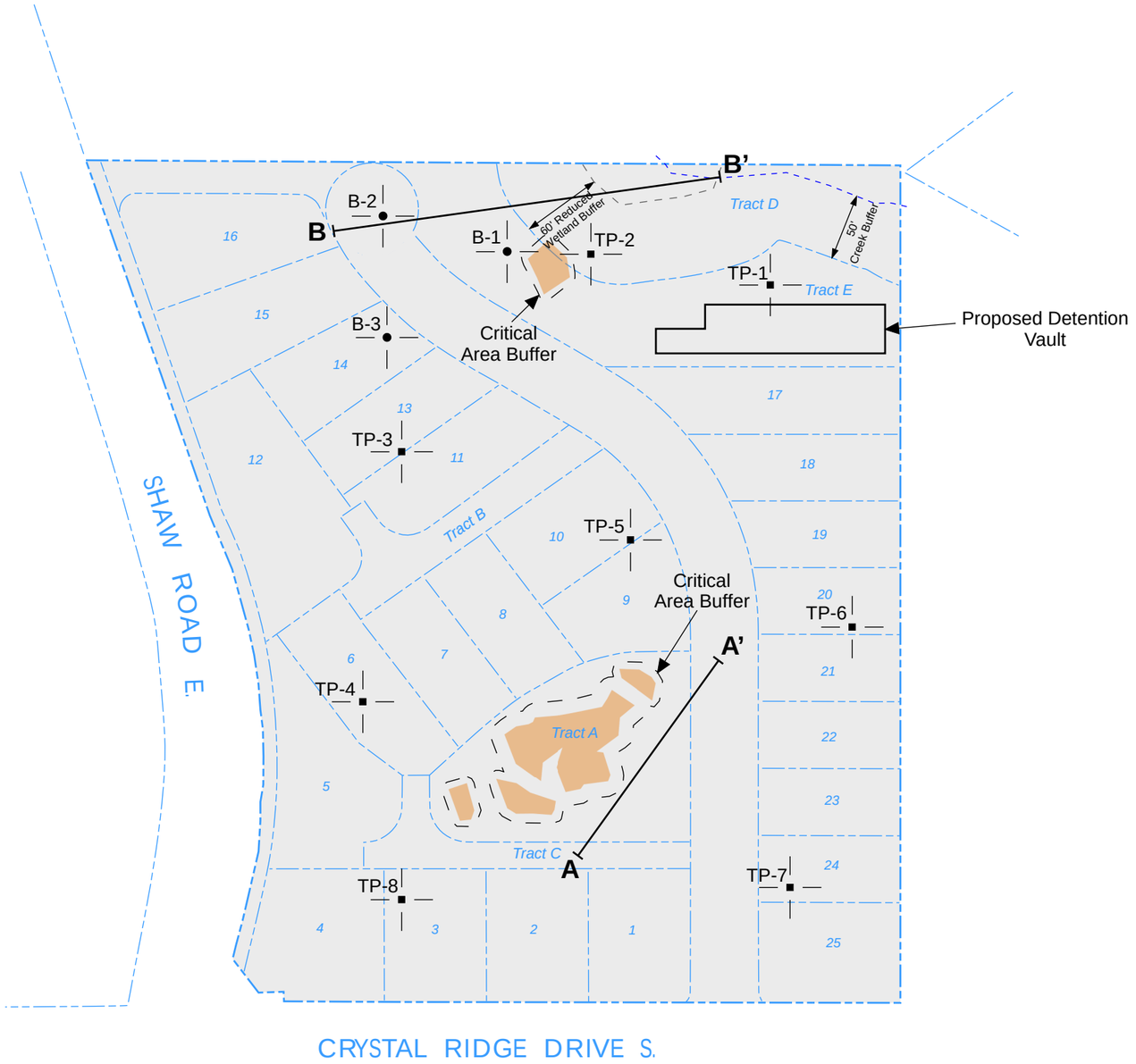
Scott S. Riegel, L.G., L.E.G.
Associate Principal Geologist

Attachments: Plate 1 – Subsurface Exploration Plan
SlopeW Computer Output

cc: Barghausen Consulting Engineers, Inc.
Attention: Tyler Murphy
Cara Visintainer

References:

- Geotechnical Peer Review, prepared by HWA Geosciences, Inc., dated September 13, 2024
- PMC Chapter 21.06
- Preliminary Grading and Utility Layout, prepared by BCE, Job No. 12663, Sheet C3 of 5, dated April 3, 2024
- Updated Geotechnical Engineering Study, prepared by ESNW, ES-0593, updated May 3, 2022



LEGEND

- B-1 — Approximate Location of ESNW Boring, Proj. No. ES-0593.03, Feb. 2022
- TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-0593, Oct. 2006
- Subject Site
- Steep Slope Area
- Cross-Section

NORTH

1"=100'

0 50 100 200

Scale in Feet

NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

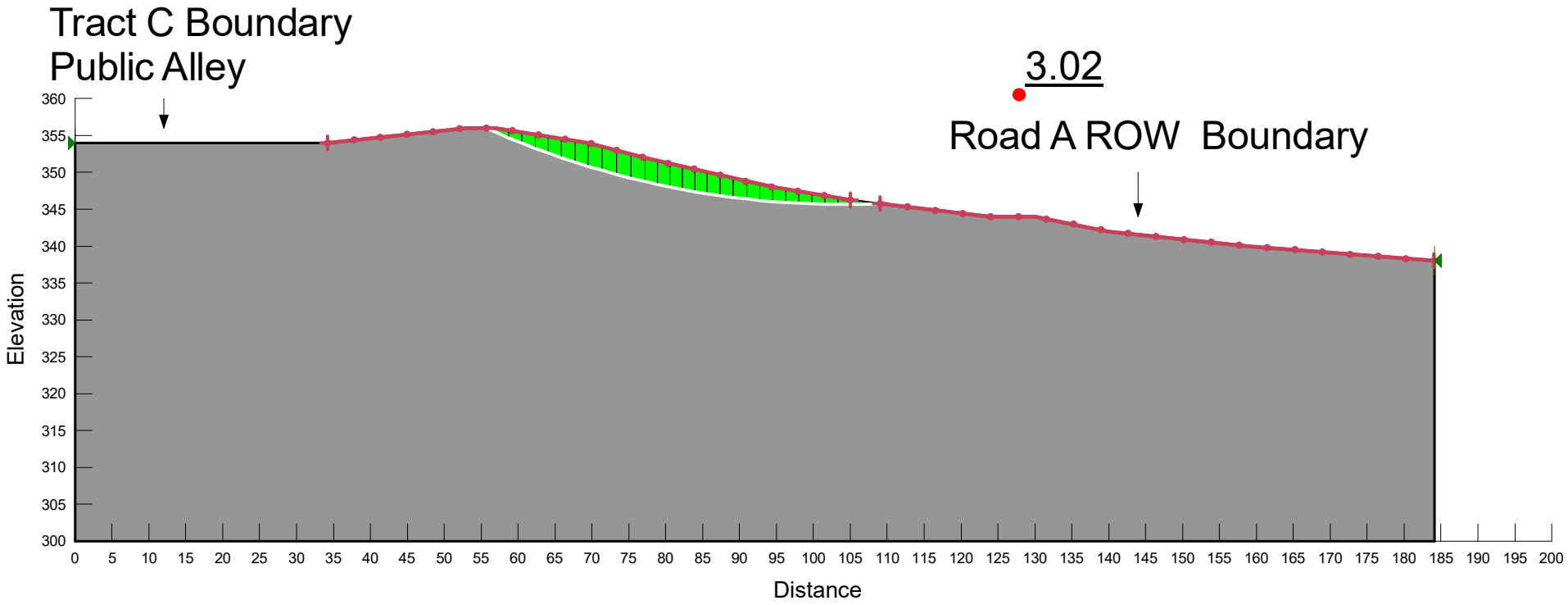
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Subsurface Exploration Plan
Normandy Heights
Puyallup, Washington

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Drawn	MRS
Checked	CGH
Date	11/04/2024
Proj. No.	0593.05
Plate	1

A-A' Static



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Sands and Gravels	Mohr-Coulomb	125	0	32

Tract A

File Information

File Version: 11.07
Product Version: 24.2.0.298
Created By: Chase Halsen
Last Edited By: Chase Halsen
Revision Number: 41
Date: 10/25/2024
Time: 02:23:30 PM
File Name: Tract A.gsz
Directory: C:\Users\chase.halsen\Desktop\Project Files\0593.03\0593.05\Slope Runs\
Last Solved Date: 10/25/2024
Last Solved Time: 02:23:35 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Tract A

Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Settings
- Side Function
  - Intercolumn force function option: Half-Sine
- PWP Conditions from: (none)
- Unit Weight of Water: 62.430189 pcf

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack Option: (none)

Distribution
- F of S Calculation Option: Constant

Convergence

Geometry Settings
- Minimum Slip Surface Depth: 3 ft
- Minimum Slip Surface Volume: 35.314667 ft³
- Number of Columns: 30

Factor of Safety Convergence Settings
- Maximum Number of Iterations: 100
- Tolerable difference in F of S: 0.001

Under-Relaxation Criteria
- Initial Rate: 1
- Minimum Rate: 0.1
- Rate Reduction Factor: 0.65
- Reduction Frequency (iterations): 50

Solution Settings
- Search Method: Root Finder
- Tolerable difference between starting and converged F of S: 3
- Maximum iterations to calculate converged lambda: 20
- Max Absolute Lambda: 2

Materials

Sands and Gravels

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 32 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (34.2, 354) ft
Left-Zone Right Coordinate: (105, 346.29268) ft
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: (109, 345.74269) ft
Right-Zone Right Coordinate: (184, 338.00797) ft
Right-Zone Increment: 20
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 354) ft
Right Coordinate: (184.1, 338) ft

Geometry

Name: Tract A

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	354 ft
Point 2	34.2 ft	354 ft
Point 3	53.1 ft	356 ft
Point 4	56.9 ft	356 ft
Point 5	69.5 ft	354 ft
Point 6	77.2 ft	352 ft
Point 7	85.6 ft	350 ft
Point 8	94.5 ft	348 ft
Point 9	106.8 ft	346 ft
Point 10	123.9 ft	344 ft
Point 11	130 ft	344 ft
Point 12	139.9 ft	342 ft
Point 13	159 ft	340 ft
Point 14	184.1 ft	338 ft
Point 15	184.1 ft	300 ft
Point 16	0 ft	300 ft

Regions

	Material	Points	Area
Region 1	Sands and Gravels	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	8,868.4 ft²

Slip Results

Slip Surfaces Analysed: 4254 of 4851 converged

Current Slip Surface

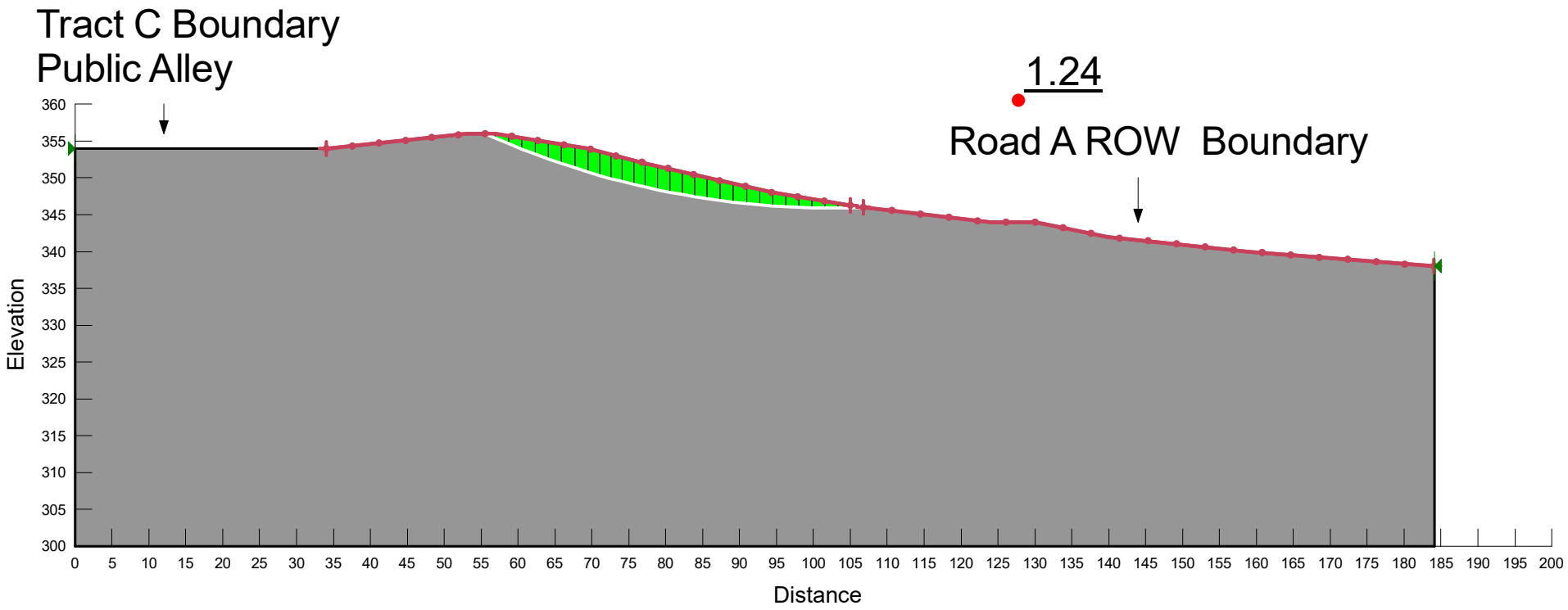
Slip Surface: 1,388
Factor of Safety: 3.02
Volume: 114.40021 ft³
Weight: 14,300.026 lbf
Resisting Moment: 1,046,601.2 lbf·ft

Activating Moment: 346,913.62 lbf·ft
Resisting Force: 8,568.1764 lbf
Activating Force: 2,839.8438 lbf
Slip Rank: 1 of 4,851 slip surfaces
Exit: (109, 345.74269) ft
Entry: (55.668505, 356) ft
Radius: 118.98006 ft
Center: (104.2129, 464.62641) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Column Base Material
Column 1	56.28425 ft	355.72899 ft	0 psf	30.929779 psf	19.327071 psf	0 psf	0 psf	Sands and Gravels
Column 2	57.80000 ft	355.07668 ft	0 psf	88.80886 psf	55.493934 psf	0 psf	0 psf	Sands and Gravels
Column 3	59.60000 ft	354.33134 ft	0 psf	140.72093 psf	87.932194 psf	0 psf	0 psf	Sands and Gravels
Column 4	61.40000 ft	353.62019 ft	0 psf	188.73282 psf	117.93336 psf	0 psf	0 psf	Sands and Gravels
Column 5	63.20000 ft	352.94258 ft	0 psf	233.13035 psf	145.67601 psf	0 psf	0 psf	Sands and Gravels
Column 6	65.00000 ft	352.29790 ft	0 psf	274.16118 psf	171.31492 psf	0 psf	0 psf	Sands and Gravels
Column 7	66.80000 ft	351.68558 ft	0 psf	312.03057 psf	194.97834 psf	0 psf	0 psf	Sands and Gravels
Column 8	68.60000 ft	351.10510 ft	0 psf	346.89834 psf	216.76614 psf	0 psf	0 psf	Sands and Gravels
Column 9	70.46250 ft	350.53803 ft	0 psf	368.60667 psf	230.33101 psf	0 psf	0 psf	Sands and Gravels
Column 10	72.38750 ft	349.98610 ft	0 psf	376.86002 psf	235.48827 psf	0 psf	0 psf	Sands and Gravels
Column 11	74.31250 ft	349.46899 ft	0 psf	381.61563 psf	238.45991 psf	0 psf	0 psf	Sands and Gravels
Column 12	76.23750 ft	348.98623 ft	0 psf	382.77974 psf	239.18733 psf	0 psf	0 psf	Sands and Gravels
Column 13	78.04000 ft	348.56396 ft	0 psf	382.77873 psf	239.1867 psf	0 psf	0 psf	Sands and Gravels
Column 14	79.72000 ft	348.19782 ft	0 psf	381.97137 psf	238.6822 psf	0 psf	0 psf	Sands and Gravels
Column 15	81.40000 ft	347.85700 ft	0 psf	378.16371 psf	236.30291 psf	0 psf	0 psf	Sands and Gravels
Column 16	83.08000 ft	347.54128 ft	0 psf	371.23869 psf	231.97568 psf	0 psf	0 psf	Sands and Gravels
Column 17	84.76000 ft	347.25045 ft	0 psf	361.07937 psf	225.62743 psf	0 psf	0 psf	Sands and Gravels
Column 18	86.49000 ft	346.97717 ft	0 psf	348.53567 psf	217.78926 psf	0 psf	0 psf	Sands and Gravels
Column 19	88.27000 ft	346.72275 ft	0 psf	333.31114 psf	208.27592 psf	0 psf	0 psf	Sands and Gravels
Column 20	90.05000 ft	346.49570 ft	0 psf	314.16139 psf	196.30983 psf	0 psf	0 psf	Sands and Gravels
Column 21	91.83000 ft	346.29586 ft	0 psf	291.02295 psf	181.85132 psf	0 psf	0 psf	Sands and Gravels
Column 22	93.61000 ft	346.12310 ft	0 psf	263.87049 psf	164.88458 psf	0 psf	0 psf	Sands and Gravels
Column 23	95.37857 ft	345.97805 ft	0 psf	239.81224 psf	149.85132 psf	0 psf	0 psf	Sands and Gravels
Column 24	97.13571 ft	345.86028 ft	0 psf	219.00202 psf	136.84765 psf	0 psf	0 psf	Sands and Gravels
Column 25	98.89286 ft	345.76860 ft	0 psf	194.45952 psf	121.5118 psf	0 psf	0 psf	Sands and Gravels
Column 26	100.65000 ft	345.70295 ft	0 psf	166.2736 psf	103.89928 psf	0 psf	0 psf	Sands and Gravels
Column 27	102.40714 ft	345.66330 ft	0 psf	134.56739 psf	84.087038 psf	0 psf	0 psf	Sands and Gravels
Column 28	104.16429 ft	345.64960 ft	0 psf	99.492634 psf	62.169897 psf	0 psf	0 psf	Sands and Gravels
Column 29	105.92143 ft	345.66186 ft	0 psf	61.221646 psf	38.255531 psf	0 psf	0 psf	Sands and Gravels
Column 30	107.90000 ft	345.70858 ft	0 psf	20.632207 psf	12.892434 psf	0 psf	0 psf	Sands and Gravels

A-A' Seismic
Horz Seismic Coef.: 0.275



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Sands and Gravels (Seismic)	Mohr-Coulomb	125	0	32

Tract A (Seismic)

File Information

File Version: 11.07
Product Version: 24.2.0.298
Created By: Chase Halsen
Last Edited By: Chase Halsen
Revision Number: 41
Date: 10/25/2024
Time: 02:23:30 PM
File Name: Tract A.gsz
Directory: C:\Users\chase.halsen\Desktop\Project Files\0593.03\0593.05\Slope Runs\
Last Solved Date: 10/25/2024
Last Solved Time: 02:23:36 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Tract A (Seismic)

Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Settings
- Side Function
  - Intercolumn force function option: Half-Sine
- PWP Conditions from: (none)
- Unit Weight of Water: 62.430189 pcf

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack Option: (none)

Distribution
- F of S Calculation Option: Constant

Convergence

Geometry Settings
- Minimum Slip Surface Depth: 3 ft
- Minimum Slip Surface Volume: 35.314667 ft³
- Number of Columns: 30

Factor of Safety Convergence Settings
- Maximum Number of Iterations: 100
- Tolerable difference in F of S: 0.001

Under-Relaxation Criteria
- Initial Rate: 1
- Minimum Rate: 0.1
- Rate Reduction Factor: 0.65
- Reduction Frequency (iterations): 50

Solution Settings
- Search Method: Root Finder
- Tolerable difference between starting and converged F of S: 3
- Maximum iterations to calculate converged lambda: 20
- Max Absolute Lambda: 2

Materials

Sands and Gravels (Seismic)

- Slope Stability Material Model: Mohr-Coulomb
- Unit Weight: 125 pcf
- Effective Cohesion: 0 psf
- Effective Friction Angle: 32 °
- Phi-B: 0 °

Slip Surface Entry and Exit

- Left Type: Range
- Left-Zone Left Coordinate: (34, 354) ft
- Left-Zone Right Coordinate: (105, 346.29268) ft
- Left-Zone Increment: 20
- Right Type: Range
- Right-Zone Left Coordinate: (106.8, 346) ft
- Right-Zone Right Coordinate: (184, 338.00797) ft
- Right-Zone Increment: 20
- Radius Increments: 10

Slip Surface Limits

- Left Coordinate: (0, 354) ft
- Right Coordinate: (184.1, 338) ft

Seismic Coefficients

Horz Seismic Coef.: 0.275

Geometry

Name: Tract A

Settings

View: 2D

Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	354 ft
Point 2	34.2 ft	354 ft
Point 3	53.1 ft	356 ft
Point 4	56.9 ft	356 ft
Point 5	69.5 ft	354 ft
Point 6	77.2 ft	352 ft
Point 7	85.6 ft	350 ft
Point 8	94.5 ft	348 ft
Point 9	106.8 ft	346 ft
Point 10	123.9 ft	344 ft
Point 11	130 ft	344 ft
Point 12	139.9 ft	342 ft
Point 13	159 ft	340 ft
Point 14	184.1 ft	338 ft
Point 15	184.1 ft	300 ft
Point 16	0 ft	300 ft

Regions

	Material	Points	Area
Region 1	Sands and Gravels (Seismic)	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16	8,868.4 ft²

Slip Results

Slip Surfaces Analysed: 4233 of 4851 converged

Current Slip Surface

Slip Surface: 1,388

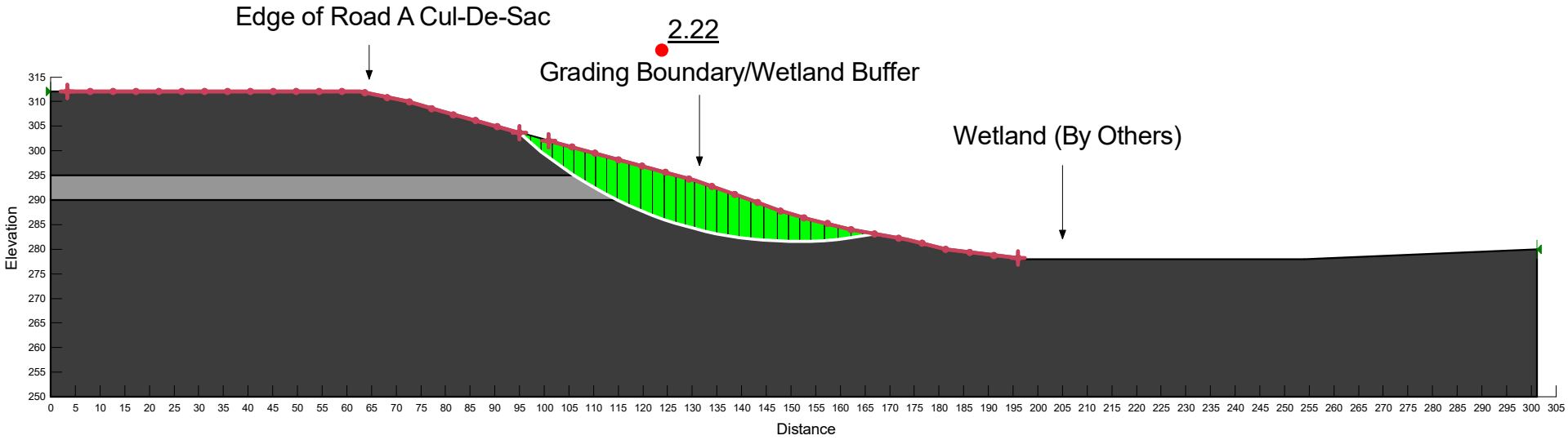
Factor of Safety: 1.24
Volume: 110.7214 ft³
Weight: 13,840.176 lbf
Resisting Moment: 923,984.99 lbf·ft
Activating Moment: 745,354.96 lbf·ft
Resisting Force: 7,853.5293 lbf
Activating Force: 6,331.6533 lbf
Slip Rank: 1 of 4,851 slip surfaces
Exit: (106.8, 346) ft
Entry: (55.528505, 356) ft
Radius: 114.73889 ft
Center: (102.5524, 460.66024) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Column Base Material
Column 1	56.21425 ft	355.69726 ft	0 psf	30.635952 psf	19.143467 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 2	57.80000 ft	355.01328 ft	0 psf	84.675657 psf	52.911223 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 3	59.60000 ft	354.26869 ft	0 psf	129.58985 psf	80.976725 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 4	61.40000 ft	353.55953 ft	0 psf	170.73231 psf	106.68539 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 5	63.20000 ft	352.88509 ft	0 psf	208.64613 psf	130.37657 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 6	65.00000 ft	352.24473 ft	0 psf	243.8397 psf	152.36796 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 7	66.80000 ft	351.63785 ft	0 psf	276.77221 psf	172.94647 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 8	68.60000 ft	351.06389 ft	0 psf	307.83798 psf	192.35852 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 9	70.27000 ft	350.55931 ft	0 psf	327.26937 psf	204.5006 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 10	71.81000 ft	350.11939 ft	0 psf	335.09455 psf	209.39032 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 11	73.35000 ft	349.70260 ft	0 psf	341.61422 psf	213.46426 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 12	74.89000 ft	349.30866 ft	0 psf	346.73073 psf	216.66141 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 13	76.43000 ft	348.93734 ft	0 psf	350.28382 psf	218.88162 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 14	78.04000 ft	348.57360 ft	0 psf	354.05379 psf	221.23736 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 15	79.72000 ft	348.21932 ft	0 psf	357.66045 psf	223.49105 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 16	81.40000 ft	347.89119 ft	0 psf	358.52403 psf	224.03068 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 17	83.08000 ft	347.58897 ft	0 psf	356.18689 psf	222.57027 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 18	84.76000 ft	347.31246 ft	0 psf	350.17473 psf	218.81346 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 19	86.49000 ft	347.05476 ft	0 psf	341.05463 psf	213.11459 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 20	88.27000 ft	346.81727 ft	0 psf	328.17113 psf	205.06408 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 21	90.05000 ft	346.60805 ft	0 psf	309.93283 psf	193.66753 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 22	91.83000 ft	346.42695 ft	0 psf	286.14703 psf	178.80451 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 23	93.61000 ft	346.27384 ft	0 psf	256.81488 psf	160.47575 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 24	95.37857 ft	346.14922 ft	0 psf	229.38652 psf	143.3366 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 25	97.13571 ft	346.05265 ft	0 psf	204.33478 psf	127.68254 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 26	98.89286 ft	345.98309 ft	0 psf	174.81946 psf	109.23932 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 27	100.65000 ft	345.94049 ft	0 psf	141.29739 psf	88.292408 psf	0 psf	0 psf	Sands and Gravels (Seismic)

Column 28	102.40714 ft	345.92481 ft	0 psf	104.27811 psf	65.160196 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 29	104.16429 ft	345.93604 ft	0 psf	64.272309 psf	40.161796 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 30	105.92143 ft	345.97419 ft	0 psf	21.745586 psf	13.58815 psf	0 psf	0 psf	Sands and Gravels (Seismic)

B-B' Static



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Loose to Medium Dense Silt	Mohr-Coulomb	115	50	28
	Sands and Gravels	Mohr-Coulomb	125	0	32

Tract D

File Information

File Version: 11.07
Product Version: 24.2.0.298
Created By: Chase Halsen
Last Edited By: Chase Halsen
Revision Number: 40
Date: 10/25/2024
Time: 02:19:05 PM
File Name: Tract A.gsz
Directory: C:\Users\chase.halsen\Desktop\Project Files\0593.03\0593.05\Slope Runs\
Last Solved Date: 10/25/2024
Last Solved Time: 02:19:10 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Tract D

Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Settings
- Side Function
  - Intercolumn force function option: Half-Sine
- PWP Conditions from: (none)
- Unit Weight of Water: 62.430189 pcf

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack Option: (none)

Distribution
- F of S Calculation Option: Constant

Convergence

Geometry Settings
Minimum Slip Surface Depth: 1 ft
Minimum Slip Surface Volume: 5 ft³
Number of Columns: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Under-Relaxation Criteria
Initial Rate: 1
Minimum Rate: 0.1
Rate Reduction Factor: 0.65
Reduction Frequency (iterations): 50
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Sands and Gravels

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 32 °
Phi-B: 0 °

Loose to Medium Dense Silt

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 115 pcf
Effective Cohesion: 50 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (3.42846, 312) ft
Left-Zone Right Coordinate: (95, 303.67969) ft
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: (100.83131, 302.08519) ft
Right-Zone Right Coordinate: (196, 278.16456) ft

Right-Zone Increment: 20
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 312) ft
Right Coordinate: (301.2, 280) ft

Geometry

Name: Tract D

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	312 ft
Point 2	62.6 ft	312 ft
Point 3	72.3 ft	310 ft
Point 4	79.2 ft	308 ft
Point 5	130.4 ft	294 ft
Point 6	141.8 ft	290 ft
Point 7	147.2 ft	288 ft
Point 8	154 ft	286 ft
Point 9	162.2 ft	284 ft
Point 10	173.4 ft	282 ft
Point 11	181.5 ft	280 ft
Point 12	197.3 ft	278 ft
Point 13	254 ft	278 ft
Point 14	301.2 ft	280 ft
Point 15	301.2 ft	250 ft
Point 16	0 ft	250 ft
Point 17	126.74286 ft	295 ft
Point 18	0 ft	295 ft
Point 19	0 ft	290 ft

Regions

	Material	Points	Area
Region 1	Loose to Medium Dense Silt	16,15,14,13,12,11,10,9,8,7,6,19	10,456 ft²
Region 2	Loose to Medium Dense Silt	1,18,17,4,3,2	1,625 ft²

Region 3	Sands and Gravels	18,19,6,5,17	672.97 ft²

Slip Results

Slip Surfaces Analysed: 4794 of 4851 converged

Current Slip Surface

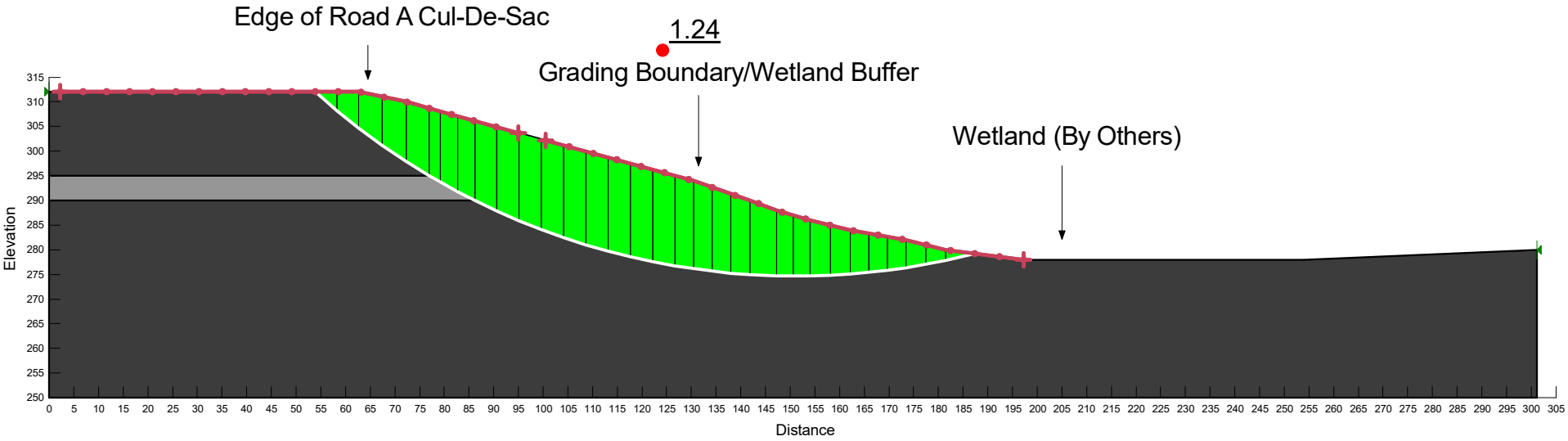
Slip Surface: 4,778
Factor of Safety: 2.22
Volume: 447.9862 ft³
Weight: 52,736.631 lbf
Resisting Moment: 2,591,742.3 lbf·ft
Activating Moment: 1,167,777.5 lbf·ft
Resisting Force: 29,779.34 lbf
Activating Force: 13,418.152 lbf
Slip Rank: 1 of 4,851 slip surfaces
Exit: (166.95338, 283.15118) ft
Entry: (94.999999, 303.67969) ft
Radius: 81.984089 ft
Center: (150.99093, 363.5663) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Column Base Material
Column 1	96.10459 ft	302.68388 ft	0 psf	48.673682 psf	25.880256 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 2	98.31378 ft	300.76160 ft	0 psf	172.56842 psf	91.756256 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 3	100.52296 ft	298.97210 ft	0 psf	282.596 psf	150.25896 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 4	102.73215 ft	297.30460 ft	0 psf	380.99762 psf	202.58003 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 5	104.94134 ft	295.75006 ft	0 psf	469.59241 psf	249.68672 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 6	107.14087 ft	294.30677 ft	0 psf	554.93055 psf	346.7591 psf	0 psf	0 psf	Sands and Gravels
Column 7	109.33074 ft	292.96741 ft	0 psf	637.43717 psf	398.31495 psf	0 psf	0 psf	Sands and Gravels
Column 8	111.52062 ft	291.71977 ft	0 psf	713.65835 psf	445.94323 psf	0 psf	0 psf	Sands and Gravels
Column 9	113.71050 ft	290.55912 ft	0 psf	784.26448 psf	490.06284 psf	0 psf	0 psf	Sands and Gravels
Column 10	115.99918 ft	289.43651 ft	0 psf	849.92008 psf	451.91052 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 11	118.38666 ft	288.35553 ft	0 psf	905.66223 psf	481.54915 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 12	120.77415 ft	287.36468 ft	0 psf	956.03797 psf	508.33441 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 13	123.16163 ft	286.46046 ft	0 psf	1,000.9333 psf	532.2057 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 14	125.54912 ft	285.63987 ft	0 psf	1,040.021 psf	552.98896 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 15	127.65714 ft	284.97867 ft	0 psf	1,067.4209 psf	567.55776 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 16	129.48571 ft	284.45866 ft	0 psf	1,083.7793 psf	576.25568 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 17	131.54000 ft	283.93167 ft	0 psf	1,085.9561 psf	577.4131 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 18	133.82000 ft	283.40901 ft	0 psf	1,071.5542 psf	569.75546 psf	50 psf	0 psf	Loose to Medium Dense Silt

Column 19	136.10000 ft	282.95422 ft	0 psf	1,047.8766 psf	557.1659 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 20	138.38000 ft	282.56615 ft	0 psf	1,014.1259 psf	539.22029 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 21	140.66000 ft	282.24384 ft	0 psf	969.58342 psf	515.53665 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 22	143.15000 ft	281.96930 ft	0 psf	909.24455 psf	483.4539 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 23	145.85000 ft	281.75474 ft	0 psf	830.02314 psf	441.33113 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 24	148.33333 ft	281.63314 ft	0 psf	753.20383 psf	400.48558 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 25	150.60000 ft	281.59098 ft	0 psf	681.98317 psf	362.61689 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 26	152.86667 ft	281.61151 ft	0 psf	599.735 psf	318.88476 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 27	155.36667 ft	281.71051 ft	0 psf	504.8149 psf	268.41484 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 28	158.10000 ft	281.90254 ft	0 psf	395.7401 psf	210.41874 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 29	160.83333 ft	282.18680 ft	0 psf	274.22941 psf	145.81036 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 30	163.38834 ft	282.53390 ft	0 psf	160.71364 psf	85.452957 psf	50 psf	0 psf	Loose to Medium Dense Silt
Column 31	165.76503 ft	282.93345 ft	0 psf	57.653678 psf	30.655004 psf	50 psf	0 psf	Loose to Medium Dense Silt

B-B' Seismic
Horz Seismic Coef.: 0.275



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Loose to Medium Dense Silt (Seismic)	Mohr-Coulomb	115	150	28
	Sands and Gravels (Seismic)	Mohr-Coulomb	125	0	32

Tract D (Seismic)

File Information

File Version: 11.07
Product Version: 24.2.0.298
Created By: Chase Halsen
Last Edited By: Chase Halsen
Revision Number: 40
Date: 10/25/2024
Time: 02:19:05 PM
File Name: Tract A.gsz
Directory: C:\Users\chase.halsen\Desktop\Project Files\0593.03\0593.05\Slope Runs\
Last Solved Date: 10/25/2024
Last Solved Time: 02:19:11 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Tract D (Seismic)

Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Settings
- Side Function
  - Intercolumn force function option: Half-Sine
- PWP Conditions from: (none)
- Unit Weight of Water: 62.430189 pcf

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack Option: (none)

Distribution
- F of S Calculation Option: Constant

Convergence

Geometry Settings
- Minimum Slip Surface Depth: 1 ft
- Minimum Slip Surface Volume: 5 ft³
- Number of Columns: 30

Factor of Safety Convergence Settings
- Maximum Number of Iterations: 100
- Tolerable difference in F of S: 0.001

Under-Relaxation Criteria
- Initial Rate: 1
- Minimum Rate: 0.1
- Rate Reduction Factor: 0.65
- Reduction Frequency (iterations): 50

Solution Settings
- Search Method: Root Finder
- Tolerable difference between starting and converged F of S: 3
- Maximum iterations to calculate converged lambda: 20
- Max Absolute Lambda: 2

Materials

Sands and Gravels (Seismic)

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 32 °
Phi-B: 0 °

Loose to Medium Dense Silt (Seismic)

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 115 pcf
Effective Cohesion: 150 psf
Effective Friction Angle: 28 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (2.20012, 312) ft
Left-Zone Right Coordinate: (95, 303.67969) ft
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: (100.49546, 302.17702) ft
Right-Zone Right Coordinate: (197.3, 278) ft

Right-Zone Increment: 20
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 312) ft
Right Coordinate: (301.2, 280) ft

Seismic Coefficients

Horz Seismic Coef.: 0.275

Geometry

Name: Tract D

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	312 ft
Point 2	62.6 ft	312 ft
Point 3	72.3 ft	310 ft
Point 4	79.2 ft	308 ft
Point 5	130.4 ft	294 ft
Point 6	141.8 ft	290 ft
Point 7	147.2 ft	288 ft
Point 8	154 ft	286 ft
Point 9	162.2 ft	284 ft
Point 10	173.4 ft	282 ft
Point 11	181.5 ft	280 ft
Point 12	197.3 ft	278 ft
Point 13	254 ft	278 ft
Point 14	301.2 ft	280 ft
Point 15	301.2 ft	250 ft
Point 16	0 ft	250 ft
Point 17	126.74286 ft	295 ft
Point 18	0 ft	295 ft
Point 19	0 ft	290 ft

Regions

	Material	Points	Area
Region 1	Loose to Medium Dense Silt (Seismic)	16,15,14,13,12,11,10,9,8,7,6,19	10,456 ft²
Region 2	Loose to Medium Dense Silt (Seismic)	1,18,17,4,3,2	1,625 ft²
Region 3	Sands and Gravels (Seismic)	18,19,6,5,17	672.97 ft²

Slip Results

Slip Surfaces Analysed: 4743 of 4851 converged

Current Slip Surface

Slip Surface: 2,743
Factor of Safety: 1.24
Volume: 1,683.1293 ft³
Weight: 196,217.29 lbf
Resisting Moment: 17,352,096 lbf·ft
Activating Moment: 14,020,408 lbf·ft
Resisting Force: 113,349.86 lbf
Activating Force: 91,635.678 lbf
Slip Rank: 1 of 4,851 slip surfaces
Exit: (187.37747, 279.25602) ft
Entry: (53.827493, 312) ft
Radius: 145.57603 ft
Center: (151.15859, 420.2545) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Column Base Material
Column 1	56.02062 ft	310.10575 ft	0 psf	83.612434 psf	44.45752 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 2	60.40687 ft	306.46243 ft	0 psf	386.97396 psf	205.7577 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 3	65.02500 ft	302.93300 ft	0 psf	629.36558 psf	334.63962 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 4	69.87500 ft	299.52003 ft	0 psf	817.49414 psf	434.66934 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 5	74.63587 ft	296.44371 ft	0 psf	965.71022 psf	513.47723 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 6	78.08587 ft	294.35336 ft	0 psf	1,066.3338 psf	666.31929 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 7	80.93745 ft	292.74985 ft	0 psf	1,141.6846 psf	713.40369 psf	0 psf	0 psf	Sands and Gravels (Seismic)

Column 8	84.41234 ft	290.89649 ft	0 psf	1,232.1224 psf	769.9155 psf	0 psf	0 psf	Sands and Gravels (Seismic)
Column 9	88.40496 ft	288.92243 ft	0 psf	1,322.451 psf	703.15968 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 10	92.91530 ft	286.86019 ft	0 psf	1,418.6976 psf	754.33491 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 11	97.42564 ft	284.97974 ft	0 psf	1,512.603 psf	804.26531 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 12	101.93598 ft	283.27358 ft	0 psf	1,605.1505 psf	853.47368 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 13	106.44632 ft	281.73527 ft	0 psf	1,696.56 psf	902.07695 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 14	110.95666 ft	280.35926 ft	0 psf	1,786.1908 psf	949.73448 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 15	115.46701 ft	279.14079 ft	0 psf	1,872.4418 psf	995.59494 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 16	119.97735 ft	278.07581 ft	0 psf	1,952.6731 psf	1,038.2547 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 17	124.48769 ft	277.16089 ft	0 psf	2,023.1836 psf	1,075.7458 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 18	128.57143 ft	276.45334 ft	0 psf	2,070.8751 psf	1,101.1038 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 19	132.30000 ft	275.91788 ft	0 psf	2,076.8178 psf	1,104.2636 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 20	136.10000 ft	275.47201 ft	0 psf	2,046.7922 psf	1,088.2987 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 21	139.90000 ft	275.12700 ft	0 psf	1,993.6886 psf	1,060.063 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 22	144.50000 ft	274.85595 ft	0 psf	1,895.7992 psf	1,008.0143 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 23	148.90000 ft	274.70593 ft	0 psf	1,785.5039 psf	949.36927 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 24	152.30000 ft	274.69288 ft	0 psf	1,691.1607 psf	899.20608 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 25	156.05000 ft	274.77513 ft	0 psf	1,572.4247 psf	836.07303 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 26	160.15000 ft	274.97093 ft	0 psf	1,424.0673 psf	757.19002 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 27	164.06667 ft	275.26399 ft	0 psf	1,269.9662 psf	675.25302 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 28	167.80000 ft	275.64498 ft	0 psf	1,116.0386 psf	593.40824 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 29	171.53333 ft	276.12367 ft	0 psf	942.28876 psf	501.02382 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)

Column 30	175.42500 ft	276.72993 ft	0 psf	725.37971 psf	385.69123 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 31	179.47500 ft	277.47390 ft	0 psf	468.47108 psf	249.09049 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)
Column 32	184.43873 ft	278.56576 ft	0 psf	185.27791 psf	98.514014 psf	150 psf	0 psf	Loose to Medium Dense Silt (Seismic)