PanGEO
INCORPORATED
Geotechnical & Earthquake
Engineering Consultants

August 1, 2019
File No. 07-073-100

Mr. Edward Knopf
9507 SE 43rd Street
Mercer Island, WA 98040

Subject: **Slope Stabilization**
9507 SE 43rd Street
Mercer Island WA

Dear Mr. Knopf,

Attached is our calculation package for the proposed TECCO G65/3 slope stabilization system which will be used to stabilize a section of the hillside above your house that was involved in debris flow landslides in 1982 and most recently in 2017 resulting from excessive rainfall during winter storms saturating the steep uphill slopes of adjacent property owners which resulted in debris flows which descended onto your property. This report discusses stabilizing the easternmost landslide with Tecco mesh and soil anchors. In our opinion, the flatter slopes below the westernmost slide can be stabilized with plantings of native shrubs and trees. The following discusses the basis of design for the Tecco stabilization system, the stability of the hillside in areas that did not slide, and rehabilitation of the debris chute area below the westernmost slide

We appreciate the opportunity to work on this project. Please call if there are any questions.

Sincerely,

W. Paul Grant

W. Paul Grant, P.E.
Principal Geotechnical Engineer

Encl.: Calculation Package
Design Plans

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Tel (206) 262-0370
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TECCO SLOPE STABILIZATION DESIGN CALCULATIONS
9507 SE 43RD STREET, MERCER ISLAND, WASHINGTON

1.0 PROJECT DESCRIPTION

The Knopf property at 9507 SE 43rd Street is located on a southeasterly facing slope overlooking Lake Washington (see Figure 1). The purpose of the engineering studies was to develop plans for slope stabilization to address the 2017 landslides originating on two adjoining uphill parcels (9409 SE 43rd Street and 43o4 94th Avenue SE) that descended as debris flows onto your parcel and the adjacent property below. Similar slope movement also occurred in 1982 in the same area (see Figure 2). Our study specifically addresses slope repairs on your parcel at the approximate locations shown on Figure 2.

Repairs on the steeper slope to the east will consist of Tecco mesh surfacing restrained with soil anchors. The flatter slope within the debris chute on the west may be remediated with native plantings. We understand that the owners of the neighboring uphill parcels will be responsible for the remaining repairs. Tecco mesh and soil nail will also be used on the adjacent uphill properties.

2.0 SUBSURFACE CONDITIONS

Geologic maps (Troost and Wisher, 2006) indicate that the property is underlain by several different geologic units as shown on Figure 3. Specifically, the northeast corner, which experienced landslides in 1982 and 2017, has been mapped as being underlain by advance glacial outwash deposits that typically consist of very dense, sands and gravels with silt interbeds. The advance outwash is mapped as being underlain by lacustrine deposits of stiff silt and clayey silt of the Lawton Clay formation. Finally, the southeast corner of the site is shown to be underlain by dense till, which is an unsorted mixture of sand, silt, and clay, and other non-glacial deposits such as silts.

The generalized geologic conditions are confirmed with the results of borings drilled at the top of the slope in the spring of 2017. Specifically, Boring B-3 was drilled by Matvey behind the crest of the slope at the location shown on Figure 4. The boring was drilled to a depth of 81.5 feet below the ground surface and the results of the log of the boring is presented in Appendix A. Boring B-3 encountered about 6 feet of surficial fill overlying about 5 feet of medium dense (weathered?) glacial till. The till was underlain by outwash deposits and till to a depth of 81.5 feet.

Perched groundwater was encountered between depths of 29 and 35 feet and between depths of 62 to 70 feet. The lower groundwater depth is consistent with our observations of seepage at the face of the slope between elevations 260 and 270 feet as shown on Figure 4.

3.0 STABILIZATION SYSTEM RECOMMENDATIONS

To improve the stability of the exposed soils in the landslide head scarp, we developed a design for soil anchors restraining a TECCO (G65/3) mesh at the face of the slope consistent with the restraining methods that will be used by the uphill property owners to stabilize the near vertical slope face on their parcels.

The process involves clearing the slope, drilling ground anchors (soil nails) which will secure the TECCO high-tensile strength steel wire mesh to the face of the slope. The mesh is attached to the ground anchors by a system of spike plates. By tightening the nuts, the slope stabilization system is pretensioned to a defined force. Additionally, the edges of the TECCO mesh are restrained with boundary ropes (steel cables).

3.1 TECCO MESH SLOPE STABILIZATION

The soil anchor system was designed using propriety GEOBRUGG software using the soil parameters discussed below

3.1.1 Subsurface Design Parameters

The following parameters were used for the TECCO G65/3 slope stabilization system:

Unit	*Soil Parameter*	*Design Values*
Outwash	Friction Angle:	36 degrees
	Apparent Cohesion:	100 psf
	Soil Unit Weight:	130 pcf
	Ultimate Load Transfer:	3 kips per foot

The ultimate load transfer value will be affected by many factors including soil conditions, drilling methods and grouting pressures. Therefore, the recommended ultimate value must be verified in the field by conducting proof tests up to 1.33x the design load.

3.1.2 Wire Mesh and Spike Plates

Design assumes TECCO steel wire mesh G65/3 and P33 spike plates.

3.1.3 Ground Anchors

Design assumes:

- Anchor spacing should not exceed 10 feet in either the horizontal or vertical directions and installed declined 20 degrees below the horizontal;
- Anchors have a minimum pullout capacity (design load) of 30 kips and a minimum yield strength of 16 kips; and
- Anchors are locked-off at a load of 4.5 kips.

3.1.4 Design Method

1. Determine by inspection, slope section for analysis runs based on ground topography and soils present.
2. Input cross-section geometry, soil properties, and partial factors of safety into ROVOLUM (by GEOBRUGG).
3. Based on results of initial runs, adjust mesh, bar size or spacing until a factor of safety of at least 1.5 is achieved for long term static conditions

3.1.5 Results

Design calculations are presented in Appendix B

3.2 SLOPE STABILITY ANALYSES

At the request of the City of Mercer Island, we also conducted stability analyses on the adjacent section of the slope that did not fail in the 1982 or 2017 landslides. Global slope stability analyses were conducted using the computer program SLIDE v.6, by RocScience. The stability analysis was conducted for the soil strength parameter recommended for the design of the soil nails (see Section 3.1.2). The results of the analyses, which are presented in Figure 5, indicate that the intact, material underlying the slope would have a static factor of safety of at lease 1.5.

3.3 SLOPE PLANTINGS

The narrow landslide runout chute on the west (see Fig. 6) is inclined at a relatively modest slope (approximately 2(H):1(V)) and is underlain by relatively competent material. In our opinion, this area does not require Tecco mesh and ground anchor stabilization. Consequently, we recommend stabilizing this area (~500 s.f.) with native plants (trees and shrubs).

4.0 LIMITATIONS

We have prepared this report for use Mr. Ed Knopf and the project design team. Recommendations contained in this report are based on a site reconnaissance, review of pertinent subsurface information, and our understanding of the City's requirements for slope stabilization. The study was performed using a mutually agreed-upon scope of work.

Variations in soil conditions may exist between the explorations and the actual conditions underlying the site. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at the site that are different from those described in this report, we should be notified immediately to review the applicability of our recommendations. Additionally, we should also be notified to review the applicability of our recommendations if there are any changes in the project scope.

The scope of our work does not include services related to construction safety precautions. Our recommendations are not intended to direct the contractors' methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design. Additionally, the scope of our work specifically excludes the assessment of environmental characteristics, particularly those involving hazardous substances. We are not mold consultants nor are our recommendations to be interpreted as being preventative of mold development. A mold specialist should be consulted for all mold-related issues.

This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issuance. PanGEO should be notified if the project is delayed by more than 24 months from the date of this report so that we may review the applicability of our conclusions considering the time lapse.

It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk. Any party other than the client who wishes to use this report shall notify PanGEO of such intended use and for permission to copy this report. Based on the intended use of the report, PanGEO may require that additional work be performed and that an updated report be reissued. Noncompliance with any of these requirements will release PanGEO from any liability resulting from the use this report.

Within the limitation of scope, schedule and budget, PanGEO engages in the practice of geotechnical engineering and endeavors to perform its services in accordance with generally accepted professional principles and practices at the time the Report or its contents were prepared. No warranty, express or implied, is made.

We appreciate the opportunity to be of service to you on this project. Please feel free to contact our office with any questions you have regarding our study, this report, or any geotechnical engineering related project issues.

W. Paul Grant, P.E.
Principal Geotechnical Engineer

Encl.

4.0 REFERENCES

GEOBRUGG (2018). "RUVOLUM Slope Stabilization – Software Manual," Geobrugg AG, CH-8590 Romanshorn

GEOBRUGG (2019). "TECCO System Slope Stabilization - Manual," Geobrugg AG, CH-8590 Romanshorn

Troost, K.G., and Wisher, A.P., 2006, Geologic Map of Mercer Island, Washington, City of Mercer Island, Scale 1:12,000.

Z:\Projects\2007 Projects\07-073 Knopf Short Plat\100 Landslide\CADD\Vicinity Map.dwg

DATE: 6/13/2019

CHECKED BY: WPG

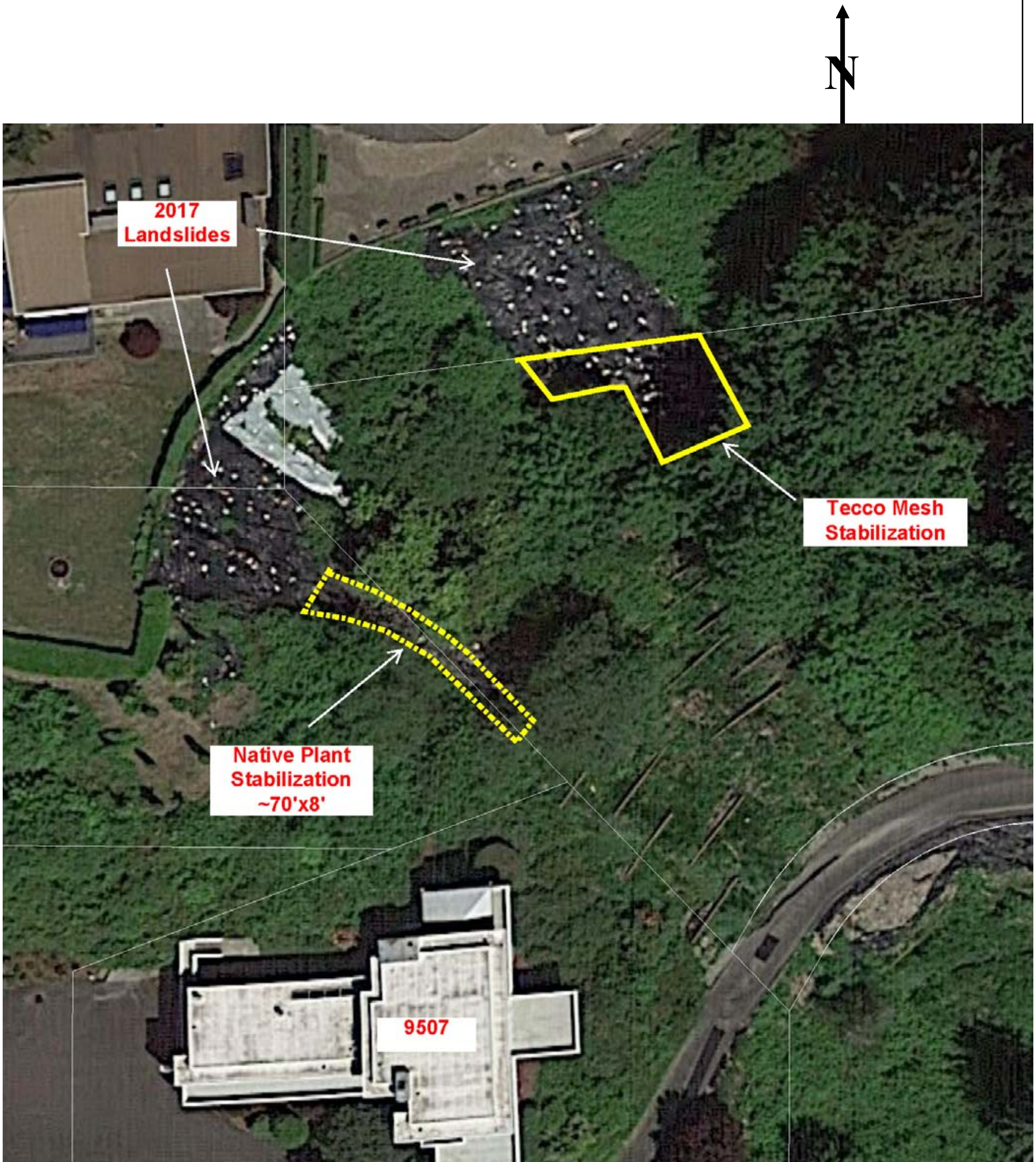
DRAWN BY: NTW

PanGEO INCORPORATED

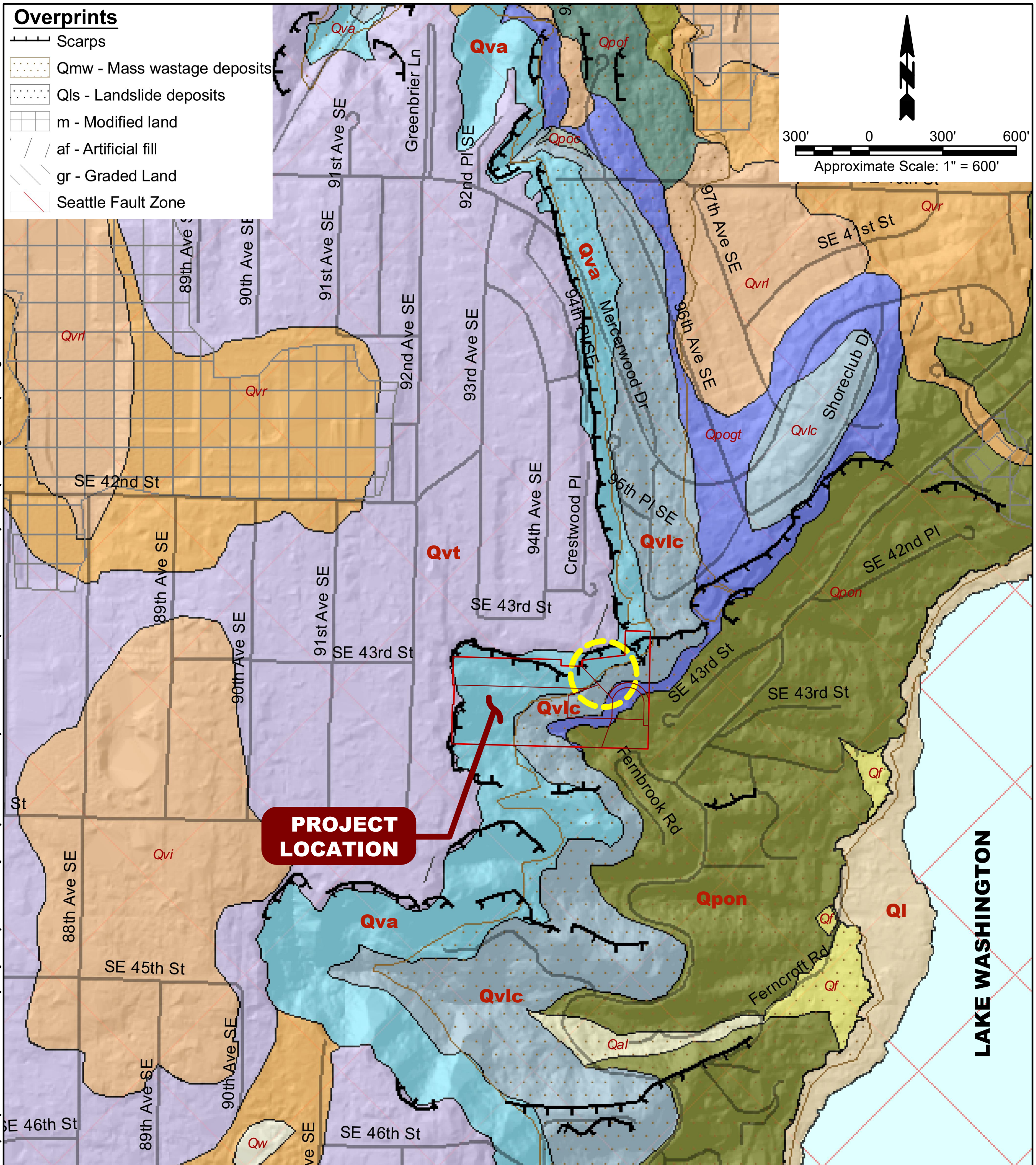
Geotechnical Evaluation
9507 SE 43rd Street
Mercer Island, Washington

VICINITY MAP

PROJECT NO.	FIGURE NO.
07-073.100	1



PanGEO INCORPORATED	**Geotechnical Evaluation** **9507 SE 43rd Street** **Mercer Island, Washington**	**SITE PLAN** Project No. 07-073	Figure No. 2



GEOLOGIC UNITS

Ql	Lake deposits
Qw	Wetland deposits
Qf	Fan deposits
Qal	Alluvium
Qvr	Vashon recessional outwash deposits
Qvrl	Vashon recessional lacustrine deposits
Qvi	Vashon ice-contact deposits
Qvt	Vashon glacial till
Qva	Vashon advance outwash deposits
Qvlc	Lawton clay
Qpof	Pre-Olympia, fine-grained deposits
Qpoc	Pre-Olympia, coarse-grained deposits
Qpogt	Pre-Olympia, glacial till
Qpogn	Pre-Olympia, nonglacial deposits

NOTES

1. Derived from the Geologic Map of Mercer Island, Washington (Troost and Wisher, 2006)
2. Detailed descriptions of the geologic units can be found in the text of the report.
3. Only the applicable geologic units are listed.

Z:\Projects\2007 Projects\07-073 Knopf Short Plat\100 Landslide\CADD\Geologic Map.dwg

DATE: 6/13/2019

CHECKED BY: WPG

DRAWN BY: NTW

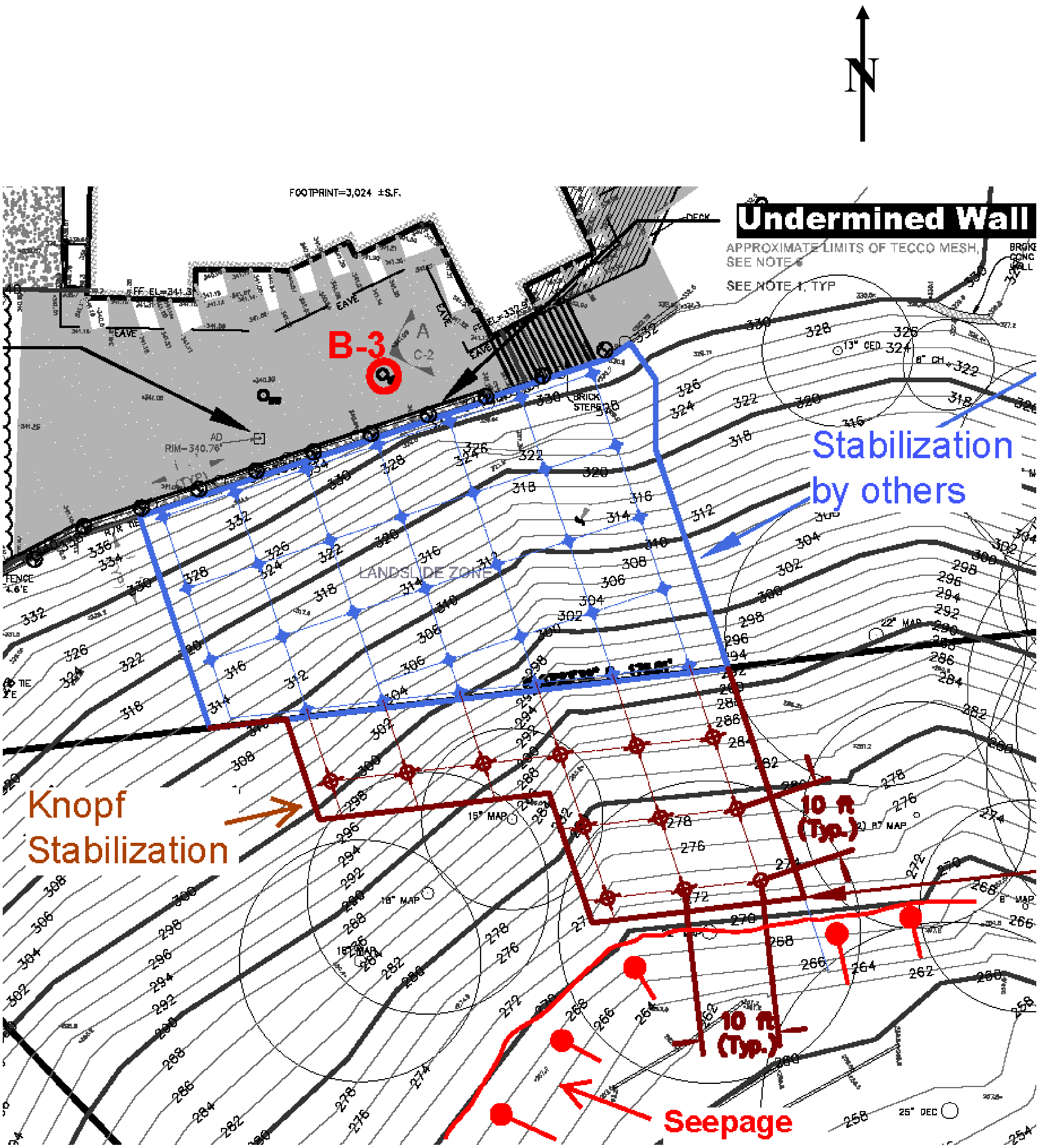
PanGEO INCORPORATED

Geotechnical Evaluation
9507 SE 43rd Street
Mercer Island, Washington

GEOLOGIC MAP

PROJECT NO. 07-073.100

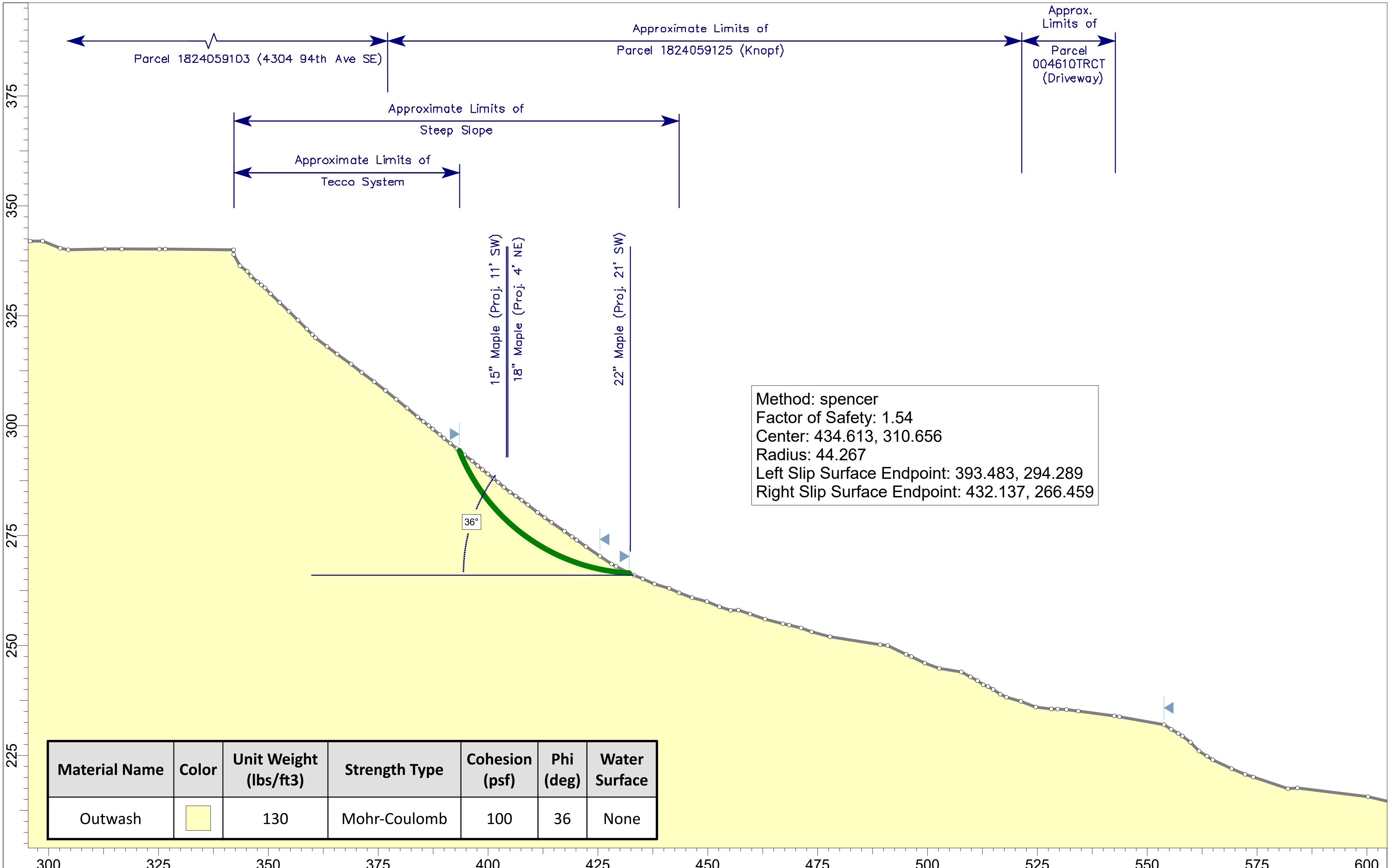
FIGURE NO. 3



Notes:

10’x10’ anchor spacing applies to slope face distances. Actual anchor layout along the fall line will be more closely spaced than locations shown above. Accordingly, actual anchor count may be 40% greater than that shown above

PanGEO INCORPORATED	Geotechnical Evaluation 9507 SE 43rd Street Mercer Island, Washington	STABILIZATION PLAN	
		Project No. 07-073	Figure No. 4



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Outwash		130	Mohr-Coulomb	100	36	None

PanGEO INCORPORATED

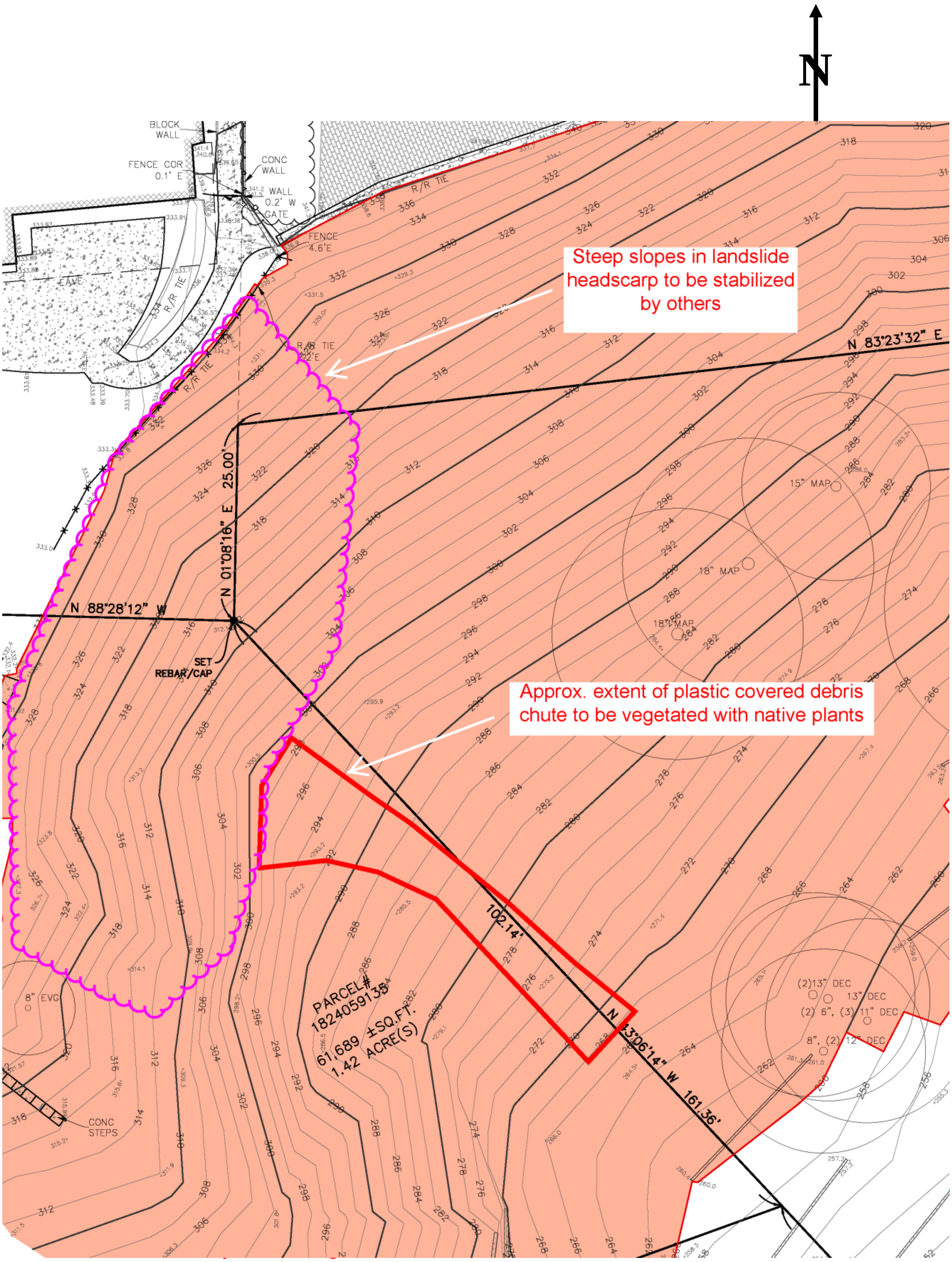
SLIDEINTERPRET 6.039

Geotechnical Evaluation
9507 SE 43rd Street
Mercer Island, WA

Static Stability Analysis
Slope Outside of Stabilized Area

Project No. **07-073.100**

Figure No. **5**



PanGEO INCORPORATED	**Geotechnical Evaluation** **9507 SE 43rd Street** **Mercer Island, Washington**	**West Chute Stabilization Area** Project No. 07-073 Figure No. 6

APPENDIX A

BORING LOGS

Boring Location: See Figure 2, Site and Exploration Plan
Top Elevation: 341'
Date Drilled: 5/17/2017

Drilling Company: BoreTec
Drilling Method: Hollow Stem Auger
Drill Rig: Acker

Bore Hole Dia.: 8 Inch
Hammer Type: Cathead
Logged by: JPG

B-3

SOIL DESCRIPTION

The stratification lines represent the approximate boundaries between soil types. The transition may be gradual. Refer to report text and appendices for additional information.

PENETRATION RESISTANCE (blows/foot)

▲ Standard Penetration Test
△ Hammer Weight and Drop:

Depth (ft)	Soil Description	Sample Number	Recovery	Blow Counts	Testing
0	2.5 inches of pavers over 1/4 inch of sand over 6 inches of concrete.				
	Medium dense, wet, dark gray, silty SAND, some gravel. (Fill)	S-1	12"	14	
5	Loose to medium dense, wet, gray-brown with iron oxide staining, silty SAND, some gravel. (Weathered Glacial Till)	S-2	16"	10	
	Medium dense, moist, gray-brown, silty SAND, some gravel. (Glacial Till)	S-3	18"	26	
10	Medium dense, moist, gray, fine to medium SAND, some silt. (Glacial Outwash)	S-4	18"	27	
	Dense, moist, gray SAND, trace to some silt and gravel. (Glacial Outwash)	S-5	14"	37	
15	Dense, moist, gray SAND, trace to some silt and gravel. (Glacial Outwash)	S-6	14"	37	
	(Smoother drilling action)				
20	Dense, moist, gray, fine to medium SAND, trace to some silt. (Glacial Outwash)	S-7	16"	36	
25					

SAMPLE LEGEND

2-inch O.D. split spoon sample
3-inch I.D. Shelby tube sample

GROUNDWATER LEGEND

Clean Sand
Bentonite
Grout/Concrete
Screened Casing
Blank Casing
Groundwater level at time of drilling (ATD) or on date of measurement.
11/2/12

TESTING KEY

GSA = Grain Size Analysis
200W = 200 Wash Analysis
Consol. = Consolidation Test
Att. = Atterberg Limits

◇ % Fines (<0.075 mm)
○ % Water (Moisture) Content
Plastic Limit ├──○──┤ Liquid Limit
Natural Water Content

Panteleakos Residence
4304 94th Ave SE
Mercer Island, WA

Date: May 2017
Project No.: 1797.09

Zipper Geo Associates
19023 36th Ave. W, Suite D
Lynnwood, WA

BORING LOG: B-3

Boring Location: See Figure 2, Site and Exploration Plan
Top Elevation: 341'
Date Drilled: 5/17/2017
Drilling Company: BoreTec
Drilling Method: Hollow Stem Auger
Drill Rig: Acker
Bore Hole Dia.: 8 Inch
Hammer Type: Cathead
Logged by: JPG

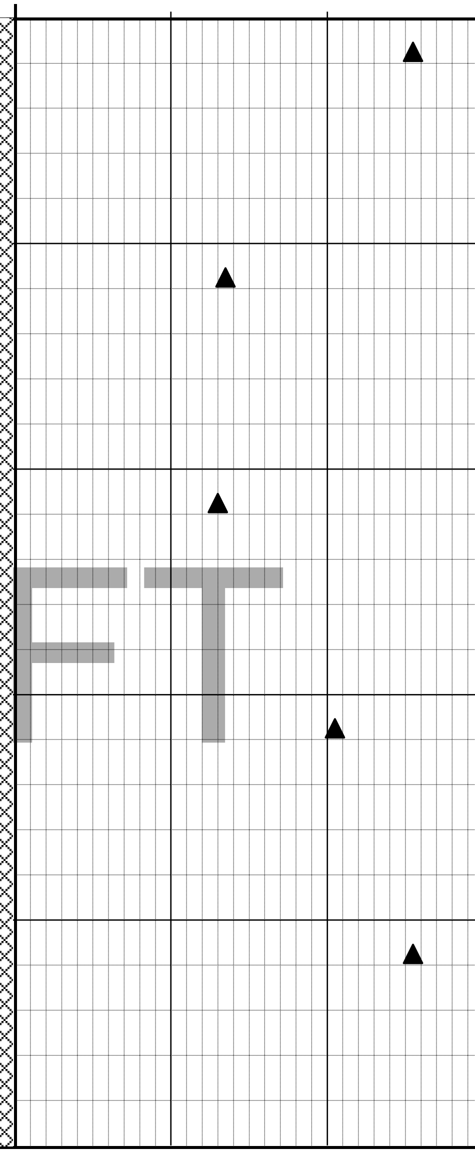
B-3

Depth (ft)	SOIL DESCRIPTION	Sample Number	Recovery	Ground Water	Blow Counts	Testing
25	Very dense, moist, gray SAND, some gravel, trace silt. (Glacial Outwash)	S-8	18"		51	
	Medium dense, saturated, gray SAND, trace to some silt and gravel. (Glacial Outwash)			ATD		
30	Medium dense, wet to saturated, gray, interbedded fine to medium SAND, some silt and fine sandy SILT. (Glacial Outwash)	S-9	18"		27	
35	Very stiff, moist to wet, gray, finely laminated to massive SILT, with some fine sand and trace clay.	S-10	18"		26	
	Very stiff, moist to wet, gray SILT with some clay, interbedded with medium dense, saturated, gray SAND with trace to some silt. (Glacial Outwash)					
40	Hard, moist to wet, gray SILT, with some clay and 1- to 3-inch thick interbeds of dense, saturated, gray SAND with trace to some silt. (Glacial Outwash)	S-11	16"		41	
	(Rougher drilling action)					
45	Very dense, moist to wet, gray SAND, with gravel, trace to some silt. (Glacial Outwash)	S-12	16"		51	
50						

The stratification lines represent the approximate boundaries between soil types. The transition may be gradual. Refer to report text and appendices for additional information.

PENETRATION RESISTANCE (blows/foot)

▲ Standard Penetration Test
△ Hammer Weight and Drop:



DRAFT

SAMPLE LEGEND
- 2-inch O.D. split spoon sample
- 3-inch I.D. Shelby tube sample

GROUNDWATER LEGEND
- Clean Sand
- Bentonite
- Grout/Concrete
- Screened Casing
- Blank Casing
- Groundwater level at time of drilling (ATD) or on date of measurement. 11/2/12

◇ % Fines (<0.075 mm)
○ % Water (Moisture) Content
Plastic Limit —⊖— Liquid Limit
Natural Water Content

TESTING KEY
GSA = Grain Size Analysis
200W = 200 Wash Analysis
Consol. = Consolidation Test
Att. = Atterberg Limits

Panteleakos Residence
4304 94th Ave SE
Mercer Island, WA

Date: May 2017 Project No.: 1797.09

Zipper Geo Associates
19023 36th Ave. W, Suite D
Lynnwood, WA

BORING LOG: B-3

Boring Location: See Figure 2, Site and Exploration Plan	Drilling Company: BoreTec	Bore Hole Dia.: 8 Inch	**B-3**
Top Elevation: 341'	Drilling Method: Hollow Stem Auger	Hammer Type: Cathead	
Date Drilled: 5/17/2017	Drill Rig: Acker	Logged by: JPG	

SOIL DESCRIPTION

The stratification lines represent the approximate boundaries between soil types. The transition may be gradual. Refer to report text and appendices for additional information.

PENETRATION RESISTANCE (blows/foot)

▲ Standard Penetration Test

△ Hammer Weight and Drop:

Depth (ft)	Soil Description	Sample Number	Recovery	Blow Counts	Testing
50	Very dense, moist, gray SAND, trace silt and fine gravel. (Glacial Outwash)	S-13	16"	64	
55	Very dense, moist, gray SAND, trace silt and fine gravel. (Glacial Outwash)	S-14	16"	54	
60	Very dense, moist, gray SAND, trace silt and fine gravel. (Glacial Outwash)	S-15	16"	63	
65	Very dense, moist, gray, silty SAND, some gravel. (Glacial Till))	S-16	16"	50/6"	
	Very dense, saturated, SAND, trace silt and gravel. (Glacial Outwash)				
70	Very dense, saturated, gray SAND, trace to some silt and gravel (Glacial Outwash)	S-17	10"	50/4"	
	Very dense, moist, gray, silty SAND, some gravel. (Glacial Till)				
75					

Ground Water: 5/24/17; ATD

DRAFT

SAMPLE LEGEND

- 2-inch O.D. split spoon sample
- 3-inch I.D. Shelby tube sample

GROUNDWATER LEGEND

- Clean Sand
- Bentonite
- Grout/Concrete
- Screened Casing
- Blank Casing
- Groundwater level at time of drilling (ATD) or on date of measurement. 11/2/12

◇ % Fines (<0.075 mm)

○ % Water (Moisture) Content

Plastic Limit ├──○──┤ Liquid Limit

Natural Water Content

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Panteleakos Residence
4304 94th Ave SE
Mercer Island, WA

Date: May 2017 — Project No.: 1797.09

Zipper Geo Associates
19023 36th Ave. W, Suite D
Lynnwood, WA

BORING LOG: **B-3**

Boring Location:	See Figure 2, Site and Exploration Plan	Drilling Company:	BoreTec	Bore Hole Dia.:	8 Inch
Top Elevation:	341'	Drilling Method:	Hollow Stem Auger	Hammer Type:	Cathead
Date Drilled:	5/17/2017	Drill Rig:	Acker	Logged by:	JPG

B-3

SOIL DESCRIPTION

The stratification lines represent the approximate boundaries between soil types. The transition may be gradual. Refer to report text and appendices for additional information.

PENETRATION RESISTANCE (blows/foot)

▲ Standard Penetration Test

△ Hammer Weight and Drop:

Depth (ft)	Soil Description	Sample Number	Recovery	Blow Counts	Testing
75	Very dense, moist, gray, silty SAND, some gravel. (Glacial Till)	S-18	6"	50/6"	
	Hard, moist, gray, massive SILT, some clay.	S-19	14"	76	
81.5	Boring completed at about 81.5 feet. Perched groundwater encountered from about 29.5 to 34.5 feet and from about 66 to 70.5 feet at time of drilling. Groundwater measured at 62.15 feet on 5/24/2017. Well Tag # BIT-739				

Depth scale: 75, 80, 85, 90, 95, 100. Penetration resistance scale: 0, 20, 40, 60.

DRAFT

SAMPLE LEGEND

- 2-inch O.D. split spoon sample
- 3-inch I.D. Shelby tube sample

GROUNDWATER LEGEND

- Clean Sand
- Bentonite
- Grout/Concrete
- Screened Casing
- Blank Casing
- Groundwater level at time of drilling (ATD) or on date of measurement. 11/2/12

◇ % Fines (<0.075 mm)

○ % Water (Moisture) Content

Plastic Limit ├──○──┤ Liquid Limit

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Panteleakos Residence
4304 94th Ave SE
Mercer Island, WA

Date: May 2017 — Project No.: 1797.09

Zipper Geo Associates
19023 36th Ave. W, Suite D
Lynnwood, WA

BORING LOG: B-3

APPENDIX B

TECCO System Analysis

for slopes < = 45 degrees

RUVOLUM® ONLINE TOOL

RUVOLUM® - The Program to dimension the slope stabilization system TECCO®/SPIDER®

Project No.	07-073.100
Project Name	Knopf Short Plat (Slope <= 45 degrees
Date, Author	2019-07-22, NTW

Input quantities			
Slope inclination	α=	45.0	degrees
Layer thickness	t=	3.50	ft
Friction angle ground (characteristic value)	Φ_k=	36.0	degrees
Volume weight ground (characteristic value)	γ_k=	130.0	lb/ft^3
Nail inclination	ψ=	20.0	degrees
Nail distance horizontal	a=	10.00	ft
Nail distance in line of slope	b=	10.00	ft

Load cases			
Streaming pressure		No	
Earthquake		No	
Coefficient of horizontal acceleration due to earthquake	ε_h=	0.000	[-]
Coefficient of vertical acceleration due to earthquake	ε_v=	0.000	[-]

Defaults and Safety Factors			
Cohesion ground (characteristic value)	c_k=	100.0	lb/ft^2
Radius of pressure cone, top	ζ=	0.49	ft
Inclination of pressure cone to horizontal	δ=	45.0	degrees
Slope-parallel force	Z_d=	3.4	kips
Pretensioning force of the system	V=	6.7	kips
Partial safety correction value for friction angle	γ_Φ	1.25	[-]
Partial safety correction value for cohesion	γ_c	1.60	[-]
Partial safety correction value for volume weight	γ_γ	1.20	[-]
Model uncertainty correction value	γ_{mod}	1.50	[-]

Dimensioning quantities	Φ_d=	30.2	degrees
	c_d=	62.7	lb/ft^2
	γ_d=	155.8	lb/ft^3

Elements of the system			
Applied mesh type		TECCO G65/3	
Applied spike plate		system spike plate P33	
Bearing resistance of mesh to selective, slope parallel tensile stress	Z_R=	7	kips
Bearing resistance of mesh to pressure stress in nail direction	D_R=	41	kips
Bearing resistance of mesh against shearing-off in nail direction	P_R=	20	kips
Applied nail type		GEWI D = 28 mm	
Taking into account rusting away		Yes	
Bearing resistance of nail to tensile stress	T_{Rred}=	51	kips
Bearing resistance of nail to shear stress	S_{Rred}=	29	kips
Cross-section surface of the applied nail with / without rusting away	A_{red}=	1483	in^2

Proofs	
Proof of the mesh against shearing-off at the upslope edge of the spike plate	Fulfilled
Proof of the mesh to selective transmission of the force Z onto the nail	Fulfilled
Proof of the nail against sliding-off of a superficial layer parallel to the slope	Fulfilled
Proof of the mesh against puncturing	Fulfilled
Proof of the nail to combined stress	Fulfilled

The given proofs concern the investigation of superficial instabilities. Additional investigations are required if there is a risk regarding global stability of the slope. If necessary the nail type and nail pattern have to be adapted.

Investigation of local instabilities between single nails			
Proof of the mesh against shearing-off at the upslope edge of the spike plate			
Maximum stress on the mesh for shearing-off in nail direction at the upslope edge of the spike plate (dimensioning level).	P_d=	5.8	kips
Thickness of decisive sliding mechanism	t_{rel}=	3.33	ft
Bearing resistance of the mesh against shearing-off in nail direction at the upslope edge of the spike plate (characteristic value).	P_R=	20.2	kips
Resistance correction value for shearing-off of the mesh	γ_{PR}=	1.5	[-]
Dimensioning value of the bearing resistance of the mesh against shearing-off	P_R/γ_{PR}=	13.5	kips
Proof of bearing safety	P_d<=P_R/γ_{PR}	Fulfilled	
Proof of the mesh to selective transmission of the force Z onto the nail			
Slope parallel force taken into account in the equilibrium considerations	Z_d=	3.4	kips
Bearing resistance of the mesh to selective, slope-parallel tensile stress	Z_R=	6.7	kips
Resistance correction value for selective, slope-parallel transmission of the force Z	γ_{ZR}=	1.5	[-]
Dimensioning value of the bearing resistance of the mesh to tensile stress	Z_R/γ_{ZR}=	4.5	kips
Proof of bearing safety	Z_d<=Z_R/γ_{ZR}	Fulfilled	

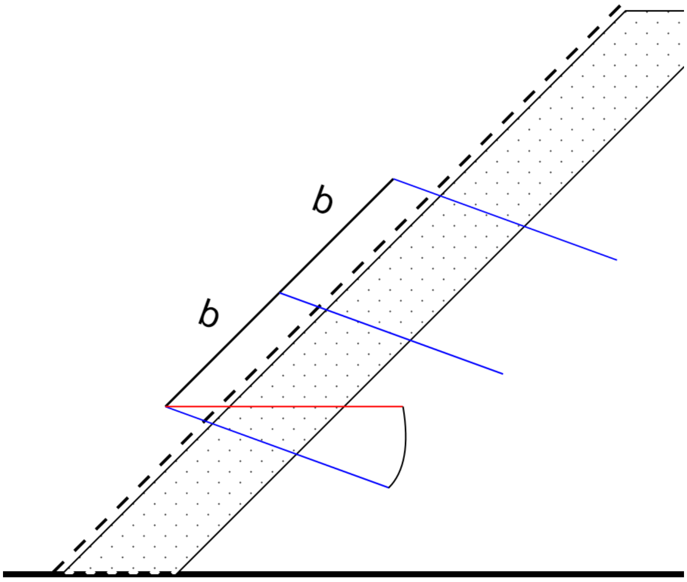
Investigation of slop-parallel instabilities

Proof of the nail against sliding-off of a superficial layer parallel to the slope			
Pretensioning force effectively applied on nail	$V=$	6.7	kips
Load factor for positive influence of pretension V	$\gamma_{VI}=$	0.8	[-]
Dimensioning value of the applied pretensioning force by positive influence of V	$V_{dI}=$	5.4	kips
Calculatorily required shear force at dimensioning level in function of V_{dI}	$S_d=$	15.4	kips
Bearing resistance of the nail to shear stress	$S_{Rred}=$	29.4	kips
Resistance correction value for shearing-off of the nail	$\gamma_{SR}=$	1.5	[-]
Dimensioning value of the bearing resistance of the nail to shear stress	$S_{Rred}/\gamma_{SR}=$	19.6	kips
Proof of bearing safety	$S_d<=S_{Rred}/\gamma_{SR}$	Fulfilled	
Proof of the mesh against puncturing			
Pretensioning force effectively applied on nail	$V=$	6.7	kips
Load factor for positive influence of pretension V	$\Upsilon_{VII}=$	1.5	[-]
Dimensioning value of the applied pretensioning force by positive influence of V	$V_{dII}=$	10.0	kips
Bearing resistance of the mesh to pressure stress in nail direction	$D_R=$	40.5	kips
Resistance correction value for puncturing	$\Upsilon_{DR}=$	1.5	[-]
Dimensioning value of the bearing resistance of the mesh to pressure stress	$D_R/\Upsilon_{DR}=$	27.0	kips
Proof of bearing safety	$V_{dII} <= D_R/\Upsilon_{DR}$	Fulfilled	
Proof of the nail to combined stress			
Pretensioning force effectively applied on nail	$V=$	6.7	kips
Load factor for positive influence of pretension V	$\gamma_{VI}=$	0.8	[-]
Dimensioning value of the applied pretensioning force by positive influence of V	$V_{dI}=$	5.4	kips
Load factor for negative influence of pretension V	$\gamma_{VII}=$	1.5	[-]
Dimensioning value of the applied pretensioning force by negative influence of V	$V_{dII}=$	10.0	kips
Calculatorily required shear force at dimensioning level in function of V_{dII}	$S_d=$	15.4	kips
Maximum stress on the mesh for shearing-off	$P_d=$	5.8	kips
Bearing resistance of the nail to tensile stress	$T_{Rred}=$	50.8	kips
Bearing resistance of the nail to shear stress	$S_{Rred}=$	29.4	kips
Resistance correction value for tensile stress	$\gamma_{TR}=$	1.5	[-]
Resistance correction value for shear stress	$\gamma_{SR}=$	1.5	[-]
Proof of bearing safety $\{[V_{dII}/(T_{Rred}/\gamma_{TR})]^2 + [S_d/(S_{Rred}/\gamma_{SR})]^2\}^{0.5} <= 1.0$	0.84	Fulfilled	
Proof of bearing safety $\{[P_d/(T_{Rred}/\gamma_{TR})]^2 + [S_d/(S_{Rred}/\gamma_{SR})]^2\}^{0.5} <= 1.0$	0.80	Fulfilled	
Minimal tensile strength in the nail for superficial instabilities			
Dimensioning value of the static equivalent tensile force in the nail for determination of the nail length	$T_d=$	26.5	kips

Use Design Load of 30 kips

Cross-section:

Layer thickness	t=	3.50 ft
Nail inclination	ψ=	20.0 degrees
Slope inclination	α=	45.0 degrees



View nail arrangement: