PanGEO
INCORPORATED
Geotechnical & Earthquake
Engineering Consultants

March 19, 2019
PanGEO Project No. 19-056

Mr. Charlie Lai
7505 92nd Avenue SE
Mercer Island, Washington 98040

Subject: **Geotechnical Report**
Proposed Patio
7505 92nd Avenue SE, Mercer Island, Washington 98040

Dear Mr. Lai:

As requested, PanGEO has completed a geotechnical engineering study for the proposed patio at the above address. In preparing this report, we performed a reconnaissance of the property, reviewed existing data, drilled one test boring at the site, and conducted engineering analyses. The results of our study and our design recommendations are presented in the attached report.

In summary, the proposed patio footprint is underlain by competent native soils (glacial till) at shallow depths. In our opinion, the proposed patio is feasible from a geotechnical standpoint, provided that the recommendations presented in this report are incorporated into the design and construction of the project.

We appreciate the opportunity to be of service. Should you have any questions, please do not hesitate to call.

Sincerely,

Siew L. Tan, P.E.
Principal Geotechnical Engineer

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GEOTECHNICAL REPORT
PROPOSED PATIO
7505 92ND AVENUE SE , MERCER ISLAND, WASHINGTON

1.0 GENERAL

PanGEO, Inc. is pleased to present this geotechnical report to assist the project team with the design and construction of the proposed patio at 7505 92nd Avenue SE, in Mercer Island, Washington. This study was prepared in general accordance with our mutually agreed scope of services outlined in our proposal dated February 4, 2019, which was subsequently approved on February 18, 2019. Our scope of services included reviewing readily available geologic and geotechnical data, conducting a site reconnaissance, advancing one test boring at the site, conducting engineering analyses, and preparing the following geotechnical report.

2.0 SITE AND PROJECT DESCRIPTION

The subject site is located at 7505 92nd Avenue SE in Mercer Island, Washington, as shown on Figure 1, Vicinity Map. The site consists of an approximate quarter-acre, rectangular parcel that measures about 123 feet in the north-south direction, and about 93 feet in the east-west direction. The site is surrounded by existing single-family homes, and is situated immediately west of 92nd Avenue SE.

The site is currently occupied by a two-story single-family residence with a garage and basement. The existing residence is accessed by a driveway from 92nd Avenue SE.

The topography of the proposed patio area generally gently slopes down from west to east. The southern portion of the site slopes down from north to south at a grade of approximately 100%. The western portion of the site slopes down from west to east at approximately 50% grade. Based on our review of the topographic survey, prepared by Terrane, site grades along the western property line are a maximum of about 218 feet (NAVD88) and site grades along the southern property line are as low as 168 feet.

Plates 1 and 2 below depict current site conditions. A building cross section view of the proposed patio addition is shown on Plates 3 and 4.

Plate 1. *Looking west from 92nd Avenue SE at the base of the southern slope. 7505 92nd Street SE is cream-colored house in the distance. (03/04/2019)*

Plate 2. *Looking west, in the area of the proposed patio (02/25/2019)*

Plate 3: *Cross Section through the patio addition with proposed elevations, facing North (Credit: JOSH PS dated, January 14, 2019)*

Plate 4: *Cross Section through the patio addition with proposed elevations, facing West. (Credit: JOSH PS dated, January 14, 2019)*

We understand that the proposed project includes the demolition of the existing concrete patio and the construction of a new 372 square foot patio with a roof over it, extending approximately 16 feet off the existing deck at the south side of the residence. Figure 2 depicts the approximate location of the proposed patio.

3.0 SUBSURFACE EXPLORATIONS

3.1 CURRENT EXPLORATION

A test boring (PG-1) was completed on March 4, 2019. The approximate test boring location was measured from existing site features and is indicated on the attached Figure 2. The boring was drilled to about 11 feet below ground surface using a limited access, portable acker drill rig owned and operated by CN Drilling, of Seattle, Washington. The drill rig was equipped with a 4-inch outside diameter hollow stem auger, and soil samples were obtained from the borings at 2½ and 5-foot intervals in general accordance with Standard Penetration Test (SPT) sampling methods (ASTM test method D-1586) in which the samples are obtained using a 2-inch outside diameter split-spoon sampler. The sampler was driven into the soil a distance of 18 inches using a 140-pound weight falling a distance of 30 inches. The number of blows required for each 6-inch increment of sampler penetration was recorded. The number of blows required to achieve the last 12 inches of sample penetration is defined as the SPT N-value. The N-value provides an empirical measure of the relative density of cohesionless soil, or the relative consistency of fine-grained soils.

A geologist from PanGEO was present during the field exploration to observe the test boring, obtain representative samples, and to describe and document the soils encountered in the exploration. The completed boring was backfilled with bentonite chips.

The soil samples retrieved from the boring were described using the system outlined on Figure A-1 of Appendix A, and the summary boring logs are included as Figures A-2.

3.2 PREVIOUS EXPLORATION

A previous test boring (B-1) was advanced by Geotech Consultants, Inc (1988) near the southwest corner of the existing residence to about 30 feet deep. The approximate location of this previously advanced test boring is shown on the attached Figure 2. The summary boring log for B-1 is included in Appendix B.

4.0 SUBSURFACE CONDITIONS

4.1 SITE GEOLOGY

According to the *Geologic Map of Mercer Island, Washington* (Troost and Wisher, 2006), the project site is underlain by Vashon till (geologic map unit Qvt). Vashon till (Qvt) consists of an unsorted mixture of clay, silt, sand, and gravel that is directly deposited below a glacier. This soil unit has been glacially overridden; as such it is typically dense to very dense.

4.2 SOIL CONDITIONS

The test borings completed at the site generally encountered topsoil and fill over dense to very dense glacial till. The subsurface conditions encountered appeared to be consistent with the mapped geology described above. A summary of the generalized soil units encountered in our test borings are presented below. For additional details, please refer to the test boring logs included in Appendices A and B of this report.

> ***Topsoil:*** A thin surficial layer of topsoil was encountered in boring PG-1. The organic rich soil unit was approximately 6 inches thick and consisted of loose silty sand with scattered to prevalent organics and rootlets. This soil unit was not noted on the boring log for B-1.
>
> ***Fill:*** Approximately 3 feet of medium dense, silty sand with trace gravel and rootlets was observed in boring PG-1. We interpreted this soil to be fill placed during original construction of the house. The fill was not noted on the boring log for B-1.
>
> ***Vashon Till (Q_{vt}):*** Dense to very dense silty sand with gravel that we interpreted to be the mapped Vashon Till (Q_{vt}) was encountered at about 3 feet in our test boring PG-1, and at the ground surface in boring B-1 . This unit extended to the termination depths of the test borings at about 11 feet in boring PG-1, and 30 feet in B-1.

4.3 GROUNDWATER CONDITIONS

At the time of our subsurface investigations (March 2019), groundwater was not encountered in test boring PG-1. Perched groundwater, however, was encountered at a depth of approximately 17 feet in boring B-1 (Geotech Consultants, 1988). Based on the observed soil conditions and prevalent iron-oxide staining therein, we anticipate that groundwater may become perched within the fill soils on top of the underlying very dense or hard native deposits during certain times of the year. It should be noted that groundwater elevations and seepage rates are likely to vary depending on the season, local subsurface conditions, and other factors. Generally, the water level is higher and seepage rates are greater in the wetter, winter months (typically October through May).

5.0 GEOLOGIC HAZARDS ASSESSMENT

5.1 Potential Landslide Hazards

The subject site is mapped within a potential landslide hazard area according to the City of Mercer Island's Geologic Hazards Map. The map indicates that slopes of 15% or more and slopes between 40 - 79% are present at the site. The map also indicates that mass wasting deposits exist over the eastern slopes of the site, and a landslide scarp is mapped near the west side of the subject site. According to the City's map, previously documented landslides (pink triangles) and springs (blue circles) are located at several parcels surrounding the subject site (see Plate 5, right), but none at the subject site.

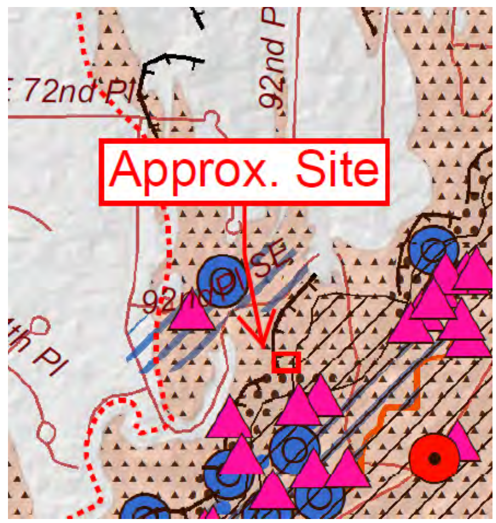


Plate 5. *Capture from Mercer Island Landslide Hazard Assessment (Troost and Wisher, 2009)*

Site Reconnaissance: A site reconnaissance was conducted on March 4, 2019. As part of our site reconnaissance we traversed the slope to look for evidence of past or on-going slope instability, including the mapped scarp on the site, and mass wasting deposits. During our site reconnaissance we did not observe evidence of past instability in the project area, such hummocky terrain, obvious slide scarps, uneven topography, or tension cracks. No evidence of mass wasting deposits were noted in the immediate vicinity of the proposed developed area, nor were mass wasting deposits encountered in our test borings.

On the slope south of the proposed patio, we observed the mature trees on the slope to have generally straight trunks with only minor pistol-butting and no evidence of significant soil creep (see Plate 6). This slope is heavily vegetated and uniform, and slopes at an angle of about 1H:1V. South of the property line, the slope levelling out to about 2H:1V, and an east-west trending drainage ditch is located roughly 10 feet south of the property (see Plate 7).

Plate 6. *Mature trees at the top of the slope at the southern extent of the proposed patio. Looking east. (03/04/2019)*

Plate 7. *Looking west along south property line where a drainage ditch is located. (03/04/2019). Subject property is to the right.*

During our site reconnaissance we also observed the condition of the existing residence, to look for signs of settlement and distress, which may indicate slope movement. No significant foundation cracks, evidence of tilting, or displacement was noted in the exposed portion of the existing house foundation.

Conclusions: Based on our reconnaissance and the presence of glacial till at shallow depths at the construction area, in our opinion a large, deep-seated type slope failure is unlikely on the subject property. In our opinion, small, shallow surficial slides could occur on the steep portions of the slope. However, due to the limited amount of surficial loose soils encountered in our test borings, the lack of observed evidence of recent shallow slides, and the relatively thick vegetation cover which protects the surface of the slope from erosion, in our opinion the potential for a shallow slides at the site is relatively low.

It is our opinion that the proposed development as currently planned is feasible from a geotechnical engineering standpoint, and in our opinion will not adversely affect the overall stability of the site or adjacent properties, provided the recommendations outlined herein are followed and the proposed development is properly design and constructed.

5.2 Seismic Hazards

Based on our review of the City of Mercer Island's Geologic Hazards Maps, the project site is mapped in a seismic hazard area. The City of Mercer Island Code defines seismic hazard areas as those areas subject to risk of damage as a result of earthquake-induced ground shaking, slope failure, soil liquefaction or surface faulting.

Based on the dense to very dense glacial till underlying the proposed patio site, as well as the lack of groundwater at shallow depths, in our opinion, the potential for soil liquefaction during an IBC-code level earthquake is considered minimal, and special design considerations associated with soil liquefaction are not required.

It is also our opinion that the potential for significant seismic-induced land sliding is relatively low at the site due to the dense to very dense glacial till underlying the slope. Shallow slides within over-steepened portions of the slope could have the potential to be triggered by a seismic event. However, provided the design of the proposed patio considers the potential of shallow slides triggered by a seismic event, such as adequate foundation embedment and set back from the slope, in our opinion the potential shallow slides will not negatively impact the proposed patio.

5.3 Erosion Hazards

The subject site is mapped within a potential erosion hazard area according to the City of Mercer Island's Geologic Hazards Map. Based on soil conditions encountered in the borings, the near-surface site soils are likely to exhibit moderate to low erosion potential. In our opinion, the erosion hazards at the site can be effectively mitigated with the best management practice during construction and with properly designed and implemented landscaping for permanent erosion control. During construction, the temporary erosion hazard can be effectively managed with an appropriate erosion and sediment control plan, including but not limited to installing silt fencing at the construction perimeter, limiting removal of vegetation to the construction area, placing gravel or hay bales at the disturbed/traffic areas, covering stockpile soil or cut slopes with plastic sheets, constructing a temporary drainage pond to control surface runoff and sediment trap, and placing quarry spalls at the construction entrance.

Permanent erosion control measures should include establishing vegetation, landscape plants, and hardscape established at the end of project, and reducing surface runoff to the minimum extent possible.

6.0 GEOTECHNICAL RECOMMENDATIONS

6.1 SEISMIC DESIGN CONSIDERATIONS

6.1.1 Seismic Site Class

The 2015 International Building Code (IBC) seismic design section provides a basis for seismic design of structures, which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years), and the 2008 USGS seismic hazard maps. For design purposes, it is our opinion that Site Class D should be assumed for this project.

6.1.2 Liquefaction

Liquefaction is a process that can occur when soils lose shear strength for short periods of time during a seismic event. Ground shaking of sufficient strength and duration results in the loss of grain-to-grain contact and an increase in pore water pressure, causing the soil to behave as a fluid. Soils with a potential for liquefaction are typically cohesionless, predominately silt and sand sized, loose to medium dense, and must be saturated. Because the proposed patio is underlain by dense to very dense sand and gravel, in our opinion the liquefaction potential below the proposed patio is low, and design considerations related to soil liquefaction are not necessary for this project.

6.2 FOOTINGS

Based on the results of the subsurface explorations conducted at the site, it is our opinion that the proposed patio can be supported on conventional footings bearing on the undisturbed glacial till, and the bottom of the footings should be located at least 3 feet below the existing ground surface. Any soft soils should be removed from below the footings to expose the glacial till.

We also recommend that footings be located at least 5 feet from the top of steep slope.

6.2.1 Allowable Bearing Pressure

We recommend that a maximum allowable soil bearing pressure of 2,500 pounds per square foot (psf) be used to size the footings. For allowable stress design, the recommended bearing pressure may be increased by one-third for transient loading, such as wind or seismic forces.

6.2.2 Lateral Resistance

Lateral loads acting on the foundations may be resisted by passive earth pressure developed against the embedded portion of the foundation system and by frictional resistance at the bottom of the footings. For footings bearing on the compacted structural fill, a frictional coefficient of 0.35 may be used to evaluate sliding resistance. Passive soil resistance may be calculated using an equivalent fluid unit weight of 300 pcf, assuming properly compacted structural fill will be placed against the footings. The above values include a factor of safety of 1.5. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches of soil should be neglected.

6.2.3 Settlement Estimate

Total and differential settlements are anticipated to be within tolerable limits for footings designed and constructed as discussed above. Footing settlement under static loading conditions is estimated to be less than about 1 inch. We anticipate differential settlement between the spread footings across the structure should be less than about ½ inch. Most settlement will occur during construction as loads are applied.

6.2.4 Footing Subgrade Preparation

Footing subgrades should be in a firm and stable condition prior to setting forms and placing reinforcing steel. Any loose or softened soil should be removed from the footing excavations. The adequacy of the footing subgrade soils should be verified by a representative of PanGEO, prior to placing forms or rebar.

If loose or disturbed soil is encountered at the footing elevation, the footing may be lowered to bear on the undisturbed soils, or the unsuitable soils should be removed and replaced with properly compacted structural fill, or lean-mix concrete.

6.3 STRUCTURAL FILL AND COMPACTION

Structural fill should consist of imported fill, and should consist of a fairly well graded granular material having a maximum grain size of three inches and no more than 7 percent fines passing the US No. 200 sieve based on the minus 3/4-inch fraction. On site soils should be not be re-used as structural fill.

Structural fill should be placed in 6- to 12-inch thick loose lifts and compacted to at least 95 percent maximum dry density, per ASTM D-1557 (Modified Proctor). In non-structural areas, the recommended compaction level may be reduced to 90 percent. Heavy compaction equipment should operate directly over utilities until a minimum of 2 feet of backfill has been placed.

The procedure to achieve proper density of a compacted fill depends on the size and type of compaction equipment, the number of passes, thickness of the lifts being compacted, and certain soil properties. If the excavation to be backfilled is constricted and limits the use of heavy equipment, smaller equipment can be used, but the lift thickness will need to be reduced to achieve the required relative compaction.

Generally, loosely compacted soils are a result of poor construction technique or improper moisture content. Soils with high fines contents are particularly susceptible to becoming too wet and coarse-grained materials easily become too dry, for proper compaction. Silty or clayey soils with a moisture content too high for adequate compaction should be dried as necessary, or moisture conditioned by mixing with drier materials, or other methods.

6.4 Wet Weather Construction

General recommendations relative to earthwork performed in wet weather or in wet conditions are presented below. The following procedures are best management practices recommended for use in wet weather construction:

- Earthwork should be performed in small areas to minimize subgrade exposure to wet weather. Excavation or the removal of unsuitable soil should be followed promptly by the placement and compaction of clean structural fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance.
- During wet weather, the allowable fines content of the structural fill should be reduced to no more than 5 percent by weight based on the portion passing the 0.75-inch sieve. The fines should be non-plastic.
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water.
- Geotextile silt fences should be installed at strategic locations around the site to control erosion and the movement of soil.
- Excavation slopes and soils stockpiled on site should be covered with plastic sheeting.

6.5 Erosion Considerations

Surface runoff can be controlled during construction by careful grading practices. Typically, this includes the construction of shallow, upgrade perimeter ditches or low earthen berms in conjunction with silt fences to collect runoff and prevent water from entering excavations or to prevent runoff from the construction area leaving the immediate work site. Temporary erosion control may require the use of hay bales on the downhill side of the project to prevent water from leaving the site and potential storm water detention to trap sand and silt before the water is discharged to a suitable outlet. All collected water should be directed under control to a positive and permanent discharge system.

Permanent control of surface water should be incorporated in the final grading design. Adequate surface gradients and drainage systems should be incorporated into the design such that surface runoff is collected and directed away from the structure to a suitable outlet. Potential issues associated with erosion may also be reduced by establishing vegetation within disturbed areas immediately following grading operations.

7.0 STATEMENT OF RISK

The site is mapped as a geologic hazard area by the City of Mercer Island, as documented above. Per Mercer Island City Code, development within geologic hazard areas and critical slopes may occur if the geotechnical engineer provides a statement of risk with supporting documentation indicating that one of the following conditions can be met:

a. The geologic hazard area will be modified, or the development has been designed so that the risk to the lot and adjacent property is eliminated or mitigated such that the site is determined to be safe; or

b. Development practices are proposed for the alteration that would render the development as safe as if it were not located in a geologic hazard area; or

c. The alteration is so minor as not to pose a threat to the public health, safety, and welfare; or

d. An evaluation of site-specific subsurface conditions demonstrates that the proposed development is not located in a geologic hazard area.

It is our opinion that Criterion c is appropriate given the small size of the proposed patio (372 square feet) in a localized area. The proposed patio foundation will be designed with proper embedment such that they bear on the native dense soils. As such, in our opinion, the development will not negatively affect the stability of the slope, or the surrounding properties.

In addition, in our opinion Criterion b can be met through proper footing setback and embedment, and best management practices during construction, including the proper use of a silt fence, minimize earthwork activities during periods heavy precipitation, minimize exposed areas in the wet season, and other appropriate temporary erosion control measures.

8.0 ADDITIONAL SERVICES

To confirm that our recommendations are properly incorporated into the design and construction of the proposed structure, PanGEO should be retained to conduct a review of the final project plans and specifications, and to monitor the construction of geotechnical elements. The City of Mercer Island, as part of the permitting process, may also require geotechnical construction inspection services. PanGEO can provide you a cost estimate for construction monitoring services at a later date.

9.0 CLOSURE

We have prepared this report for Mr. Charlie Lai and the project design team. Recommendations contained in this report are based on a site reconnaissance, a subsurface exploration program, review of pertinent subsurface information, and our understanding of the project. The study was performed using a mutually agreed-upon scope of services.

Variations in soil conditions may exist between the locations of 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 services 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 has been prepared for planning and design purposes for specific application to the proposed project in accordance with the generally accepted standards of local practice at the time this report was written. No warranty, express or implied, is made.

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.

Sincerely,

PanGEO, Inc.

SIEW LAN TAN
STATE OF WASHINGTON
30342
REGISTERED
PROFESSIONAL ENGINEER
3/19/2019

Spenser Scott, L.G.
Staff Geologist

Siew L Tan, P.E.
Principal Geotechnical Engineer

10.0 REFERENCES

ASTM D1586-11, *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*, ASTM International, West Conshohocken, PA, 2011, www.astm.org.

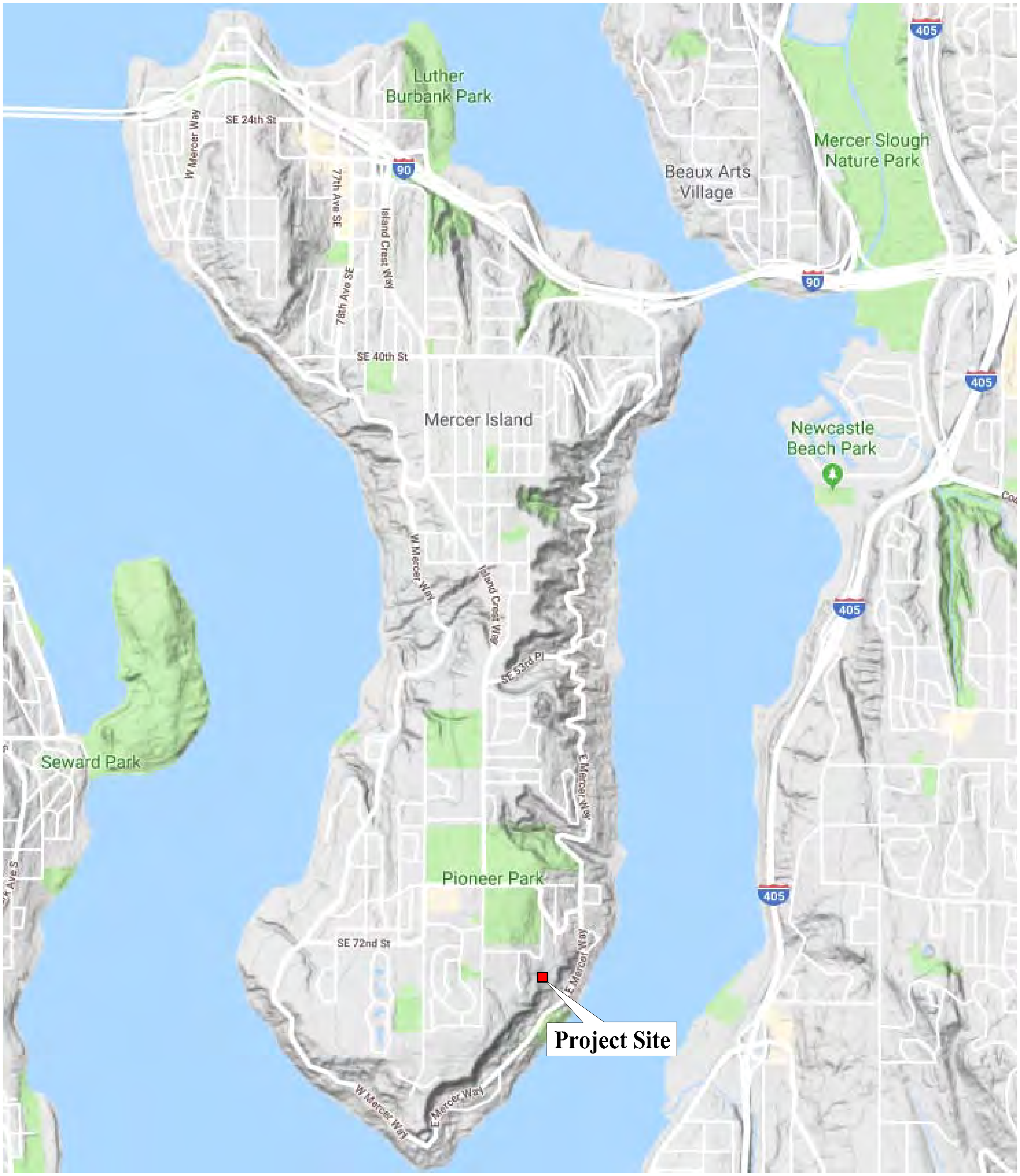
Geotechnical Engineering Study, Kerry Hills Short Plat, Southeast 76th Street and 92nd Avenue Southeast, Mercer Island, Washington. Prepared by Geotech Consultants, Inc. dated, July 18, 1988, accessed February 18, 2019, https://geologyportal.dnr.wa.gov.

International Code Council, 2015, *International Building Code (IBC), 2015.*

Troost, K.G., and Wisher, A.P, 2006, *Geologic Map of Mercer Island, Washington,* scale 1:24,000.

Washington State Department of Transportation (WSDOT), 2018, *Standard Specifications for Road, Bridges, and Municipal Construction*, Olympia, Washington.

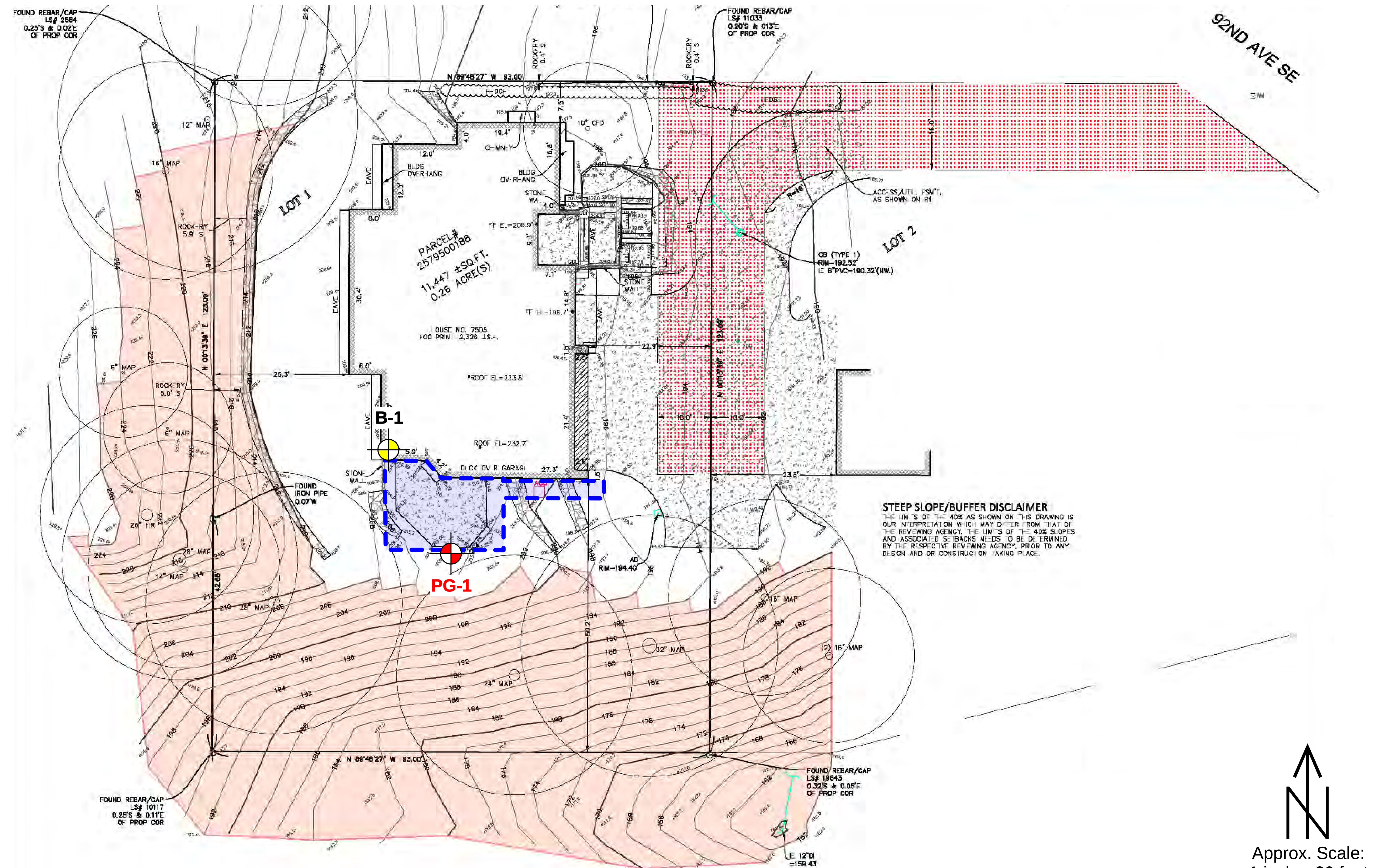
Washington Administrative Code (WAC), 2013, Chapter 296-155 - Safety Standards for Construction Work, Part N - Excavation, Trenching, and Shoring, Olympia, Washington.



Not to Scale

Reference: Google Terrain Maps

PanGEO INCORPORATED	Proposed Patio 7505 92nd Avenue SE Mercer Island, Washington	VICINITY MAP	
		Project No. 19-056	Figure No. 1



Approx. Scale:
1 inch = 20 feet

Base map modified from Topographic and Boundary Survey by Terrane, dated July 4, 2018

Legend:

- Approximate Boring Location *PanGEO, Inc., March 2019*
- Existing Boring Location *Geotech Consultants, July 1988*
- Approx. Proposed Patio
- Slope Greater Than ~40% *(as mapped by Terrane)*

PanGEO INCORPORATED

Proposed Patio
7505 92nd Avenue SE
Mercer Island, Washington

SITE AND EXPLORATION PLAN

Project No. 19-056 | Figure No. 2

19-056 Fig 2 Site and Exploration Plan.grf 3/18/19 (14:44) SPS

APPENDIX A

TEST BORING LOG

RELATIVE DENSITY / CONSISTENCY

SAND / GRAVEL			SILT / CLAY		
Density	SPT N-values	Approx. Relative Density (%)	Consistency	SPT N-values	Approx. Undrained Shear Strength (psf)
Very Loose	<4	<15	Very Soft	<2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Med. Dense	10 to 30	35 - 65	Med. Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	>50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	>30	>4000

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP DESCRIPTIONS	
Gravel 50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines.	GRAVEL (<5% fines)	GW	Well-graded GRAVEL
		GP	Poorly-graded GRAVEL
	GRAVEL (>12% fines)	GM	Silty GRAVEL
		GC	Clayey GRAVEL
Sand 50% or more of the coarse fraction passing the #4 sieve. Use dual symbols (eg. SP-SM) for 5% to 12% fines.	SAND (<5% fines)	SW	Well-graded SAND
		SP	Poorly-graded SAND
	SAND (>12% fines)	SM	Silty SAND
		SC	Clayey SAND
Silt and Clay 50%or more passing #200 sieve	Liquid Limit < 50	ML	SILT
		CL	Lean CLAY
		OL	Organic SILT or CLAY
	Liquid Limit > 50	MH	Elastic SILT
		CH	Fat CLAY
		OH	Organic SILT or CLAY
Highly Organic Soils		PT	PEAT

Notes:
1. Soil exploration logs contain material descriptions based on visual observation and field tests using a system modified from the Uniform Soil Classification System (USCS). Where necessary laboratory tests have been conducted (as noted in the "Other Tests" column), unit descriptions may include a classification. Please refer to the discussions in the report text for a more complete description of the subsurface conditions.

2. The graphic symbols given above are not inclusive of all symbols that may appear on the borehole logs. Other symbols may be used where field observations indicated mixed soil constituents or dual constituent materials.

DESCRIPTIONS OF SOIL STRUCTURES

- **Layered:** Units of material distinguished by color and/or composition from material units above and below
- **Laminated:** Layers of soil typically 0.05 to 1mm thick, max. 1 cm
- **Lens:** Layer of soil that pinches out laterally
- **Interlayered:** Alternating layers of differing soil material
- **Pocket:** Erratic, discontinuous deposit of limited extent
- **Homogeneous:** Soil with uniform color and composition throughout
- **Fissured:** Breaks along defined planes
- **Slickensided:** Fracture planes that are polished or glossy
- **Blocky:** Angular soil lumps that resist breakdown
- **Disrupted:** Soil that is broken and mixed
- **Scattered:** Less than one per foot
- **Numerous:** More than one per foot
- **BCN:** Angle between bedding plane and a plane normal to core axis

COMPONENT DEFINITIONS

COMPONENT	SIZE / SIEVE RANGE	COMPONENT	SIZE / SIEVE RANGE
Boulder:	> 12 inches	Sand	
Cobbles:	3 to 12 inches	Coarse Sand:	#4 to #10 sieve (4.5 to 2.0 mm)
Gravel		Medium Sand:	#10 to #40 sieve (2.0 to 0.42 mm)
Coarse Gravel:	3 to 3/4 inches	Fine Sand:	#40 to #200 sieve (0.42 to 0.074 mm)
Fine Gravel:	3/4 inches to #4 sieve	Silt	0.074 to 0.002 mm
		Clay	<0.002 mm

TEST SYMBOLS

for In Situ and Laboratory Tests listed in "Other Tests" column.

ATT	Atterberg Limit Test
Comp	Compaction Tests
Con	Consolidation
DD	Dry Density
DS	Direct Shear
%F	Fines Content
GS	Grain Size
Perm	Permeability
PP	Pocket Penetrometer
R	R-value
SG	Specific Gravity
TV	Torvane
TXC	Triaxial Compression
UCC	Unconfined Compression

SYMBOLS

Sample/In Situ test types and intervals

- 2-inch OD Split Spoon, SPT (140-lb. hammer, 30" drop)
- 3.25-inch OD Spilt Spoon (300-lb hammer, 30" drop)
- Non-standard penetration test (see boring log for details)
- Thin wall (Shelby) tube
- Grab
- Rock core
- Vane Shear

MONITORING WELL

- Groundwater Level at time of drilling (ATD)
- Static Groundwater Level
- Cement / Concrete Seal
- Bentonite grout / seal
- Silica sand backfill
- Slotted tip
- Slough
- Bottom of Boring

MOISTURE CONTENT

Dry	Dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

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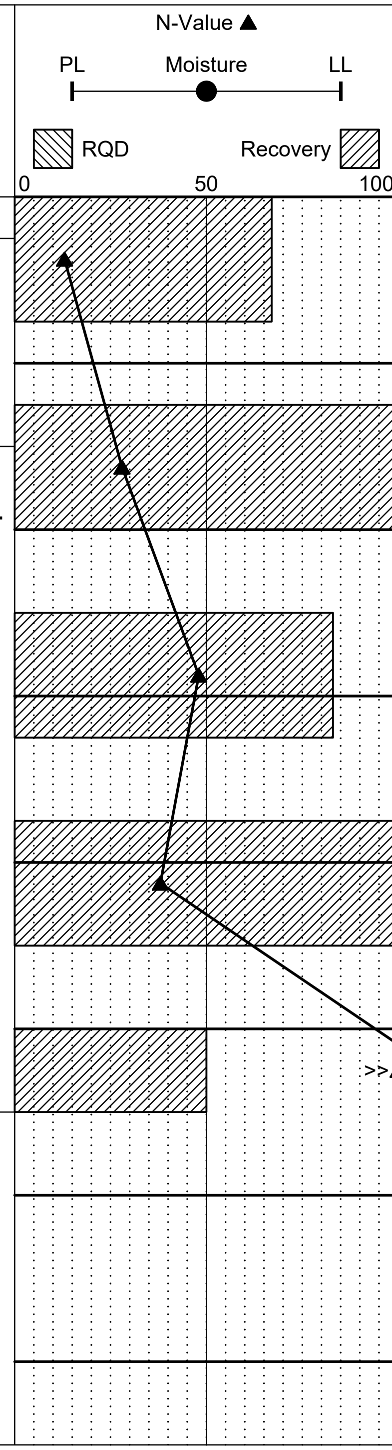
Terms and Symbols for Boring and Test Pit Logs

Figure A-1

Project:	Proposed Patio	Surface Elevation:	~204 feet
Job Number:	19-056	Top of Casing Elev.:	N/A
Location:	7505 92nd Avenue SE, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0			4			*- Approximately 6 inches of topsoil.*
	S-1		6			Medium dense, moist, brown to grey-brown, silty fine SAND; trace gravel, trace carbon, iron-oxide staining, trace rootlets. **[FILL].**
			7			
2						*- Water added at approximately 3 feet to aid with drilling.*
			6			
	S-2		13			Medium dense, moist, grey-brown, silty fine to medium SAND with gravel; trace iron oxide staining, slightly cemented. **[VASHON TILL- Qvt].**
4			15			
			16			*- Becomes dense.*
6	S-3		22			
			26			
						- Water added at approximately 7 feet to aid with drilling.
			12			*- Grades to coarse sand at approximately 7.5 feet.*
8	S-4		17			
			21			
						- Increase in gravel content at approximately 9 feet.
10			29			*- Becomes very dense.*
	S-5		50/6			
						Boring terminated at approximately 11 feet below ground surface.. Groundwater was not observed at the time of drilling..
12						
14						



Completion Depth:	11.0ft
Date Borehole Started:	3/4/19
Date Borehole Completed:	3/4/19
Logged By:	S. Scott
Drilling Company:	CN Drilling

Remarks: Boring drilled using a portable hand acker drill rig. Standard penetration test (SPT) sampler driven with a 140 lb safety hammer. Hammer operated with a rope and cathead mechanism. Surface elevations (NAVD88) estimated from Topographic and Boundary Survey by Terrane, dated July 4, 2018.

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LOG OF TEST BORING PG-1

Figure A-2

The stratification lines represent approximate boundaries. The transition may be gradual.

APPENDIX B

PREVIOUS TEST BORING LOG

BORING 1

Elevation: 204' ±

Depth (ft)	Moisture Content (%)	Sample	Blows per Foot	USCS	Description
0–27	8.1	1	54	SM	Brownish Orange Silty SAND with gravel, Moist, Very Dense (till)
	6.3	2	55/6"		
	6.2	3	76		
	9.3	4	38		saturated below 17 feet
	11.6	5	87/10"		
27–30	26.7	6	94/10"	ML	Gray Silt, Slightly Plastic, Wet, Hard

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

GEOTECH CONSULTANTS

TEST BORING LOG

KERRY HILLS SHORT PLAT

MERCER ISLAND, WASHINGTON 142

Job No.	Date:	Logged By:	Plate
88228	JULY 1988	FC	3