PanGEO
INCORPORATED
Geotechnical & Earthquake
Engineering Consultants

October 31, 2022
File No. 22-268

Charles and Julie Hately
4114 83rd Avenue SE
Mercer Island, WA 98040

Subject: **Geotechnical Engineering Report**
Proposed Single-Family Residence
4114 83rd Avenue SE, Mercer Island, Washington

Dear Charles and Julie,

As requested, PanGEO, Inc. has completed a geotechnical engineering study for the proposed single-family residence at the above-referenced property. This study was performed in general accordance with our mutually agreed scope of work outlined in our proposal dated June 2, 2022, and was subsequently approved by you. Our service scope included reviewing readily-available geologic and geotechnical data in the project vicinity, reviewing design plans, drilling three test borings, conducting a site reconnaissance, and developing the conclusions and recommendations presented in this report.

SITE AND PROJECT DESCRIPTION

The subject site is an approximately 14,085 square foot lot located at 4114 83rd Avenue SE in the City of Mercer Island, Washington (see Vicinity Map, Figure 1). The subject lot is rectangular in shape, and is bordered to the west by 83rd Avenue SE, and to other three sides by existing single-family residences. A one-story single-family house currently occupies the approximately western portion of the site. The site grade generally descends from east to west with a vertical relief of about five feet (see Figure 2, Site and Exploration Plan). Review of the City of Mercer Island GIS mapping indicates that there are no geologic hazard areas (e.g., steep slope or landslide-prone areas) mapped at the site.

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Based on the current design plans, we understand that the existing house will be demolished, and a new single-family residence will be constructed at approximately the same location as the existing one. The proposed residence will be a two-story wood framed structure with no basement. Based on the site topography, we envisage that excavation for building foundations may be on the order of four feet or less for the foundation construction.

The conclusions and recommendations in this report are based on our understanding of the proposed development, which is in turn based on the project information provided. If the above project description is incorrect, or the project information changes, we should be consulted to review the recommendations contained in this study and make modifications, if needed.

SUBSURFACE EXPLORATIONS

Three borings (PG-1 through PG-3) were drilled at the site on June 14, 2022, using a CAT track drill rig owned and operated by Geologic Drill Partners of Fall City, Washington. The approximate boring locations were taped in the field from on-site features and are shown on Figure 2. The borings were drilled to depths of about 13 to 21½ feet below the surface.

The drill rig was equipped with 5-inch outside diameter hollow stem augers. Soil samples were obtained from the borings at 2½-foot depth 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 freely 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 to observe the drilling, assist in sampling, and to describe and document the soil samples obtained from the borings. The soil samples were described and field classified in general accordance with the symbols and terms outlined in Figure A-1 of Appendix A, and the summary boring logs are included as Figures A-2 through A-4.

SITE GEOLOGY AND SUBSURFACE CONDITIONS

SITE GEOLOGY

According to the Geologic Map of Mercer Island (Troost and Wisher, 2006), the site is underlain by Vashon till (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.

Deposits of Pre-Fraser glaciation age are also mapped in the project vicinity. Pre-Fraser deposits (Qpf) generally consist of interbedded sand, gravel, and silt deposited prior to the Fraser glaciation. The unit has been glacially overridden, and as such, is typically very dense.

SOIL AND GROUNDWATER CONDITIONS

The soils encountered in the test borings consisted of up to about 2½ feet of loose to medium dense fill overlying about 7½ to 12 feet of dense to very dense silty sand with gravel (Vashon till) overlying hard/very dense interlayered silt, sand, and clay (pre-Fraser deposits). The pre-Fraser deposits were not encountered in boring PG-1 to the bottom of exploration. Please refer to the boring summary logs in Appendix A for a detailed description of the conditions encountered at each boring location.

Light perched groundwater seepage was observed at about 4 feet depth at PG-1, at about 7 feet and between about 11½ and 13 feet depth at PG-2, and between about 4 and 7 feet depth at PG-3 during drilling. It should be noted that groundwater elevations and seepage rates are likely to vary depending on the season, local subsurface conditions, and other factors. Groundwater levels and seepage rates are normally highest during the winter and early spring.

GEOTECHNICAL DESIGN RECOMMENDATIONS

SEISMIC SITE CLASS

We anticipate that the seismic design of the structures will be accomplished using the 2018 edition of the International Building Code (IBC). Based on the site soil conditions and the proposed design, it is our opinion that Site Class C (Very Dense Soil and Soft Rock) should be used for the seismic design of the proposed structures.

BUILDING FOUNDATIONS

Based on the subsurface conditions encountered at the site and our understanding of the current building design, it is our opinion that the proposed building may be supported on conventional footings. The footings should bear on the competent native soils that are expected to be encountered at the construction subgrade elevation. Footings may also be founded on properly compacted structural fill placed on undisturbed native soils.

Exterior foundation elements should be placed at a minimum depth of 18 inches below final exterior grade. Interior spread foundations should be placed at a minimum depth of 12 inches below the top of slab. Where space may be limited, the use of L-shaped footings may be required to conserve space for the temporary cuts.

We recommend that a maximum allowable bearing pressure of 3,000 pounds per square feet (psf) be used for sizing the. The recommended allowable bearing pressures are for dead plus live loads. For allowable stress design, the recommended bearing pressure may be increased by one-third for transient loads, such as wind or seismic forces. Continuous and individual spread footings should have minimum widths of 18 and 24 inches, respectively.

Settlements of footings designed and constructed as described above should have a total settlement of less than one inch, and differential settlement of less than ½ inch. Most of the anticipated settlement should occur during construction as dead loads are applied.

Lateral Resistance – Lateral loads on the structure may be resisted by passive earth pressure developed against the embedded portion of the foundation system and by frictional resistance between the bottom of the foundation and the supporting subgrade soils. For footings bearing on the dense native soils or compacted structural fill, a frictional coefficient of 0.35 may be used to evaluate sliding resistance at the bottom of footings. Passive soil resistance may be calculated using an equivalent fluid weight of 350 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.

Perimeter Footing Drain – Footing drains should be installed around the garage footings and building perimeter footings, at or just below the invert of the footings. Under no circumstances should roof downspout drain lines be connected to the footing drain systems. Roof downspouts must be separately tightlined to appropriate discharge locations. Cleanouts should be installed at strategic locations to allow for periodic maintenance of the footing drain and downspout tightline systems.

Footing Subgrade Preparation – All footing subgrades should be carefully prepared. Loose or softened soil exposed at the construction subgrade elevation should be removed prior to pouring concrete. The adequacy of footing subgrade should be verified by a representative of PanGEO, prior to placing forms or rebar.

FLOORS SLABS

It is our opinion that concrete slab-on-grade floors are appropriate for this project. Concrete slab-on-grade floors may be supported on the competent native soil or on compacted structural fill placed on undisturbed native soil. If loose or soft soils are encountered at the slab subgrade elevation that cannot be adequately compacted, the loose or soft soil should be over-excavated to competent native soil and replaced with compacted structural fill.

Slab-on-grade floors should be underlain by a capillary break consisting of at least of 4 inches of ¾-inch, clean crushed rock (less than 3 percent fines) compacted to a firm and unyielding condition. The capillary break should be placed on subgrade that has been compacted to a dense and unyielding condition. The capillary break should be placed on a suitable subgrade as confirmed by PanGEO. A 10-mil polyethylene vapor barrier should also be placed directly below the slab. We also recommend that control joints be incorporated into the floor slab to control cracking.

RETAINING WALL DESIGN PARAMETERS

Retaining wall should be properly designed to resist the lateral earth pressures exerted by the soils behind the wall. Proper drainage provisions should also be provided behind the walls to intercept and remove groundwater that may be present behind the wall. Our geotechnical recommendations for the design and construction of the retaining walls are presented below.

Lateral Earth Pressures

Concrete cantilever walls should be designed for an equivalent fluid pressure of 35 pcf for level backfills behind the walls assuming the walls are free to rotate. If walls are to be restrained at the top from free movement, such as basement walls, equivalent fluid pressures of 50 pcf should be used for level backfills behind the walls. Walls with a maximum 2H:1V backslope should be designed for an active and at rest earth pressure of 45 and 60 pcf, respectively.

Permanent walls should be designed for an additional uniform lateral pressure of 9H psf for seismic loading, where H corresponds to the buried depth of the wall. The recommended lateral pressures assume that the backfill behind the wall consists of a free draining and properly compacted fill with adequate drainage provisions.

Surcharge

Surcharge loads, where present, should also be included in the design of retaining walls. We recommend that a lateral load coefficient of 0.3 be used to compute the lateral pressure on the wall face resulting from surcharge loads located within a horizontal distance of one-half wall height.

Lateral Resistance

Lateral forces from seismic loading and unbalanced lateral earth pressures may be resisted by a combination of passive earth pressures acting against the embedded portions of the foundations and by friction acting on the base of the foundations. Passive resistance values may be determined using an equivalent fluid weight of 350 pcf. This value includes a factor of safety of 1.5, assuming the footing is poured against dense native sand, re-compacted on-site sandy soil or properly compacted structural fill adjacent to the sides of footing. A friction coefficient of 0.35 may be used to determine the frictional resistance at the base of the footings. The coefficient includes a factor safety of 1.5.

Wall Drainage

Provisions for wall drainage should consist of a 4-inch diameter perforated drainpipe behind and at the base of the wall footings, embedded in 12 to 18 inches of clean crushed rock and pea gravel wrapped with a layer of filter fabric. A minimum 18-inch-wide zone of free draining granular soils (i.e. pea gravel or washed rock) is recommended to be placed adjacent to the wall for the full height of the wall. Alternatively, a composite drainage material, such as Miradrain 6000, may be used in lieu of the clean crushed rock or pea gravel. The drainpipe at the base of the wall should be graded to direct water to a suitable outlet.

Wall Backfill

Retaining wall backfill should consist of free draining granular material. The site soils within the planned excavation depth are relatively silty and would not meet the requirements for wall backfill. We recommend importing a free draining granular material, such as Seattle Type 17 or a soil meeting the requirements of Gravel Borrow as defined in Section 9-03.14(1) of the WSDOT *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT, 2022). In areas where space is limited between the wall and the face of excavation, pea gravel may be used as backfill without compaction.

Wall backfill should be properly moisture conditioned, placed in loose, horizontal lifts less than 12 inches in thickness, and compacted to a dense and unyielding condition. If density tests will be performed, the test results should show at least 95 percent of the maximum dry density, as determined using test method ASTM D-1557 (Modified Proctor). Within 5 feet of the wall, the backfill should be compacted with hand-operated equipment to at least 90 percent of the maximum dry density.

INFILTRATION CONSIDERATIONS

The test borings drilled at the site encountered dense to very dense, silty sand with gravel (Vashon till) to at least ten feet depth in each test boring. Perched groundwater seepage was present at about four feet depth. Due to the presence of hydraulically restrictive till and groundwater seepage at shallow depths, it is our opinion that infiltration of surface water is not feasible for this site, and other means of stormwater disposal should be considered for this project.

CONSTRUCTION CONSIDERATIONS

SITE PREPARATION

Site preparation for the proposed project mainly includes removing the existing building, site clearing, and excavations to the design subgrade. All debris resulted from demolition and site clearing should be hauled away from the site. The stripped surface materials should be properly disposed off-site or be "wasted" on site in non-structural landscaping areas.

Following site clearing and excavations, the adequacy of the subgrade where structural fill, foundations, slabs, or pavements are to be placed should be verified by a representative of PanGEO. The subgrade soil in the improvement areas, if recompacted and still yielding, may need to be over-excavated and replaced with compacted structural fill or lean-mix concrete. The need for over-excavation should be determined by PanGEO.

TEMPORARY EXCAVATIONS

As currently planned, the excavation for the proposed foundation may be as deep as four feet. We anticipate the excavations to mainly encounter fill overlying dense to very dense native soils. All temporary excavations should be performed in accordance with Part N of WAC (Washington Administrative Code) 296-155. The contractor is responsible for maintaining safe excavation slopes and/or shoring.

Based on the soil conditions at the site, for planning purposes, it is our opinion that temporary excavations for the proposed construction may be sloped 1H:1V or flatter. Based on our current understanding of the anticipated building layout and finished floor elevations, it appears that sufficient space is available for unsupported open cuts for the proposed construction. Where space may be limited, the use of L-shaped footings may be required to conserve space for the temporary cuts.

The temporary excavations and cut slopes should be re-evaluated in the field during construction based on actual observed soil conditions, and may need to be modified in the wet reasons. The cut slopes should be covered with plastic sheets in the raining season. We also recommend that heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within a distance equal to 1/3 the slope height from the top of any excavation.

MATERIAL REUSE

The soils underlying the site primarily consist of silty sand and silt, are moisture sensitive, and will become disturbed and soft when exposed to inclement weather conditions. We do not recommend reusing the native soils as structural fill. If it is planned to use the native soil in non-structural areas, the excavated soil should be stockpiled and protected with plastic sheeting to prevent it from becoming saturated by precipitation or runoff.

STRUCTURAL FILL PLACEMENT AND COMPACTION

In the context of this report, structural fill is defined as compacted fill placed under footings, concrete stairs and landings, slabs, pavement, or other load-bearing areas. Structural fill, if needed, should consist of City of Seattle Type 17, WSDOT Section 9-03.9(3) Crushed Surfacing Base Course (WSDOT 2022), or an approved equivalent.

Structural fill should be properly moisture conditioned, placed in loose, horizontal lifts less than 12 inches in thickness, and compacted to a dense and unyielding condition. The adequacy of compaction should be verified by a PanGEO representative. Alternatively, if density tests will be performed, the test results should indicate a minimum 95 percent relative compaction level as determined using ASTM D-1557 (Modified Proctor).

Depending on the type of compaction equipment used and depending on the type of fill material, it may be necessary to decrease the thickness of each lift in order to achieve adequate compaction. PanGEO can provide additional recommendations regarding structural fill and compaction during construction.

WET WEATHER EARTHWORK

In our opinion, the proposed site construction may be accomplished during wet weather (such as in winter) without adversely affecting the site stability. However, earthwork construction performed during the drier summer months likely will be more economical. Winter construction will require the implementation of best management erosion and sedimentation control practices to reduce the risk of off-site sediment transport. Most of the site soils within the anticipated depth of excavation contain a high percentage of fines and are moisture sensitive. Any footing subgrade soils that become softened either by disturbance or rainfall should be removed and replaced with structural fill, Controlled Density Fill (CDF), or lean-mix concrete. General recommendations relative to earthwork performed in wet conditions are presented below:

- Site stripping, excavation and subgrade preparation should be followed promptly by the placement and compaction of clean structural fill or CDF;
- The size and type of construction equipment used may have to be limited to prevent soil disturbance;
- 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 strategically located to control erosion and the movement of soil;
- Structural fill should consist of less than 5% fines; and
- Excavation slopes should be covered with plastic sheets.

SURFACE DRAINAGE 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 from leaving the immediate work site.

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 directed away from slopes and structures. Water from roof drains and other impervious areas should be properly collected and discharged into a storm drain system, and should not be discharged on to the slope areas.

ADDITIONAL SERVICES

To confirm that our recommendations are properly incorporated into the design and construction of the proposed residence, 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, will also require geotechnical construction inspection services. PanGEO can provide you a cost estimate for construction monitoring services at a later date.

We anticipate that the following additional services will be required:

- Review final project plans and specifications
- Verify implementation of erosion control measures;
- Verify adequacy of footing subgrade;
- Monitor temporary excavation;
- Verify the adequacy of subsurface drainage installation;
- Confirm the adequacy of the compaction of structural backfill; and
- Other consultation as may be required during construction

Modifications to our recommendations presented in this report may be necessary, based on the actual conditions encountered during construction.

CLOSURE

We have prepared this report for Charles and Julie Hately 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 work.

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 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 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.

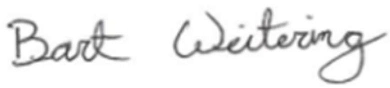
This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. 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.

We appreciate the opportunity to be of service.

Sincerely,

PanGEO, Inc.



Bart Weitering, G.I.T.
Project Geologist

Chien-Lin (Johnny) Chen, P.E.
Senior Geotechnical Engineer

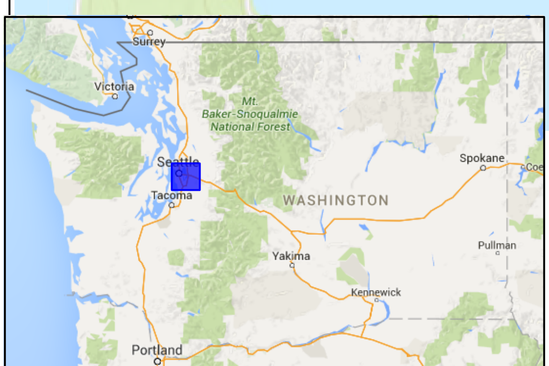
Enclosures:

REFERENCES

International Code Council, 2018, *International Building Code (IBC)*.

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

WSDOT, 2022, *Standard Specifications for Road, Bridge and Municipal Construction, M 41-10.*



Base Map: ESRI Topographic

NORTH

Not to Scale

PanGEO INCORPORATED

Proposed SFR
4114 83rd Avenue SE
Mercer Island, Washington

VICINITY MAP

Project No.	22-268	Figure No.	1

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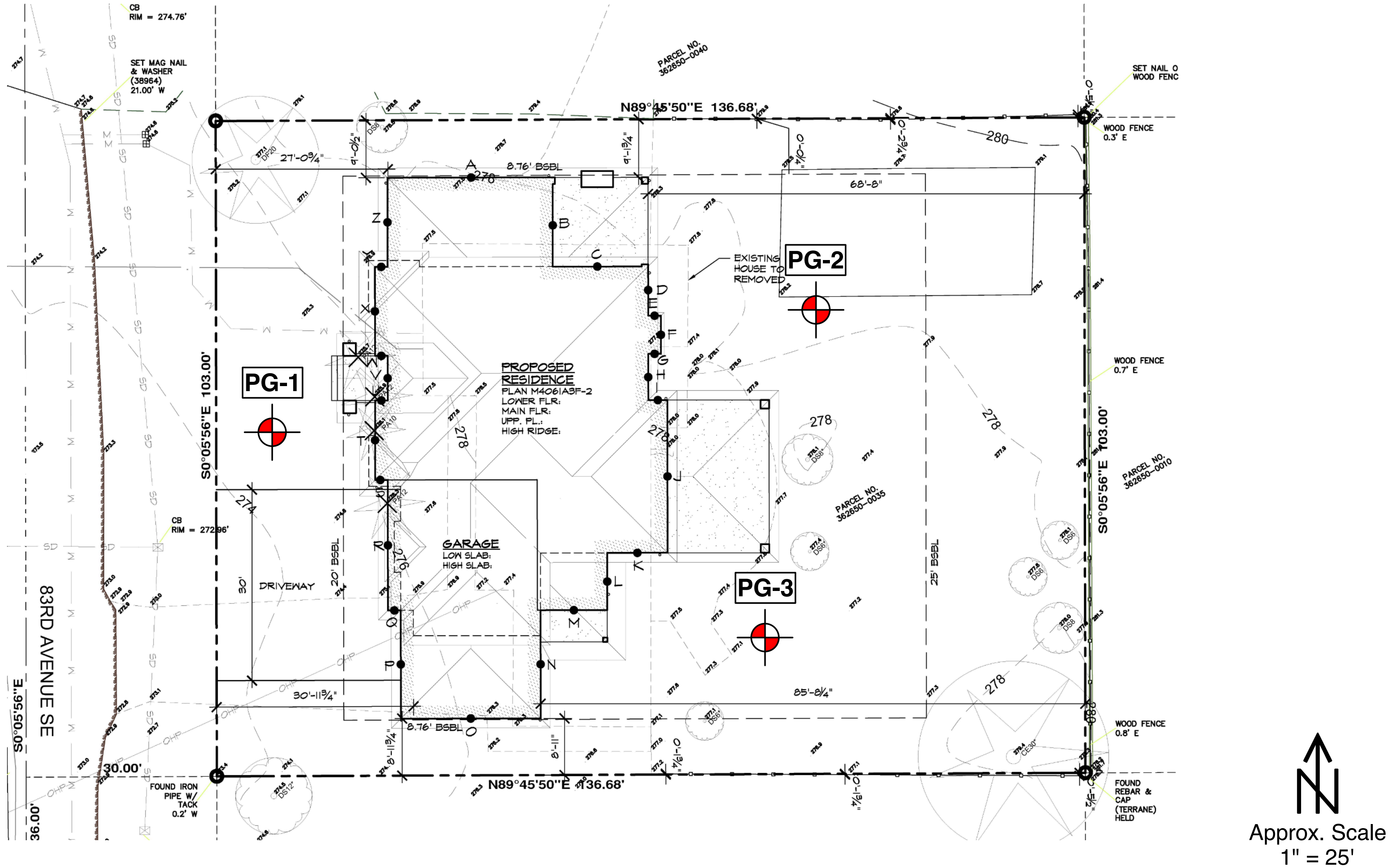

Base map modified from Sheet A0 - Site Plan by Architects Northwest dated April 14, 2022

Legend:

Approx. Test Boring Location

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Proposed SFR
4114 83rd Avenue SE
Mercer Island, Washington

SITE AND EXPLORATION PLAN

Project No.	22-268	Figure No.	2

APPENDIX A

SUMMARY TEST BORING LOGS

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

LOG KEY 16-056_LOGS.GPJ PANGEO.GDT 02/22/16

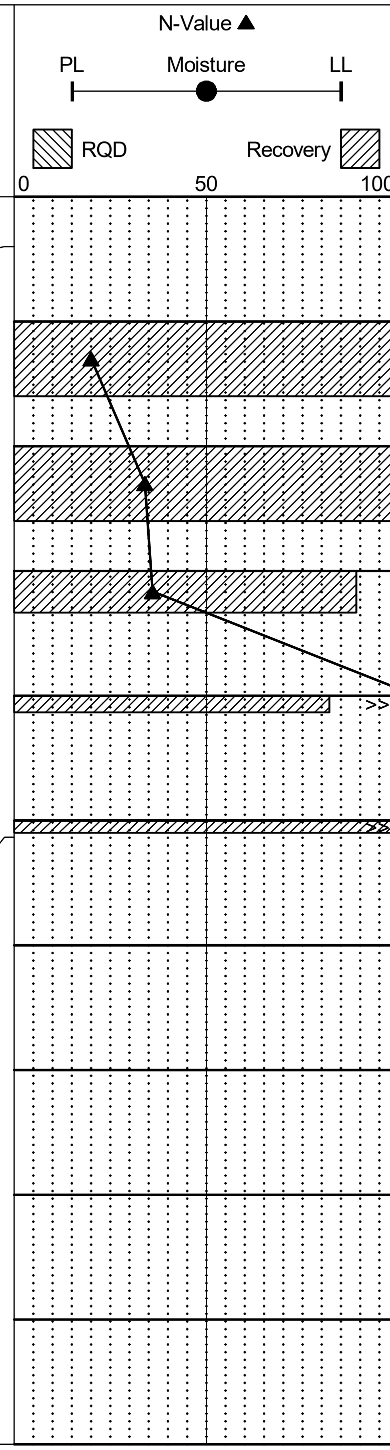
PanGEO INCORPORATED
Phone: 206.262.0370

Terms and Symbols for Boring and Test Pit Logs

Figure A-1

Project:	Proposed Single-Family Residence	Surface Elevation:	275.0ft
Job Number:	22-268	Top of Casing Elev.:	N/A
Location:	4114 83rd Ave SE, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.572, Easting: -122.2281	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0						Grass and sod over loose to medium dense, dark brown, silty SAND trace gravel; moist; poorly graded, slightly organic [Topsoil/Fill].
						Medium dense, gray-brown, gravelly, silty fine SAND; moist; poorly graded, diamict, iron oxide staining [Qvt - Vashon Till].
2.5	S-1		6 9 11			
						--becomes wet in tip.
5.0	S-2		10 16 18			--becomes dense, moist, slightly cemented; no iron oxide staining.
7.5	S-3		13 16 20			
10.0	S-4		13 26 50/5			--becomes very dense.
12.5	S-5		50/4			--becomes gray.
						Boring terminated at about 12.8 feet below ground surface due to practical drilling refusal. Light perched groundwater seepage was observed at about 4 feet depth during drilling.
15.0						
17.5						
20.0						
22.5						
25.0						



Completion Depth:	12.8ft
Date Borehole Started:	6/14/22
Date Borehole Completed:	6/14/22
Logged By:	B. Weitering
Drilling Company:	Geologic Drill Partners

Remarks: Boring drilled using a Bobcat track drill rig. Standard penetration test (SPT) sampler driven with a 140 lb. safety hammer. Hammer operated with a rope and cathead mechanism. Surface elevation estimated from Site Plan by Architects Northwest dated April 14, 2022.

PanGEO INCORPORATED

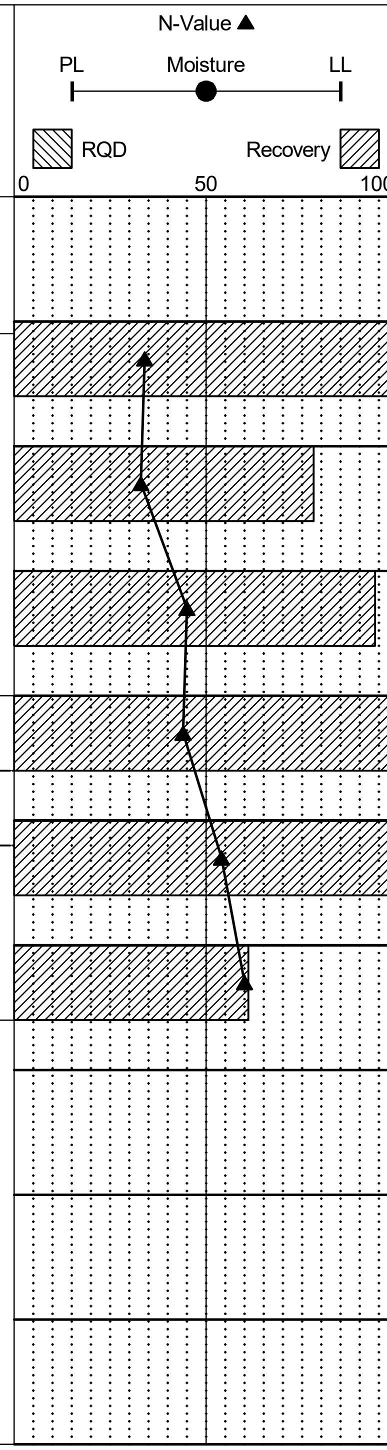
LOG OF TEST BORING PG-1

Figure A-2

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

Project:	Proposed Single-Family Residence	Surface Elevation:	278.0ft
Job Number:	22-268	Top of Casing Elev.:	N/A
Location:	4114 83rd Ave SE, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.57208, Easting: -122.22775	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0						Grass and sod over loose to medium dense, dark brown, silty SAND trace gravel; moist; poorly graded, slightly organic [Topsoil/Fill].
2.5	S-1		12 15 19			Dense, gray-brown, gravelly, silty fine SAND; moist; poorly graded, diamict, iron oxide staining [Qvt - Vashon Till].
5.0	S-2		9 15 18			
7.5	S-3		18 20 25			--minor perched groundwater seepage observed at about 7 feet depth during drilling.
10.0	S-4		13 19 25			Hard, gray-brown, SILT; very moist; non-plastic, iron oxide banding, few sand laminations [Qpf - Pre-Fraser Deposit].
						Very dense, gray, gravelly SAND; wet; poorly graded [Qpf - Pre-Fraser Deposit].
12.5	S-5		25 26 28			Hrad, gray, SILT; moist; non-plastic [Qpf - Pre-Fraser Deposit].
15.0	S-6		18 25 35			
						Boring terminated at about 16.5 feet below ground surface. Light perched groundwater seepage was observed at about 7 feet and 11.5 to 13 depth during drilling.
17.5						
20.0						
22.5						
25.0						



Completion Depth:	16.5ft
Date Borehole Started:	6/14/22
Date Borehole Completed:	6/14/22
Logged By:	B. Weitering
Drilling Company:	Geologic Drill Partners

Remarks: Boring drilled using a Bobcat track drill rig. Standard penetration test (SPT) sampler driven with a 140 lb. safety hammer. Hammer operated with a rope and cathead mechanism. Surface elevation estimated from Site Plan by Architects Northwest dated April 14, 2022.

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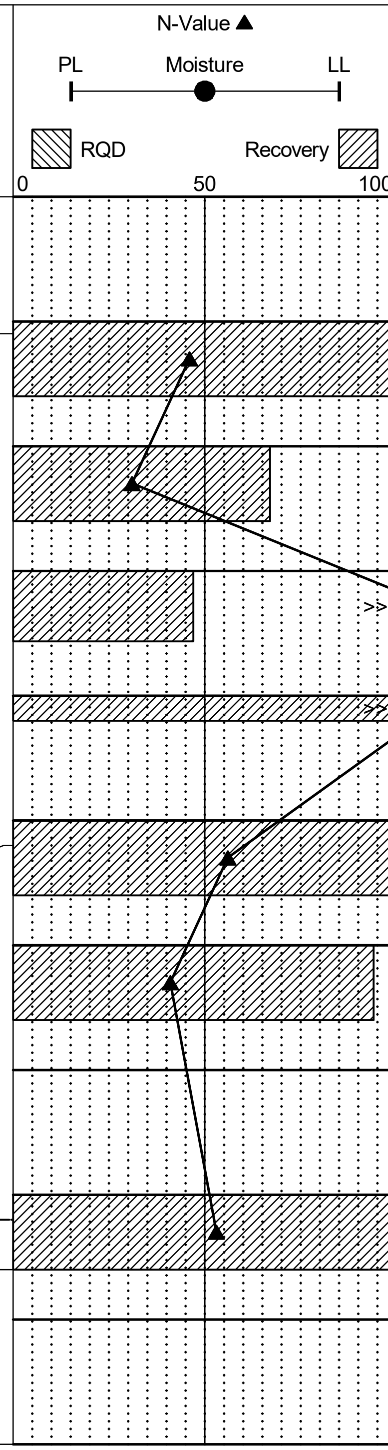
LOG OF TEST BORING PG-2

Figure A-3

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

Project:	Proposed Single-Family Residence	Surface Elevation:	277.0ft
Job Number:	22-268	Top of Casing Elev.:	N/A
Location:	4114 83rd Ave SE, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.5719, Easting: -122.22775	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0						Grass and sod over loose to medium dense, dark brown, silty SAND trace gravel; moist; poorly graded, slightly organic [Topsoil/Fill].
2.5	S-1		12 23 23			Dense, gray-brown, gravelly, silty fine SAND; moist to wet; poorly graded, diamict, iron oxide staining [Qvt - Vashon Till].
5.0	S-2		12 14 17			
7.5	S-3		24 37 50/5			--becomes very dense, moist, slightly cemented; no iron oxide staining.
10.0	S-4		50/6			
12.5	S-5		19 26 30			--trace iron oxide staining at contact. Hard, gray, SILT; moist; non-plastic [Qpf - Pre-Fraser Deposit].
15.0	S-6		14 19 22			--becomes dense, sandy SILT. --2" gravelly sand interlayer.
17.5						
20.0	S-7		19 20 33			Hard, gray, CLAY; moist; low plasticity [Qpf - Pre-Fraser Deposit].
22.5						Boring terminated at about 21.5 feet below ground surface. Light perched groundwater seepage was observed at about 4 to 7 feet depth during drilling.
25.0						



Completion Depth:	21.5ft
Date Borehole Started:	6/14/22
Date Borehole Completed:	6/14/22
Logged By:	B. Weitering
Drilling Company:	Geologic Drill Partners

Remarks: Boring drilled using a Bobcat track drill rig. Standard penetration test (SPT) sampler driven with a 140 lb. safety hammer. Hammer operated with a rope and cathead mechanism. Surface elevation estimated from Site Plan by Architects Northwest dated April 14, 2022.

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LOG OF TEST BORING PG-3

Figure A-4

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