PanGEO
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Geotechnical & Earthquake
Engineering Consultants

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Project No. 22-111

Ms. Cheryl McConnell
c/o **Heliotrope Architects**
5140 Ballard Avenue NW, Suite B
Seattle, WA 98107
Mr. Mike Mora, AIA

Subject: Geotechnical Report and Geologically Hazardous Areas Evaluation
Proposed Addition
7845 Southeast 62nd Street, Mercer Island, Washington

Dear Mr. Mora:

Attached please find our geotechnical report for the proposed addition in Mercer Island, Washington. This report documents the subsurface conditions at the site and presents results of our Geologically Hazardous Areas review and geotechnical engineering recommendations.

In summary, the site is generally underlain by three to four feet of loose soils, in turn underlain by medium dense to very dense silt interlayered with silty sand and sand (pre-Olympia deposits). In our opinion, the proposed additions may be supported with conventional footings bearing on competent native soils, or on properly compacted structural fill placed on the competent native soils. Minor over-excavations below the proposed footings may be needed to remove the loose soils to expose the competent bearing soils. Temporary unsupported excavations may be sloped as steep as 1H:1V (Horizontal:Vertical). The floor slabs for the proposed additions may be constructed using conventional concrete slab-on-grade floor construction.

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

Sincerely,

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

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TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 PROJECT AND SITE DESCRIPTION 1
3.0 SUBSURFACE EXPLORATIONS 3
4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS 3
4.1 Site Geology 3
4.2 USDA Soil Survey 4
4.3 Subsurface Conditions 4
4.4 Groundwater 5
5.0 GEOLOGIC HAZARDS EVALUATION 5
5.1 Erosion Hazards 5
5.2 Landslide Hazards 6
5.3 Seismic Hazards 6
6.0 GEOTECHNICAL RECOMMENDATIONS 7
6.1 Site Class 7
6.2 Building Foundations 7
6.2.1 Allowable Bearing Pressure 7
6.2.2 Foundation Performance 8
6.2.3 Lateral Resistance 8
6.2.4 Perimeter Footing Drains 8
6.2.5 Footing Subgrade Preparation and Protection 9
6.3 Floors Slabs 9
6.4 Retaining Wall Design Parameters 9
6.4.1 Surcharge Loads 10

3213 Eastlake Avenue East, Suite B
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Tel (206) 262-0370
Fax (206) 262-0374

6.4.2 Lateral Resistance *10*

6.4.3 Wall Drainage *10*

6.4.4 Wall Backfill *11*

6.5 PERMANENT CUT AND FILL SLOPES 11

7.0 EARTHWORK CONSIDERATIONS 11

7.1 TEMPORARY EXCAVATIONS 11

7.2 MATERIAL REUSE 12

7.3 STRUCTURAL FILL AND COMPACTION 12

7.4 WET WEATHER CONSTRUCTION 12

7.5 EROSION CONSIDERATIONS 13

8.0 STAMENT OF RISK 14

9.0 LIMITATIONS 15

10.0 REFERENCES 17

ATTACHMENTS

Figure 1	Vicinity Map
Figure 2	Site and Exploration Plan
Appendix A	**Summary Test Boring Logs**
Figure A-1	Terms and Symbols for Boring and Test Pit Logs
Figure A-2	Log of Test Boring PG-1
Figure A-3	Log of Test Boring PG-2

GEOTCHNICAL REPORT AND
GEOLOGICALLY HAZARDOUS AREAS EVALUATION
PROPOSED ADDITION
7845 SE 62ND STREET, MERCER ISLAND, WASHINGTON

1.0 INTRODUCTION

This report presents the results of our geotechnical study and geologic hazards evaluation that was undertaken to support the design and construction of the proposed addition at 7845 Southeast 62nd Street in Mercer Island, Washington. Our service scope included reviewing readily available geologic and geotechnical data in the project vicinity, drilling two test borings, conducting a site reconnaissance, performing engineering analysis, and developing the conclusions and recommendations presented in this report.

2.0 PROJECT AND SITE DESCRIPTION

The project site is an approximately 14,577 square foot lot located at 7845 Southeast 62nd Street in Mercer Island, Washington, approximately as shown on Figure 1, Vicinity Map. The site is irregular in shape. It is bordered to the north by SE 62nd Street and to the other three sides by existing single-family residences. The site is currently occupied by a one-story single-family residence with a partial daylight basement and a detached garage. Based on review of the topographic survey and our site observations, the existing site grade generally slopes down from southeast to the north and west with a vertical relief of up to 28 feet and average an average gradient of 15 to 20 percent. Some grade separation is provided by several 1- to 2-foot-tall rockeries. The general conditions of the site at the time of our field exploration are shown on the Plates 1 and 2 on page 2.

Based on review of the City of Mercer Island hazard maps, the site is mapped within an Erosion Hazard Area.

We understand it is planned to construct an addition to expand the existing garage slightly to the west, and to construct an accessory structure near the southeast corner of the property (see Figure 2). Based on review of the preliminary design plans, the proposed additions will be one-story wood frame structures matching the existing house and garage. We anticipate that temporary excavations for the addition foundation construction will be about 3 to 4 feet deep.

Plate 1: *Rear view of the existing residence (back) and location of the proposed accessory structure (front). Looking northwest from the southeast property corner.*

Plate 2: *View of rockery (right) and existing detached garage (back), where the proposed addition will be located. Looking east from the existing residence.*

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. In any case, PanGEO should be retained to provide a review of the final design to confirm that our geotechnical recommendations have been correctly interpreted and adequately implemented in the construction documents.

3.0 SUBSURFACE EXPLORATIONS

Two test borings (PG-1 and PG-2) were completed at the site on March 23, 2022. The approximate boring locations are shown on Figure 2. The borings were drilled to about 9 and 11½ feet below the existing grades using an acker limited access drill rig owned and operated by CN Drilling of Seattle, Washington, under subcontract to PanGEO.

The drill rig was equipped with 6-inch outside diameter hollow stem augers, and soil samples were obtained from the borings at 2½ and 5-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 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 our firm was present throughout the field exploration program to observe the drilling, assist in sampling, and to document the soil samples obtained from the borings. The completed borings were backfilled with bentonite chips.

The soil samples retrieved from the borings were described using the system outlined on Figure A-1 of Appendix A, and the summary boring logs are included as Figures A-2 and A-3.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 SITE GEOLOGY

Based on our review of the *Geologic Map of Mercer Island, Washington* (Troost & Wisher, 2006), the subject site is underlain by Vashon till (Qvt) with pre-Olympia deposits (Qpo) mapped to the north, east, and west. The characteristics of these mapped soil units are described below:

> Vashon till (Qvt) typically consists of a very dense, heterogeneous mixture of silt, sand, and gravel laid down at the base of an advancing glacial ice sheet. Vashon till has been glacially overridden and typically exhibits low compressibility and high strength characteristics in its undisturbed state.

Pre-Olympia deposits (Qpo) typically consist of very dense and hard, interbedded sand, silt, gravel, and diamicts of indeterminate age and origin (deposited prior to the Olympia non-glacial interval).

4.2 USDA Soil Survey

We reviewed the USDA Natural Resource Conservation Service (NRSC) Soil Survey (NRCS, 2022) for surficial soil information. Based on our review, the site is underlain by Kitsap silt loam 15 to 30 percent slopes (Soil Map Unit KpD).

Kitsap silt loams are considered variably well-drained soils. The erosion hazard of this soil unit is considered severe when left unprotected.

4.3 Subsurface Conditions

Based on the conditions encountered in our test borings, the site is generally underlain by about 3 to 4 feet of loose soil overlying medium dense to very dense native silt, silty sand, and sand, which is generally consistent with the nearby mapped geology. A description of the soil units encountered in our test borings is presented below. Detailed descriptions of the soils encountered in our test borings can be seen in our test boring logs included in Appendix A.

Fill – Below the surface at each test boring location, the borings encountered very loose silty sand with debris. We interpret this unit as fill based on its loose condition, disturbed appearance, and presence of debris. This unit extended to about 3 feet depth at PG-1 and to about 1 foot at PG-2.

Pre-Olympia Deposits (Qpo) – Below the fill, both test borings encountered native medium dense to very dense interlayered silt and silty sand. Below about 9 feet depth, PG-2 also encountered clean sand. We interpret these soils as the pre-Olympia deposits mapped in the vicinity. This unit extended to the termination depth in each test boring up to 11½ feet deep. At PG-2 this unit is weathered to a loose condition to a depth of about 4 feet.

Our subsurface descriptions are based on the conditions encountered at the time of our exploration. Soil conditions between our exploration locations may vary from those encountered. The nature and extent of variations between our exploratory locations may not become evident until construction. If variations do appear, PanGEO should be requested to reevaluate the recommendations in this report and to modify or verify them in writing prior to proceeding with earthwork and construction.

4.4 GROUNDWATER

Light perched groundwater seepage was observed from about 1½ to 3 feet depth at PG-1, but no groundwater was observed within the drilling depths in PG-2 at the time of our field exploration. It should be noted that groundwater levels may vary during depending on the season, local subsurface conditions, and other factors. Groundwater levels are normally highest during the winter and early spring.

5.0 GEOLOGIC HAZARDS EVALUATION

As part of our study, we conducted an assessment of potential geologic hazards within the subject site as defined in Mercer Island City Code Chapter 19.07.160, Geologically Hazardous Areas. Mercer Island City Code identifies three different types of Geologic Hazards: Erosion Hazards, Landslide Hazards, and Seismic Hazards. The City's criteria for those various hazard areas and our assessment of the hazard areas with respect to the planned improvements are provided in the following sections of this report.

5.1 EROSION HAZARDS

The site is mapped as a potential erosion hazard area in accordance with the City of Mercer Island's Geologic Hazards Map. Based on the USDA Soil Survey data and our test borings, the site soils (Kitsap Silt Loam KpD) are anticipated to exhibit severe erosion potential when disturbed and left unprotected. However, 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 also be effectively managed with an appropriate erosion and sediment control plan, including but not limited to installing a silt fence at the construction perimeter, placing quarry spalls or hay bales at the disturbed and traffic areas, covering stockpiled soil or cut slopes with plastic sheets, constructing a temporary drainage pond to control surface runoff and sediment trap, placing rocks at the construction entrance, etc.

Permanent erosion control measures should be applied to the disturbed areas as soon as feasible. These measures may include but not limited to planting and hydroseeding. The use of permanent erosion control mat may also be considered in conjunction with planting/hydroseeding to protect the soils from erosion.

5.2 Landslide Hazards

Based on review of the Mercer Island GIS map, no landslide hazard areas are mapped within the project site. This is consistent with our site observations, as discussed below.

On March 23, 2022, we conducted a reconnaissance of the site and site slopes. As previously discussed, the site topography slopes from southeast to northwest with gradients of about 15 to 20 percent. Based on our reconnaissance, the site does not contain indications of recent or historical slope movements, such as scarps, sloughs, tension cracks, uneven ground surfaces, jackstrawed trees, breaks in vegetation, water features and convergent landforms. Additionally, we observed that the adjacent properties are covered with bushes and trees. The trunks of the mature trees are observed to be straight.

Our test borings did not encounter permeable soils overlying impermeable soils that may intersect the ground surface. We also did not observe any springs at the site. The site is not located near any stream or lake that could incise or undercut the base of the slope.

We also reviewed a LiDAR image of the site and its vicinity, and the landslide inventory map from the Washington Department of Natural Resources (DNR). To the best of our knowledge, there are no reported past known slides at the site.

In summary, based on subsurface conditions encountered in the test borings, the relatively gentle topography of the site, and our field observations, it is our opinion that the site appears to be globally stable in its present condition, and the landslide susceptibility at the site is considered negligible. It is also our opinion that the proposed development as currently planned will not decrease the site stability or adversely impact the subject site and surrounding properties, provided that the proposed project is properly designed and constructed. It is our further opinion that building setback distance due to potential landslide hazard is not needed for the proposed project.

5.3 Seismic Hazards

Based on review of the City of Mercer Island Seismic Hazard Map, the site is not mapped as having soil liquefaction potential.

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 can result 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, with a predominately silt and sand grain size, must be loose, and be below the groundwater table.

Based on our subsurface explorations, the site is underlain by medium dense to dense silt at shallow depths and lacks a well-defined water table. Based on these conditions, in our opinion the liquefaction potential of the soils underlying the site is negligible and design considerations related to soil liquefaction are not necessary for this project.

6.0 GEOTECHNICAL RECOMMENDATIONS

6.1 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 encountered in the test borings and the site geology, it is our opinion that Site Class C should be used for the seismic design of the proposed structures.

6.2 Building Foundations

Based on results of subsurface explorations conducted at the site and our understanding of the project, it is our opinion that the proposed additions may be supported on conventional footings bearing on the native competent soils, or structural fill placed over the competent native soils. During construction, the adequacy of the footing subgrade should be verified by PanGEO. Any unsuitable soils should be removed from below the footings and replaced with compacted structural fill. Based on the results of our test borings, competent bearing soils were encountered at 3 to 4 feet below the existing ground surface at our test boring locations (see Figure 2).

6.2.1 Allowable Bearing Pressure

We recommend an allowable soil bearing pressure of 2,500 pounds per square foot (psf) to size the footings bearing on the competent native soils and/or structural fill/lean-mix concrete placed on the competent native soils. The recommended allowable bearing pressure is for dead plus live loads. For allowable stress design, the recommended bearing pressure may be increased by one-third for transient loading, such as wind or seismic forces.

Continuous and individual spread footings should have minimum widths of 18 and 24 inches, respectively. 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.

In designing the footings, the shape of footings will need to be considered in regard to the available space for temporary excavations. Where space may be limited for an unsupported open cut, it may be necessary to use L-shaped perimeter footings in order to conserve space and to allow the temporary excavations to be made within the property limits.

6.2.2 Foundation Performance

Total and differential settlements are anticipated to be within tolerable limits for foundation designed and constructed as discussed above. For the proposed structures supported by conventional footings bearing on native soil or compacted structural fill, the total building settlement is estimated to be on the order of approximately one inch, and differential settlement between adjacent columns should be on the order of about ½ inch or less. Most settlement should occur during construction as loads are applied.

6.2.3 Lateral Resistance

Lateral forces from wind or seismic loading may be resisted by a combination of passive earth pressures acting against the embedded portions of the foundations and walls, and by friction acting on the base of the foundations. Passive resistance values may be determined using an equivalent fluid weight of 300 pounds per cubic foot (pcf). This value includes a factor safety of at least 1.5 assuming that densely compacted structural fill (95% compaction per ASTM D1557) will be placed adjacent to the sides of the foundation. A friction coefficient of 0.35 may be used to determine the frictional resistance at the base of the foundation. This coefficient includes a factor of safety of approximate 1.5. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches of soil should be neglected.

6.2.4 Perimeter Footing Drains

Footing drains should be installed around the building perimeters, 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.

6.2.5 Footing Subgrade Preparation and Protection

All footing subgrades should be carefully prepared. The footing subgrade should be in a firm/dense condition prior to concrete placement. Any loose/soft soils at the foundation levels that cannot be compacted to a dense condition should be removed and backfilled with the structural fill.

It should be noted that the site soil is poorly graded and can become disturbed or loosened when exposed to moisture and traffic. As a result, it may be necessary to place about 4 inches of clean, crushed rock to protect the footing subgrade. Footing subgrade conditions prior to concrete pour should be observed by PanGEO to confirm that the exposed footing subgrade is consistent with the expected conditions and adequate to support the design bearing pressure. The proper measures needed to protect the subgrade will be in part depend on the actual soil conditions exposed at the bottom of the excavation, and the contractor's construction methods and sequence.

6.3 Floors Slabs

Concrete slab-on-grade floors are feasible for the proposed project and may be supported on competent firm soils or on newly placed structural fill. If loose soils encountered at the slab subgrade level cannot be adequately compacted, we recommend removing a minimum of 1 foot of loose soil below the slab, and placing 1 foot of properly compacted structural fill to create a firm surface for the slab.

We recommend that the slabs be constructed on a minimum 4-inch-thick capillary break. The capillary break should consist of free-draining, clean crushed rock or well-graded gravel compacted to a firm and unyielding condition. The capillary break material should have no more than 10 percent passing the No. 4 sieve and less than 5 percent by weight of the material passing the U.S. Standard No. 100 sieve. We also recommend that a 10-mil polyethylene vapor barrier be placed below the slab.

6.4 Retaining Wall Design Parameters

Concrete retaining walls that are free to rotate 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 below-grade and basement walls, equivalent fluid pressures of 50 pcf should be used for level backfills behind the walls. Retaining walls with a maximum 2H:1V backslope should be designed for an active and at rest earth pressure of 50 and 65 pcf, respectively.

For the seismic condition, we recommend including an incremental uniform lateral earth pressure of 9H psf (where H is the height of the below grade portion of the wall) as an ultimate seismic load. The recommended lateral pressures assume that the backfill behind the wall consists of a free draining and properly compacted fill with adequate drainage provisions to prevent the development of hydrostatic pressure.

6.4.1 Surcharge Loads

Surcharge loads, where present, should also be included in the design of retaining walls. A lateral load coefficient of 0.35 should be used to compute the lateral pressure on the wall face resulting from surcharge loads located within a horizontal distance of one-half the wall height.

6.4.2 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 wall foundation. Passive resistance values may be determined using an equivalent fluid weight of 300 pcf. This value includes a factor of safety of 1.5, assuming the footing is backfilled with structural fill. 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 of safety of 1.5.

6.4.3 Wall Drainage

Provisions for wall drainage should consist of a 4-inch diameter perforated drainpipe placed behind and at the base of the wall footings, embedded in 12 to 18 inches of clean crushed rock or pea gravel wrapped with a layer of filter fabric. A minimum of an 18-inch-wide zone of free draining granular soils (i.e., pea gravel or washed rock) should 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.

6.4.4 Wall Backfill

The site soils are relatively silty and would not meet the requirements for wall backfill. Wall backfill, if needed, should consist of imported, free draining granular material, such as WSDOT Gravel Borrow. In areas where the space is limited between the wall and the face of excavation, pea gravel or clean crushed rock may be used as backfill without compaction.

Wall backfill should be moisture conditioned to near its optimum moisture content, placed in loose, horizontal lifts less than 8 to 12 inches in thickness, and systematically compacted to a dense and relatively unyielding condition. If density testing will be performed, the results should demonstrate at least 95 percent of the maximum dry density, as determined using test method ASTM D 1557. 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.

6.5 PERMANENT CUT AND FILL SLOPES

Based on the anticipated soil that will be exposed in the planned excavation, we recommend permanent cut and fill slopes be constructed no steeper than 2H:1V (Horizontal:Vertical).

Cut slopes should be observed by PanGEO during excavation to verify that conditions are as anticipated. Supplementary recommendations can then be developed, if needed, to improve stability, including flattening of slopes or installation of surface or subsurface drains.

7.0 EARTHWORK CONSIDERATIONS

7.1 TEMPORARY EXCAVATIONS

Based on the current design, the foundations will be up to about 3 to 4 feet below the existing grade. Based on our test borings, we anticipate that the site excavations will generally encounter 3 to 4 feet of loose fill and weathered native soil over medium dense silt.

All temporary excavations should be performed in accordance with Part N of WAC (Washington Administrative Code) 296-155. All temporary excavations with a total overall depth greater than 4 feet should be sloped or shored. 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 review of the current plans, it appears that sufficient space is available for unsupported open 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 flattened in the wet seasons and should be covered with plastic sheets. 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.

7.2 Material Reuse

In the context of this report, structural fill is defined as compacted fill placed under footings, concrete stairs and landings, and slabs, or other load-bearing areas. In our opinion, the on-site soils are relatively silty, and are not suitable to be reused as structural fill. The structural backfill should consist of imported, well-graded granular material, such as WSDOT Gravel Borrow or approved equivalent. Well-graded recycled concrete may also be considered as a source of structural fill in areas not exposed to surface or below surface water. Use of recycled concrete as structural fill should be approved by the geotechnical engineer. The on-site soil can be used as general fill in the non-structural and landscaping areas. If use of the on-site soil is planned, the excavated soil should be stockpiled and protected with plastic sheeting to prevent softening from rainfall in the wet season.

7.3 Structural Fill and Compaction

Structural fill should be moisture conditioned to near its optimum moisture content, placed in loose, horizontal lifts less than 8 to 12 inches in thickness, and systematically compacted to a dense and relatively unyielding condition. If density testing will be performed, the results should demonstrate at least 95 percent of the maximum dry density, as determined using test method ASTM D 1557.

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.

7.4 Wet Weather Construction

It is our opinion that construction of the project can be accomplished during wet season. However, performing earthwork activities during wet season is anticipated to be more costly than during dry weather conditions. General recommendations relative to earthwork performed in wet weather or in wet conditions are presented below:

- All footing surfaces should be protected against inclement weather, unless the footings can be poured immediately after the subgrade is exposed. It is the contractor's responsibility to protect the footing subgrade from disturbance. One option is to place a 2 to 3 inches of lean-mix concrete or 4 to 6 inches of crushed rock on the exposed foundation subgrade as soon as the subgrade is exposed. Alternatively, the footing pour may be made immediately after the footing excavation is completed. This will require the reinforcing steel to be pre-fabricated and lowered into the footing excavation once the excavation is completed.

- 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 ¾-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 strategically located to control erosion and the movement of soil. Erosion control measures should be installed along all the property boundaries.

- Excavation slopes and soils stockpiled on site should also be covered with plastic sheets.

7.5 Erosion Considerations

We recommend that the exposed slopes be covered with plastic sheeting. Surface runoff can be controlled during construction by careful grading practices. This could include 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. 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.

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.

8.0 STAMENT OF RISK

Per section 19.07.060.D.2 of the Mercer Island City Code, development within geologic hazard areas requires a stamen of risk. The statement of risk shall meet one of the following criteria:

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;

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

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

Based on our review of the civil plans dated 3/31/2022, which included erosion control measures and stormwater water management plans, 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. Hence, it is our opinion that criterion (a) per section 19.07.060.D.2 of the Mercer Island City Code is met.

9.0 LIMITATIONS

We have prepared this report for the project 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 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.

Sincerely,

PanGEO, Inc.

April 18, 2022

Bart Weitering, G.I.T.
Project Geologist

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

10.0 REFERENCES

ASTM D1557-12e1, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))*, ASTM International, West Conshohocken, PA, 2012, www.astm.org

ASTM D2488-17, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)*, ASTM International, West Conshohocken, PA, 2017, www.astm.org.

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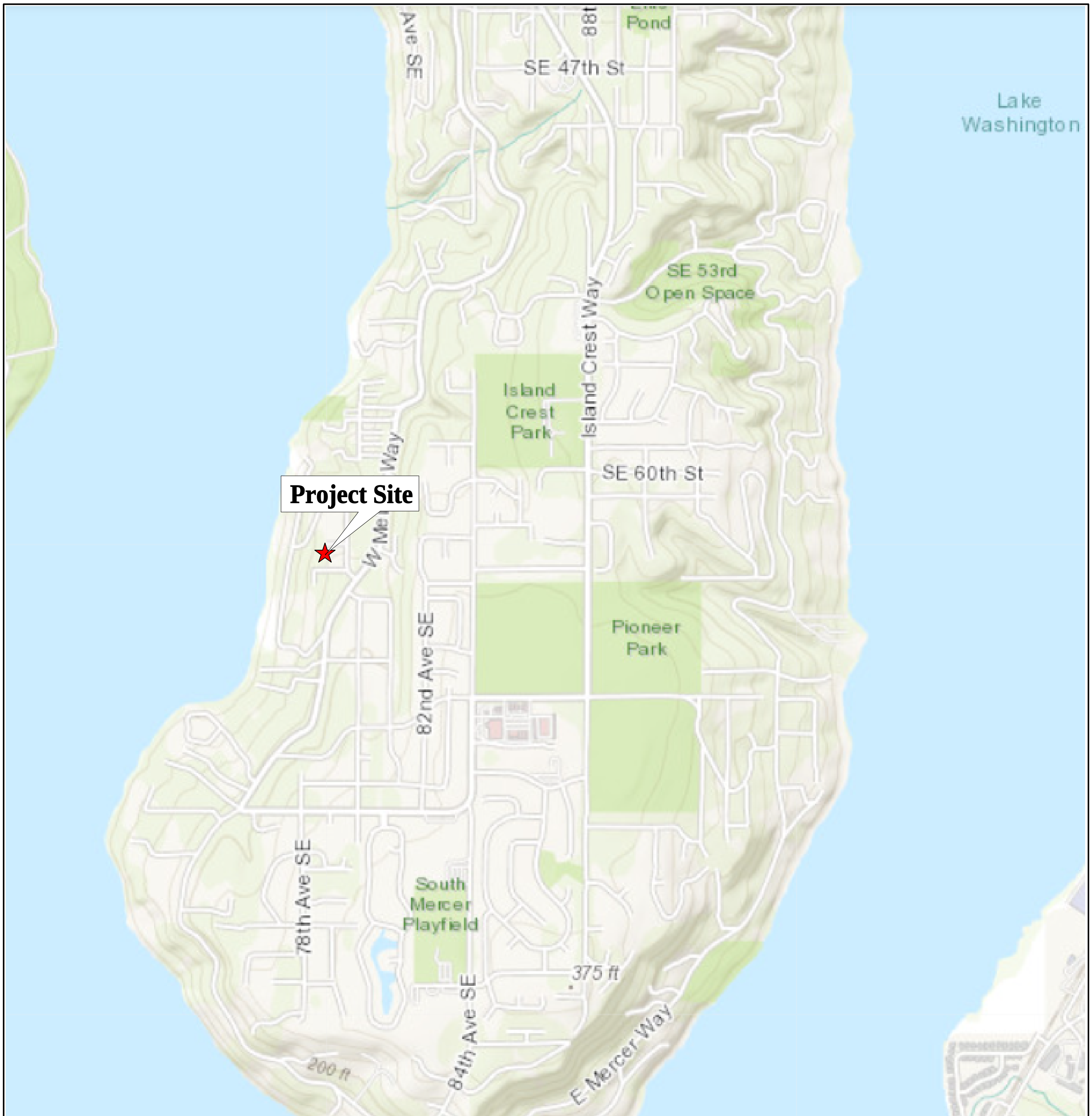

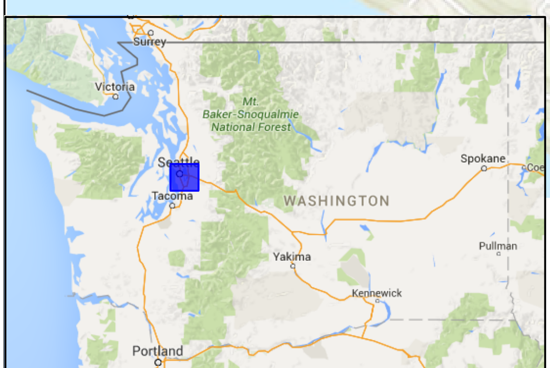

Base Map: ESRI Topographic

NORTH

Approx. Scale:
Not to Scale

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Proposed Addition
7845 Southeast 62nd Street
Mercer Island, Washington

VICINITY MAP

Project No.	22-111	Figure No.	1

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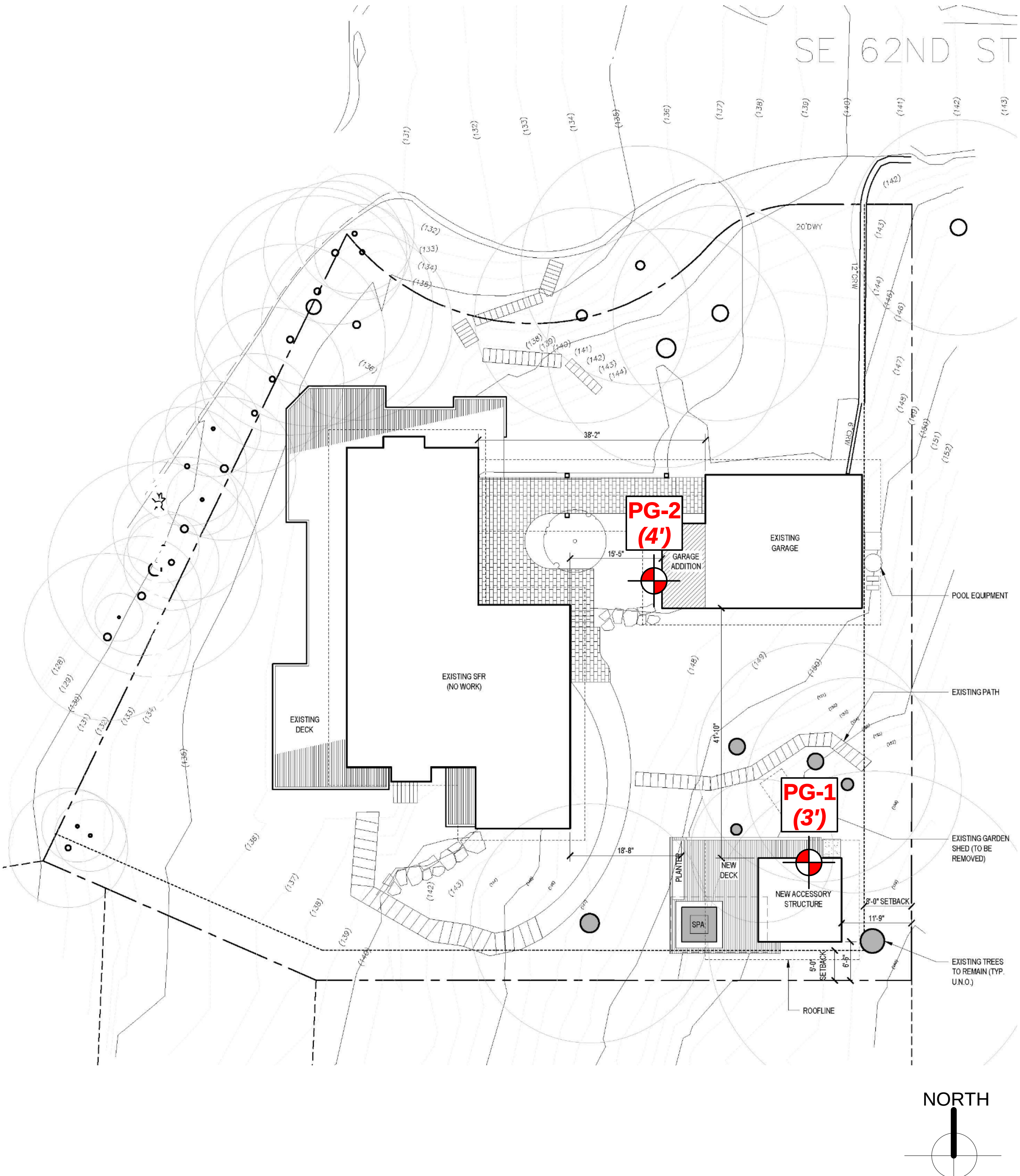

Approx. Scale:
1" = 25'

LEGEND:

Approx. Test Boring Location
(Approx. Depth to Bearing Soil, ft)

Base map modified from Sheet A1.01 - Site Plan by Heliotrope Architects dated November 5, 2021

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Proposed Addition
7845 Southeast 62nd Street
Mercer Island, Washington

SITE AND EXPLORATION PLAN

Project No.	22-111	Figure No.	2

Site and Exploration Plan.grf 4/14/22 (3:40:50) BW

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

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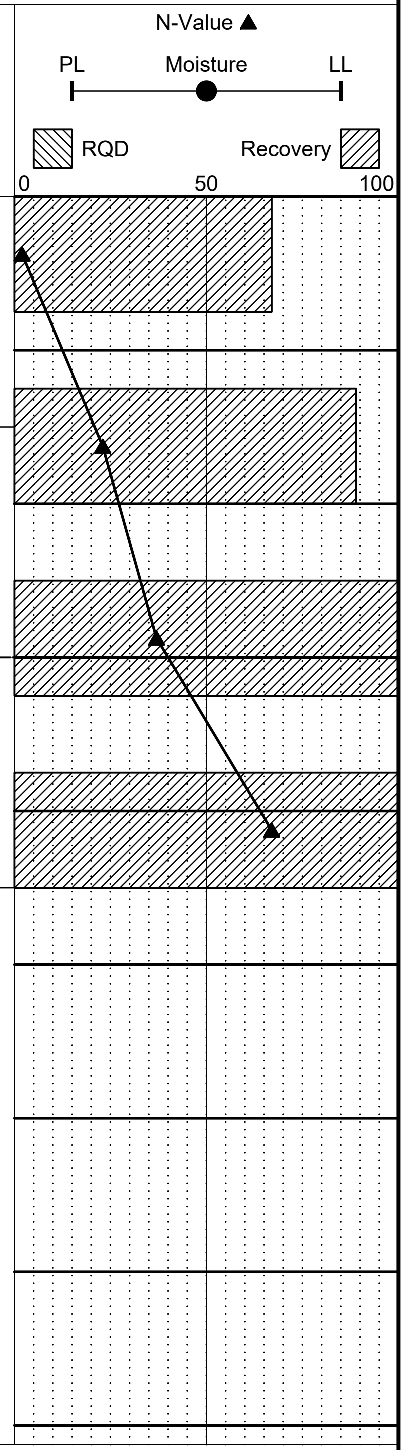
Terms and Symbols for Boring and Test Pit Logs

Figure A-1

Project:	Proposed Addition	Surface Elevation:	157.0ft
Job Number:	22-111	Top of Casing Elev.:	N/A
Location:	7845 SE 62nd St, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.54655, Easting: -122.23388	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0	S-1	SPT	1, 1, 1			Crushed rock surfacing over very loose, dark brown to brown, trace to slightly gravelly, silty SAND; moist to very moist; poorly graded, organics [Fill].
						--becomes very moist to wet.
2	S-2	SPT	3, 11, 12			Medium dense, orange- and gray-brown, slightly gravelly, silty SAND; moist; poorly graded, trace iron oxide banding [Qpo - Pre-Olympia Deposits].
4						
	S-3	SPT	8, 16, 21			--drillers begin adding water to aid drilling.
6						Dense, gray-brown, sandy SILT trace gravel; moist; non-plastic [Qpo - Pre-Olympia Deposits].
8	S-4	SPT	16, 27, 40			--becomes very dense.
						Boring terminated at about 9 feet below ground surface due to practical drilling refusal. Light perched groundwater seepage was observed at about 1.5 to 3 feet depth.
10						
12						
14						
16						



Completion Depth:	9.0ft
Date Borehole Started:	3/23/22
Date Borehole Completed:	3/23/22
Logged By:	B. Weitering
Drilling Company:	CN Drilling

Remarks: Boring drilled using an acker portable 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 Sheet A1.01 - Site Plan by Heliotrope Architects dated 11/5/2021.

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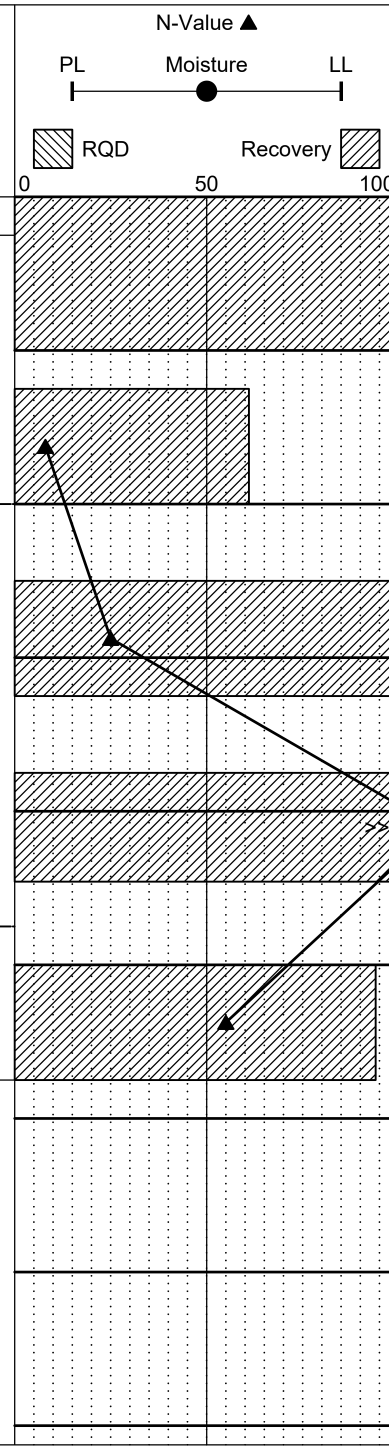
LOG OF TEST BORING PG-1

Figure A-2

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

Project:	Proposed Addition	Surface Elevation:	145.0ft
Job Number:	22-111	Top of Casing Elev.:	N/A
Location:	7845 SE 62nd St, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.54668, Easting: -122.23399	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						~6" topsoil/mulch landscaped surface [Fill].
	S-1	Grab				Loose, gray interlayered with brown, SILT; moist; non-plastic, slightly organic interlayers [Weathered Pre-Olympia Deposits].
2						
	S-2	SPT	1 3 5			
4						Medium dense, gray-brown interlayered with some gray, SILT; moist; non-plastic [Qpo - Pre-Olympia Deposits].
6	S-3	SPT	6 11 14			
						--drillers begin adding water to aid drilling.
8	S-4	SPT	13 32 50/5			--becomes very dense with trace gravel.
						Very dense, gray-brown, fine SAND; moist; poorly graded, massive [Qpo - Pre-Olympia Deposits].
10	S-5	SPT	12 22 33			
12						Boring terminated at about 11.5 feet below ground surface. No groundwater was observed during drilling.
14						
16						



Completion Depth:	11.5ft
Date Borehole Started:	3/23/22
Date Borehole Completed:	3/23/22
Logged By:	B. Weitering
Drilling Company:	CN Drilling

Remarks: Boring drilled using an acker portable 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 Sheet A1.01 - Site Plan by Heliotrope Architects dated 11/5/2021.

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LOG OF TEST BORING PG-2

Figure A-3

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