GEOTECHNICAL REPORT
PROPOSED REMODEL
8109 Southeast 71st Street
Mercer Island, Washington

PROJECT NO. 24-093
March 2024

Prepared for:

Dan Thygesen

PanGEO INCORPORATED

Geotechnical & Earthquake Engineering Consultants

PanGEO
INCORPORATED
Geotechnical & Earthquake Engineering Consultants

March 29, 2024
File No. 24-093

Dan Thygesen
8109 Southeast 71st Street
Mercer Island, WA 98040

Subject: **Geotechnical Engineering Report**
Proposed Remodel
8109 SE 71st Street, Mercer Island, WA

Dear Dan,

Please find attached our geotechnical engineering report for the proposed project at the subject site in Mercer Island, Washington. This report documents the subsurface conditions at the site and presents our geotechnical engineering recommendations for the proposed improvements to the existing house foundation.

In summary, the test borings advanced at the property generally encountered up to about 10 feet of very loose to loose sand, underlain by medium dense to very dense sand. Based on the soil conditions and our observations, in our opinion the proposed second-story additions to the north side of the house will need foundation improvements to mitigate the potential for settlement with the increase in load.

In our opinion, the foundations may be supported by driven small diameter pin piles (all footings, new and existing), or with foundation subgrade improvement or footing replacement beneath improvement areas.

We appreciate the opportunity to be of service. Please call if there are any questions.

Sincerely,

Jon C. Rehkopf, P.E.
Principal Geotechnical Engineer
jrehkopf@pangeoinc.com

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ATTACHMENTS:

GEOTECHNICAL ENGINEERING REPORT
PROPOSED REMODEL
8109 SE 71ST STREET
MERCER ISLAND, WASHINGTON

1.0 GENERAL

This report presents the results of a geotechnical engineering study that was undertaken to support the design and construction of the proposed improvements to the existing residence at the subject site, in Mercer Island, Washington. This study was performed in general accordance with our mutually agreed scope of services outlined in our proposal dated February 26, 2024, which was subsequently approved by you on March 5, 2024. Our scope of services included reviewing readily available geologic and geotechnical data, drilling two test borings, conducting a site reconnaissance, performing engineering analysis, and developing the conclusions and recommendations presented in this report.

2.0 SITE AND PROJECT DESCRIPTION

The project site is located at 8109 Southwest 71st Street on Mercer Island, Washington (see Figure 1 – Vicinity Map). The site is a rectangular property with an area of about 10,578 square feet, spanning about 90 feet from east to west and about 117 feet from north to south. The site is bounded to the south, east, and west by single-family residences and to the north by Southeast 71st Street. The site is currently occupied by a one-story single-family residence located generally at the middle of the property, a pool and concrete patio in the backyard, and lawns and minor landscaped areas in the front yard.

Based on our review of the project topographic survey, the site generally slopes down from southeast to northwest with a total vertical relief of about 12 feet, from about Elevation 307 to Elevation 295. The site is generally level in the middle of the site around the house and pool, at approximate Elevation 300 feet. Site conditions at the time of our site visits are shown on Plates 1 through 3, following.

We understand that you plan to remodel the current house with the addition of a second floor over the north portion of the house. There are also additions planned on the north side of the living room (northwest corner of the house) and on the east side of the garage (northeast corner of the house). Figure 2 shows the approximate locations of the proposed additions and second floor. We understand that the existing footings will be utilized to support the second floor over the existing house footprint and that new foundations will be needed for the living room and garage additions.

***Plate 1**. View of the front of subject property, looking southwest from Southwest 71st Street.*

***Plate 2**. View of the proposed north side improvement area, looking southeast.*

***Plate 3**. View of the proposed northeast improvement area, looking north.*

Based on our review of the City of Mercer Island GIS Map, there are potential landslide and seismic geologic hazard areas mapped on the project site. No other geologic hazards (i.e., erosion, steep slope) are mapped at the site. Considerations regarding the mapped geologic hazards are presented in Section 5.0.

The conclusions and recommendations in this report are based on our understanding of the proposed project, 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 drilled at the project site on March 13, 2024. The test borings were advanced to about 21½ to 16½ feet below the existing ground surface.

The approximate boring locations are shown on the attached Figure 2 – Site and Exploration Plan.

The drill rigs were equipped with 5-inch outside diameter hollow stem augers. Soil samples were obtained from the borings in general at 2½- and 5-foot depth intervals using Standard Penetration Test (SPT) sampling methods in general accordance with ASTM D1586, *Standard Test Method for Penetration Test and Split Barrel Sampling of Soils*, 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 below the tip of the augers using a 140-pound weight falling a distance of 30 inches using an automated hammer. 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.

An engineer from PanGEO 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 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* (Troost and Wisher, 2006), the subject property is underlain by advance outwash (Qva) with recessional outwash (Qvr) mapped nearby to the south and west. Advance outwash is described by Troost and Wisher as dense to very dense, silt and gravel, deposited by meltwater channels at the forefront of an advancing ice sheet. Recessional outwash is described as loose to dense, sand and gravel, deposited in meltwater channels at the forefront of a receding ice sheet. Advance outwash has been glacially overridden and thus typically exhibits low compressibility and high strength characteristics in its undisturbed state. Recessional outwash has not been glacially overridden and typically has a looser consistency than advance outwash.

4.2 Soil Conditions

In summary, the soils observed in our test borings appear consistent with the mapped geology. A description of the soil units encountered in our test borings is presented below. Detailed descriptions of the encountered soils in our test borings can be seen in our boring logs included in Appendix A.

Fill: In both PG-1 and PG-2, we encountered a surficial soil unit of very loose, fine sand with variable silt and organic content. This soil unit had a generally disturbed and nonuniform texture with traces of charcoal. We interpret this soil unit as fill, which extended to about 5 feet deep in both test borings.

Recessional Outwash Deposits (Qvr): Below the fill in both borings, we encountered very loose to medium dense, thinly bedded, slightly silty to silty, poorly graded, fine sand. We interpret this soil unit as recessional outwash based on the loose consistency and presence of bedding. The recessional outwash extended to about 10 feet deep in both borings.

Advance Outwash Deposits (Qva): Below the recessional outwash in both borings, we encountered medium dense to dense, thinly bedded, slightly silty, poorly graded, fine to medium sand. We interpreted this soil unit to be advance outwash based on the density consistency. The advance outwash extended to the bottom of both PG-1 and PG-2 to about 21½ and 16½ feet deep, respectively.

Our subsurface descriptions are based on the conditions encountered at the specific locations 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.

4.3 Groundwater Conditions

No groundwater was encountered during drilling. Groundwater levels will vary depending on the season, local subsurface conditions, and other factors. Groundwater levels are normally highest during the winter and early spring (typically October through May).

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. Mercer Island City Code identifies three different types of Geologic Hazards: erosion, potential landslide, steep slope, and seismic. Based on our review of the City of Mercer Island GIS Map, there are potential landslide and seismic geologic hazard areas mapped on the project site (see Plate 4 below). No other geologic hazards (i.e., erosion, steep slope) are mapped at the site. The City's criteria for those various hazard areas and our assessment of the hazard areas with respect to the planned project are provided in the following sections of this report.

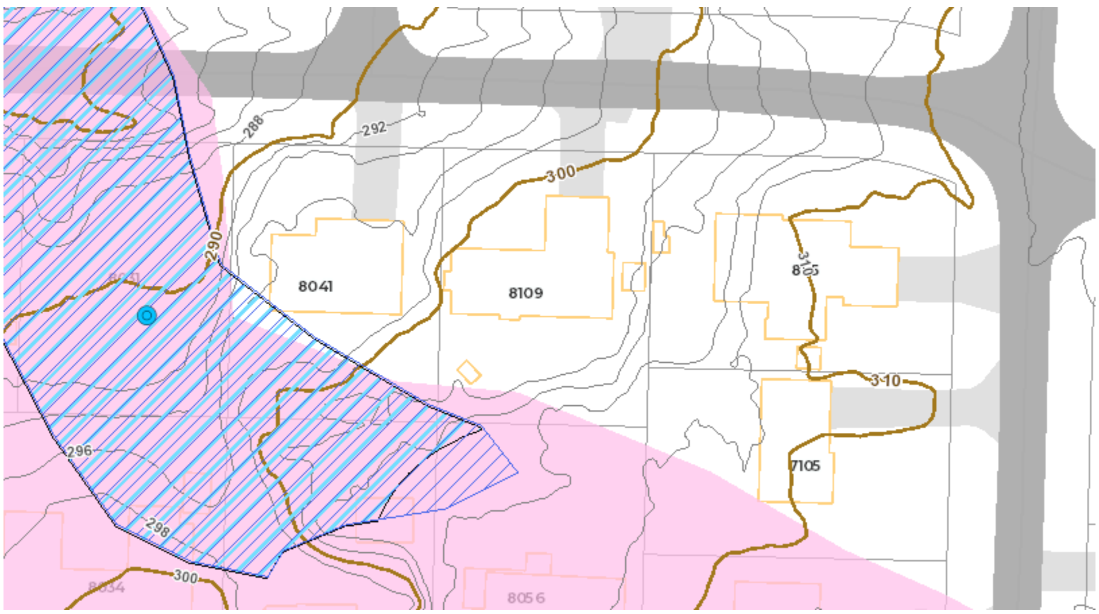


***Plate 4**. City of Mercer Island Hazard Map. Seismic hazard is shaded pink and landslide hazard area is diagonal blue lines.*

5.1 LANDSLIDE HAZARDS

The site is not mapped by the City of Mercer Island as containing a steep slope (40% or greater), however, a small portion of the site is mapped as a landslide hazard area with slide potential. Based on our review of the geologic map of the area (Troost, et al., 2006), and the City of Mercer Island Geologic Hazards Map, the site is located to the east of a mapped spring, with groundwater indicated less than 10 feet below ground surface.

A site reconnaissance of the subject property was conducted in March 6, 2024. During our site reconnaissance, we did not observe evidence of past slope instability or ground movement at the site. The site gently slopes down from the southeast corner of the backyard to the northeast corner of the front yard next to Southeast 71st Street and is relatively level through the center area of the main house and pool. The mapped hazard crosses through a 1-foot-tall rockery and shallowly sloped landscaping at the southwest corner of the site (see Plate 5 below). The sloped area is about 6 feet tall with no signs of slope movement or instability noted. The area around the proposed developments on the north side of the site is generally level.

***Plate 5**. View of the existing landscaped area mapped as a potential landslide area on the south side of the property.*

Based on our observations, the site appears globally stable and the proposed developments should not adversely affect the overall stability of the site or adjacent properties, provided our recommendations contained in this report are properly incorporated into the project design and construction.

5.2 Seismic Hazards

Based on review of the City of Mercer Island Seismic Hazard Map, the southwest portion of the property is mapped as having soil liquefaction potential (see Plate 4, prior)

Liquefaction is a process that can occur when soil loses 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 to medium dense, and be below the groundwater table.

Groundwater was not encountered in test borings, which extended about 5 feet into dense advance outwash, which would be considered a low risk of liquefaction due to the dense consistency. Based on these conditions, in our opinion the risk of soil liquefaction at the site is low, and specific design considerations to mitigate liquefaction are not required.

5.3 Erosion Hazards

The site is not mapped as a potential erosion hazard area in accordance with the City of Mercer Island's Geologic Hazards Map. However, Best Management Practices (BMPs) should be implemented during construction to mitigate the potential for erosion of any exposed soils, such as those provided in Section 8.4. Provided that proper erosion control measures are implemented during construction, in our opinion the risk of off-site soil transport during the construction of the project is minimal.

6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

6.1 Seismic Design Considerations

We anticipate that the project will be designed in accordance with the 2018 edition of the International Building Code (IBC). We recommend a seismic Site Class D (Stiff Soil) be used for design of the structure.

6.2 Foundation Design Alternatives

Based on the results of our test borings, the soils in the vicinity of the existing house generally consist of 7½ to 10 feet of very loose, slightly silty to silty sand over medium dense to dense silty sand. Although the soil is very loose to loose, based on the apparently satisfactory performance of the existing one-story house foundation, the soils have provided adequate support for the shallow spread footing foundations. However, we anticipate undesirable settlements of the existing foundation, or new footings if they are constructed on the very loose soil, once the additional load of the proposed second story addition is applied to the foundations.

Pin Piles: In our opinion there are several feasible alternatives to mitigate the potential settlement that may occur to the new and existing foundations once the second story addition has been constructed. One option is to utilize small diameter driven pipe pipes, often referred to as "pin piles" to support the foundations. The pin piles would be driven through the upper loose soils and derive support from the dense advance outwash. However, to reduce the potential of differential settlement, all new and existing foundations would need to be supported by pin piles.

Spread Footings on Improved Soil: In our opinion another feasible alternative, which would likely be less costly, would be to locally improve the soils below the new foundations with over-excavation and replacement with properly compacted structural fill. The over-excavations will only need to occur below the footings, not below the entire footprint of the structure.

Based on our discussion with the project team, we understand that the second option, to support the new footings on improved ground, is desired for this project.

6.2.1 New Footing Subgrade Preparation

Over-excavation – We recommend that the footing excavation extend a minimum of 18 inches below the design footing elevation. The over-excavation should extend horizontally out from the edge of the footing a distance equal to 12 inches.

Subgrade Compaction – At an elevation at least 18 inches below the footings, we recommend the exposed subgrade be compacted to a dense condition using a jumping-jack type compactor. We do not recommend compaction using an excavator mounted compactor, such as a hoe-pac, which can induce large vibrations of the existing subgrade soil and damage the existing foundations.

Structural Fill & Compaction – After the subgrade has been compacted, we recommend that 18 inches of structural fill be placed in at least three lifts below the footings and compacted to a dense condition using a jumping jack-type compactor. If density tests will be performed, the test results should indicate at least 95 percent of the maximum dry density, as determined using test method ASTM D 1557. Recommendations for structural fill are provided in Section 8.2.

Final Footing Subgrade Preparation - All footing subgrades should be compacted to a dense condition prior to placement of concrete formwork and reinforcing steel. The footing subgrade should be in a firm/dense condition prior to concrete placement. Footing subgrades 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.

6.2.2 New Footing Design

Allowable Bearing Pressure – For footings bearing on the prepared subgrade as described above, we recommend that an allowable bearing pressure of 1,500 psf be used to size the footings. All footings should be founded at a minimum depth of 18 inches below the adjacent finish grade, or for interior footings, 12 inches below floor slabs. For allowable stress design, the recommended allowable bearing pressure may be increased by 1/3 for transient conditions such as wind and seismic loadings.

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 geotechnical factor of safety of at least 1.5 assuming that properly compacted structural fill will be placed adjacent to the sides of the footings. An allowable friction coefficient of 0.4 may be used to determine the frictional resistance at the base of the footings. This value also includes a geotechnical factor of safety of at least 1.5.

Settlement Estimate – Total and differential settlements are anticipated to be within tolerable limits for footings designed and constructed as discussed in this report. Footing settlement under static loading conditions is estimated to be less than approximately one inch, and differential settlement across the house should be less than about ½-inch. Most settlement will occur during construction as loads are applied.

Footing Drains – Perimeter footing drains should be installed to provide permanent control of subsurface water adjacent to the new structure. As a minimum, 4-inch diameter perforated drainpipes should be installed at the base of the footings and embedded in 12 to 18 inches of pea or washed gravel. The gravel should be wrapped in a geotextile filter fabric to prevent the migration of fines into the drain system. The drainpipe should be graded to direct water to a suitable outlet.

6.2.3 Existing Footings

We do not recommend additional loads from the addition be added to the existing spread and strip footings. Because it will not be practical to improve the soil below the existing footings, if additional loads must be applied to an existing footing, we recommend removing the footing, improving the subgrade soils as described above, and constructing a new footing at that location.

6.3 CONCRETE SLAB ON GRADE

Slab on Grade Preparation – A conventual slab-on-grade may be used for the floor of the new addition. However, due to the existing loose soil, some settlement of the floor slab, and associated distress, may occur if a slab-on-grade is constructed on the existing loose fill. The risk of the settlement will depend on how much of the existing loose soil is excavated out from under the footprint of the structure during construction. To reduce the potential of slab settlement and distress, where loose fill is present below the proposed slab, we recommend removing a minimum of 1 foot of existing fill below the slab, heavily re-compacting the exposed soils to a dense and unyielding condition, and placing 1 foot of properly compacted structural fill to create a firm surface for the slab. For the subgrade improvement described above, and for slab areas bearing on the native medium dense soils, the floor slab design may be accomplished using a modulus of subgrade reaction of 125 pci.

Capillary Break - 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.

7.0 STATEMENT OF RISK

As outlined above, the site is mapped as a geologic hazard area. Per Mercer Island City Code Section 19.07.060.B.3, 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. An evaluation of site-specific subsurface conditions demonstrates that the proposed development is not located in a geologic hazard area; or

c. 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

d. The alteration is so minor as not to pose a threat to public health, safety, and welfare.

It is our opinion that Criterion B applies to the subject property because the results of our site-specific test borings and subsequent evaluation concluded that the site is not located in a Seismic Hazard Area due to the low risk of soil liquefaction. Similarly, based on our understanding of subsurface condition, and the gently sloping ground surface at and adjacent to the site, in our opinion the risk of land sliding at the site is low.

8.0 CONSTRUCTION CONSIDERATIONS

8.1 TEMPORARY EXCAVATIONS

We anticipate that excavations up to a maximum of about 4 feet deep may be needed for the construction of the new foundations. The excavation is anticipated to encounter very loose sandy soils.

Temporary excavations greater than 4 feet deep should be properly sloped or shored, however, vertical excavations 4 feet deep or less will likely not remain stable, and will slough or collapse, due to the very loose nature of the sandy soils anticipated at the site. 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.

For planning purposes, we recommend that temporary excavations less than 4 feet for the footing over-excavation, as well as for other site features, be sloped no steeper than 1H:1V (horizontal:vertical). Cuts deeper than 4 feet, if needed, will likely need to be cut back at a shallower angle of 2H:1V, to maintain stability. All cuts must be re-evaluated in the field during construction based on actual observed soil conditions and the presence of groundwater seepage. If groundwater seepage is encountered the temporary slope will likely need to be cut to shallower angles to maintain stability. During wet weather, runoff water should be prevented from entering excavations. We also recommend that heavy construction equipment, building materials and excavated soil should not be allowed within a distance equal to 1/3 the slope height from the top of any excavation.

8.2 Structural Fill Placement and Compaction

The recessional outwash encountered below 5 feet deep would be suitable for reuse as structural fill. However, we do not anticipate that excavations for the subgrade improvement would extend into this soil unit. For planning purposes, structural fill should consist of imported, well-graded, granular material such as Seattle Type 17 Mineral Aggregate (*Seattle Standards and Specifications*, 2024, Section 9-03.14), WSDOT Gravel Borrow (*WSDOT Standards and Specifications*, 2024, Section 9-03.14(1)), or an approved equivalent. Based on the absence of groundwater anticipated within the proposed excavation, recycled crushed concrete (1¼-inch with fines) may also be used as structural fill. However, the use of recycled crushed concrete should be approved by PanGEO prior to installation.

Structural fill should be moisture conditioned to within about 3 percent of optimum moisture content, placed in loose, horizontal lifts less than 8 inches in thickness, and systematically compacted to a dense and relatively unyielding condition and to 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.

8.3 Surface Drainage Considerations

Adequate drainage provisions are imperative to improve the performance of the proposed developments and adjacent structures. We recommend both short term and long-term drainage measures be incorporated into the project design and construction. 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 to collect runoff and prevent water from entering the excavation or to prevent runoff from the construction area leaving the immediate work site. Collected water should be directed to a positive and permanent discharge system.

Permanent control of surface water and roof runoff should be incorporated in the final grading design. In addition to these sources, irrigation and rainwater infiltrating into landscape and planter areas adjacent to paved areas or building walls should also be controlled. All collected runoff should be directed into conduits that carry the water away from the proposed developments and existing structures and into the storm drain systems or other appropriate outlets. Adequate surface gradients should be incorporated into the grading design such that surface runoff is directed away from structures. Collected water from surface runoff should not drain into retaining wall drain systems.

8.4 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 0.075-mm 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.

9.0 ADDITIONAL SERVICES

To confirm that our recommendations are properly incorporated into the design and construction of the proposed project, 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 a cost estimate for construction monitoring services after the design has been finalized.

10.0 CLOSURE

We have prepared this report for Dan Thygesen 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 of this report.

Sincerely,

PanGEO, Inc.

Bryce C. Townsend, P.E.
Senior Geotechnical Engineer

Jon C. Rehkopf, P.E.
Principal Geotechnical Engineer

10.0 REFERENCES

ASTM D1557, 2012, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort*, www.astm.org.

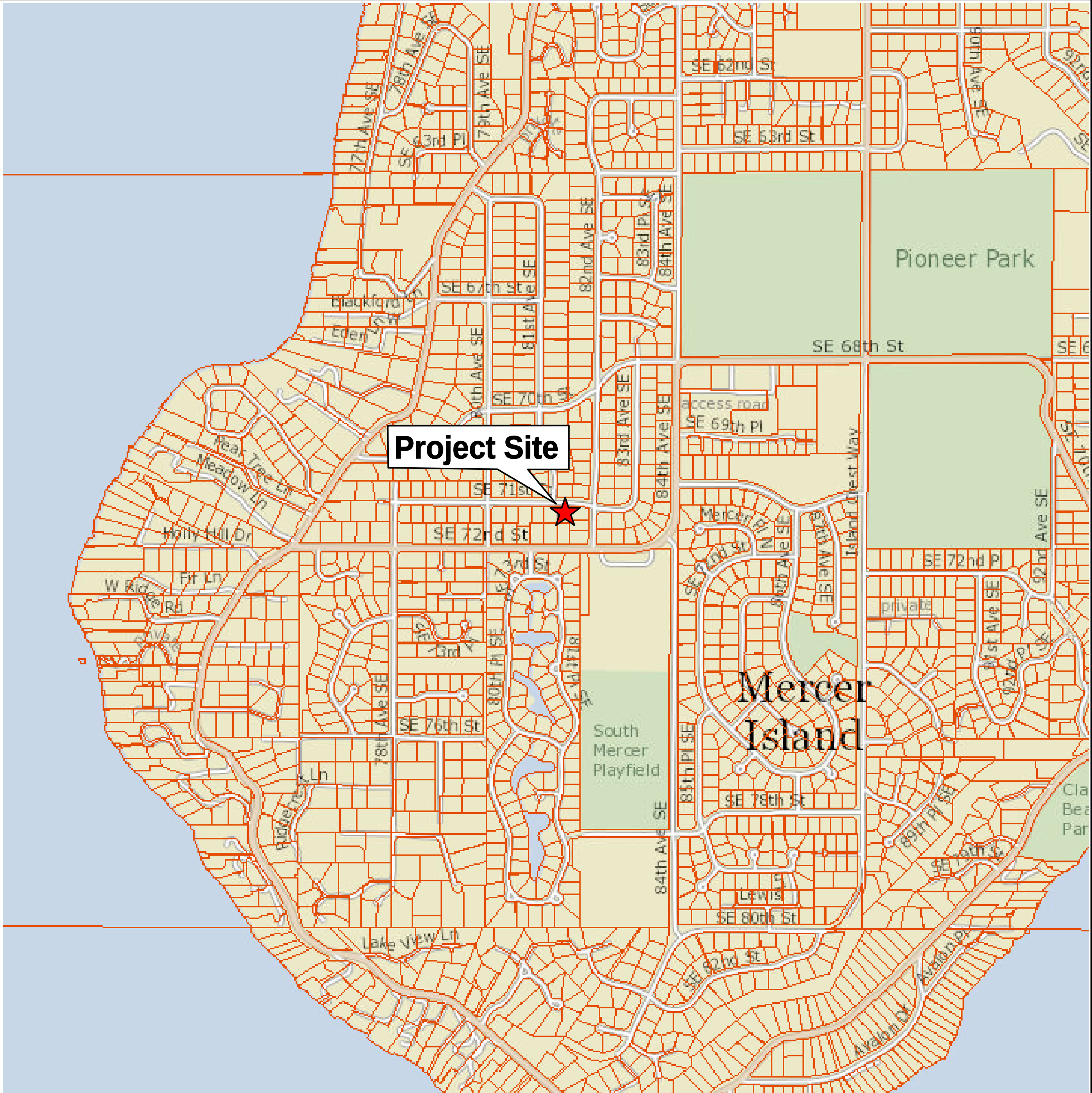
ASTM D1586 / D1586-18, 2018, *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*, www.astm.org.

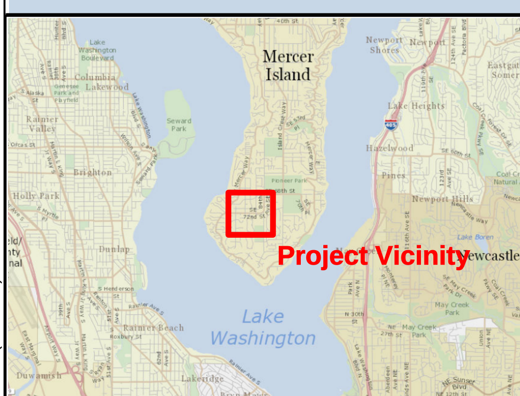
City of Seattle, 2024, *Standard Specifications for Road, Bridges, and Municipal Construction*. International Code Council, 2018, *International Building Code (IBC), 2018.*

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

Washington Administration Code (WAC), 2019, *Part N – Excavation, Trenching, and Shoring*.

WSDOT, 2024, *Standard Specifications for Road, Bridges, and Municipal Construction, M41-10*.





Base Map: King County iMap

N

NOT TO SCALE

PanGEO
INCORPORATED

Proposed Remodel
8109 Southeast 71st Street
Mercer Island, Washington

VICINITY MAP

Project No. **24-093**

Figure No. **1**

Fig 1 - Vicinity Map.gpj 3/21/24 (11:16:43) ADO

Note: Base map modified from King County iMap, 2021 Aerial Photography.

LEGEND

- Approximate Location of Explorations by PanGEO, Inc. (March 2024)
- Property Boundary
- Proposed Additions

N

1 inch ~ 30 feet

PanGEO INCORPORATED	**Proposed Remodel** **8109 Southeast 71st Street** **Mercer Island, Washington**	**SITE AND EXPLORATION PLAN**	
		Project No. **24-093**	Figure No. **2**

Fig 2 - Site and Exploration Plan.gpj 3/29/24 (12:56:45) ADO

APPENDIX A

SUMMARY 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	**Fissured:**	Breaks along defined planes
Laminated:	Layers of soil typically 0.05 to 1mm thick, max. 1 cm	**Slickensided:**	Fracture planes that are polished or glossy
Lens:	Layer of soil that pinches out laterally	**Blocky:**	Angular soil lumps that resist breakdown
Interlayered:	Alternating layers of differing soil material	**Disrupted:**	Soil that is broken and mixed
Pocket:	Erratic, discontinuous deposit of limited extent	**Scattered:**	Less than one per foot
Homogeneous:	Soil with uniform color and composition throughout	**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 Remodel	Surface Elevation:	~300 ft
Job Number:	24-093	Top of Casing Elev.:	n/a
Location:	8109 Southeast 71st Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.53917, Easting: -122.23035	Sampling Method:	SPT, Rope and Cathead

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION	N-Value ▲ (PL — Moisture ● — LL; RQD / Recovery; 0 – 50 – 100)
0.0						About 6 inches of **TOPSOIL** at ground surface. Pothole down 2 feet to clear utilities. Soil oxidized olive-brown and brown, silty sand, moist.	
2.5	S-1		1 1 1			**(FILL)** Very loose, oxidized olive-brown, very silty SAND; organics and charcoal bits present, iron oxide staining, disturbed texture, moist.	
5.0	S-2		1 1 2			**(RECESSIONAL OUTWASH)** Very loose, oxidized olive-brown, slightly silty, poorly graded SAND; fine sand, moist.	
7.5	S-3		1 4 6			*- Becomes loose to medium dense, thinly bedded, with more oxidation in 1 to 4-inch bands. Moist, but wetter in pockets.*	
10.0	S-4		3 8 12			**(ADVANCE OUTWASH)** Medium dense, oxidized olive-brown, slightly silty, poorly graded SAND; fine sand, moist.	
12.5							
15.0	S-5		10 16 19			*- Becomes dense, slightly oxidized light olive-brown to olive-gray, thinly bedded, trace silt.*	
17.5							
20.0	S-6		8 15 21			*- Increase in moisture, some oxidation in bedding.*	
21.5						Boring terminated at about 21.5 feet below ground surface and abandoned with bentonite. No groundwater observed during drilling.	
22.5							
25.0							

Completion Depth:	21.5ft
Date Borehole Started:	3/13/24
Date Borehole Completed:	3/13/24
Logged By:	A. Ong
Drilling Company:	CN Drilling, Inc.

Remarks: Borings drilled using limited-access Acker drill rig. Standard penetration test (SPT) sampler driven with a 140 lb. safety hammer. Hammer operated with a rope and cathead mechanism. Elevations are approximate from site survey by Terrane, dated 10/31/2019. **Vertical datum: NAVD88**

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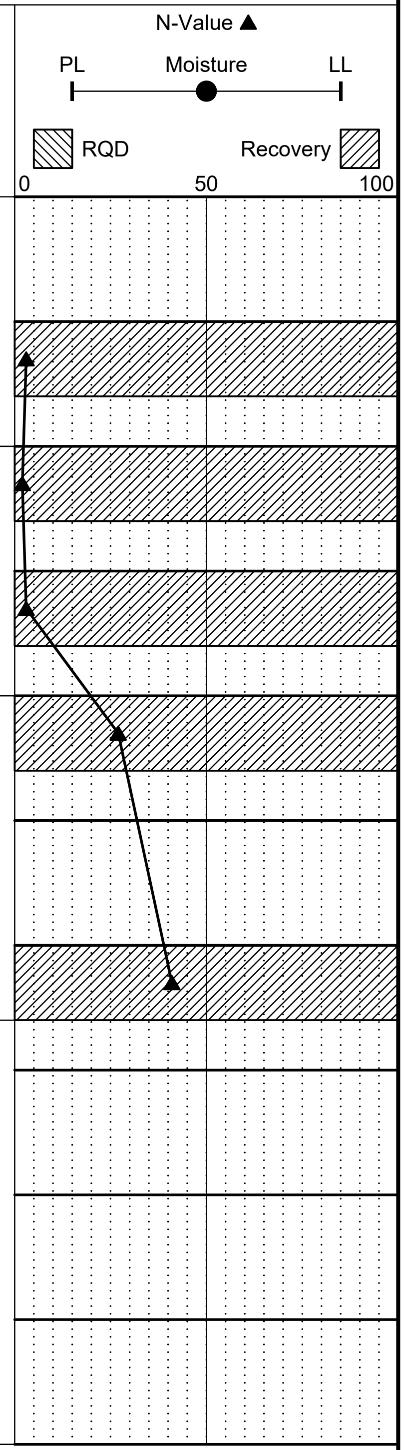
LOG OF TEST BORING PG-1

Figure A-2

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

Project:	Proposed Remodel	Surface Elevation:	~301 ft
Job Number:	24-093	Top of Casing Elev.:	n/a
Location:	8109 Southeast 71st Street, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: 47.53918, Easting: -122.23012	Sampling Method:	SPT, Rope and Cathead

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0.0						About 6 inches of **TOPSOIL** at ground surface. Pothole down 2 feet to clear utilities. Soil oxidized olive-brown and brown, silty sand, moist.
2.5	S-1		1, 1, 2			**(FILL)** Very loose, oxidized olive-brown, very silty SAND; fine sand, trace rootlets, disturbed texture, moist.
5.0	S-2		1, 1, 1			**(RECESSIONAL OUTWASH)** Very loose, oxidized olive-brown, poorly grade SAND with silt; fine to medium sand, thinly bedded, moist.
7.5	S-3		1, 1, 2			*- Bedding becomes thick, increased moisture.*
10.0	S-4		4, 11, 16			**(ADVANCE OUTWASH)** Medium dense, oxidized olive-brown, slightly silty, poorly graded SAND; fine to medium sand, moist.
12.5						
15.0	S-5		6, 17, 24			*- Becomes dense, fine sand.*
16.5						Boring terminated at about 16.5 feet below ground surface and abandoned with bentonite. No groundwater observed during drilling.
17.5						
20.0						
22.5						
25.0						



Completion Depth:	16.5ft
Date Borehole Started:	3/13/24
Date Borehole Completed:	3/13/24
Logged By:	A. Ong
Drilling Company:	CN Drilling, Inc.

Remarks: Borings drilled using limited-access Acker drill rig. Standard penetration test (SPT) sampler driven with a 140 lb. safety hammer. Hammer operated with a rope and cathead mechanism. Elevations are approximate from site survey by Terrane, dated 10/31/2019. **Vertical datum: NAVD88**

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LOG OF TEST BORING PG-2

Figure A-3

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