GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists
& Environmental Specialists

October 27th 2022 G-5781

Copy to: Jessica Larsson
Email: permit@proadminservices.net

Subject: **Geotechnical Engineering Investigation**
Proposed New Deck and Stairs
6671 E Mercer Way
Mercer Island, Washington

Dear Mr. Reutimann:

At your request, GEO Group Northwest, Inc., conducted a geotechnical engineering investigation at the above-subject location for a proposed new deck and stairs on your property in Mercer Island, Washington. We understand the city of Mercer Island has requested a geotechnical report to assess the seismic, erosion and landslide hazards onsite and respond accordingly with recommendations to mitigate onsite hazards. The scope of our services included a review of the geologic maps of the area and providing a characterization of the subsurface soil and groundwater conditions encountered, preparation of boring logs (attached) and preparation of this geotechnical report.

SITE CONDITIONS

Site Description

The project site is located in South-east Mercer Island, Washington, as illustrated in *Plate 1 – Site Location Map*. The parcel is rectangular shaped and slopes from the north-west to the south-east corners of the property at the lowest elevation. The parcel consists of 16,553 square feet and is bounded by other single family residential properties to the south, east, west and Hillside Lane to the north. The existing single-family residence was built in 1978 and has one story and a finished basement with approximately 2,760 square feet of total living space. A second story deck with stairs is attached to the south side of the existing house and a small hot tub and

supporting structure is on the first story in the south-west corner of the house. The project site is mapped by the City of Mercer Island as having a protected slope, a landslide hazard, erosion hazard and a seismic hazard on the southern most side of the property.

Description of Proposed Development

The proposed deck and stairs will replace the existing deck and stairs with no changes to the current footprint. The second story wooden deck will be approximately 284 square feet and the stairs will be approximately 33 square feet connecting the second story deck to the first story hot tub and yard area. The house and yard will not be altered save for the existing deck that will be removed entirely. Please see *Plate 2 – Site Plan*

SITE INVESTIGATION

Geologic Overview

Based on a review of the geologic maps for the area, the surficial soil in the area is mapped as Glacial Till (Qvt) and a contact with a Recessional Outwash (Qvr) is mapped to lie along the southern most property line. Glacial Till deposits typically consist of very compact mixtures of sand, silt, clay, and gravel that were overridden and over-consolidated by glacial ice during the Fraser glaciation period which ended approximately 13,000 years ago. Recessional Outwash typically consists of loose to dense stratified sand and gravel, moderately sorted to well sorted, with occasional silty sand and silt that was deposited in outwash channels from draining glacial meltwater.

Subsurface Investigation

On October 10th a Staff Engineering Geologist from our firm, visited the site to perform a visual reconnaissance of the site and investigate the subsurface soil conditions and geologic hazard areas by conducting two hand auger borings as close as possible to the location of the proposed new deck. The existing deck is the highest point of the backyard, and the rest of the yard slopes gently down to the south. Erosion was observed around some of the existing deck footings, and surficial loose soil covered the dense underlying soils around these sloping areas south of the deck.

Hand Auger 1 (HA-1) was conducted by the footing on the south side of the deck. Below a 6-inch layer of loose topsoil and leaves we observed medium dense yellow, dry, silty sands with cobbles and roots. The soil became dense with depth and the boring was terminated at 2 feet below the ground surface in this location. Hand Auger 2 (HA-2) was dug along the south-east corner of the house where there were exposed soils. Below a thin layer of weathered topsoil, yellow-brown silty sand was observed to a depth of 1 foot where the soil became dense. No groundwater was observed onsite. For a more detailed description of the soils encountered, please refer to the boring logs in *Appendix A.*

CRITICAL AREAS

The Project site is mapped to overly a City of Mercer Island Seismic, Potential Slide and Erosion Hazard area. As part of our scope of work we evaluate the hazard with respect to the project scope of work. Please see *Plate 3 and 4 – Hazardous Areas Map.*

Seismic Hazard

According to the City of Mercer Island, a seismic hazard area is an area that has potential for seismically induced ground failures including settlement, cracking, lateral spreading and liquefaction due to ground shaking. The south side of the site is mapped as having a seismic hazard further south on the property than the proposed construction. The site location is also mapped as being outside of the Seattle fault zone. There is a contact between the glacial till and recessional outwash in the southmost adjacent gulley to the property, this could potentially increase the seismic hazard, however, since the contact was not observed on the property, and is mapped to be further south of the construction, we believe the risk posed from this geologic contact is minimal. In our opinion, because of the dense soils onsite, the sites' location outside the Seattle Fault Zone, and the contact with Recessional outwash being further south than construction, the risk of seismically induced settlement or failure is minimal.

Potential Landslide Hazard

The site is also mapped as a potential slide area, and a few blocks to the north there is a steep slope and ravine sloping northwards that is mapped as having a scarp and several past slides. The slopes onsite are less than 15% and are not considered steep slopes, the soil encountered onsite is dense to very dense and the site is mapped as overlying dense glacial till.

The mapped scarp and slide area is located a block to the north of the subject property and, in our opinion, is far enough away to pose little risk to the property. In our professional opinion, because of the dense native soils observed onsite and the lack of mapped past landslide activity in the immediate vicinity, the risk of a potential slide or seismically induced settlement or failure is low.

Erosion Hazard

The site is also mapped as an erosion hazard area, and onsite we observed some signs of erosion around the existing deck. We recommend water not be allowed to stand around footings. In our opinion, the risk of erosion onsite is minimal.

CONCLUSIONS AND RECOMMENDATIONS

The site is underlain with hard, Silty and sandy soils that we interpret to be dense native soils, no groundwater was observed. We recommend the proposed addition be supported on conventional concrete footing foundations that bear on dense native soils or on structural fill that is placed on a subgrade of dense native soil. Based on the findings from our investigation, bearing soils are anticipated at depth of approximately 2 feet below the existing ground surface in the location of the proposed deck. Detailed recommendations regarding geotechnical aspects of the project are presented in the following sections of this report. From our subsurface investigation, we observed that the soils are dense and no signs of creep or instability were observed onsite. In our opinion, as long as our recommendations for proper drainage are applied the risk of a potential slide, seismic induced settling and erosion in the project area is low because of the dense to very dense soils.

Seismic Site Design Classification and Design Parameters

Based on guidance provided in the 2018 edition of the International Building Code (IBC), it is our opinion that the project site meets the criteria for seismic Site Class C for dense Soils. Seismic design parameters applicable for the site, based on the assigned Site Class C and design calculations per the 2018 IBC, are as follows:

S_s = 1.453 g	S_{ms} = 1.743	S_{ds} = 1.162
S_1 = 0.503g	S_{m1} = 0.753	S_{d1} = 0.502

The peak ground acceleration for the site, adjusted for the assigned site class, is 0.746g based on USGS seismic hazard design mapping per the 2018 IBC

Foundations

Soils that are anticipated to be acceptable for building support were encountered at a depth of approximately 2 feet bgs in the hand auger boring that was completed for our investigation. Based on these findings, it is our opinion that new foundations for the project can consist of conventional concrete strip and column footings that bear directly on dense native soils or on compacted, crushed rock structural fill that has been placed on a subgrade of dense or very dense native soils. Our recommended design criteria for conventional footing foundations supported on native soils or crushed rock structural fill are provided below.

- Allowable bearing pressure, including all dead and live loads:
  - Undisturbed, dense or very dense soil = 2,000 psf
  - Structural fill placed on dense or very dense soil = 2,000 psf

- Minimum depth to base of perimeter footing below adjacent exterior grade = 18 inches
- Minimum depth to bottom of interior footings below top of floor slab = 12 inches
- Minimum width of wall footings = 16 inches

- Minimum lateral dimension of column footings = 24 inches
- Estimated post-construction settlement = ½ inch
- Estimated post-construction differential settlement across building width = ½ inch

A one-third increase in the above allowable bearing pressures can be used when considering short-term transitory wind or seismic loads. Lateral loads against the building foundations can be resisted by friction between the foundation and the supporting subgrade or by passive earth pressure acting on the buried portions of the foundations. For the latter case, the foundations must be poured "neat" against the existing undisturbed soil or be backfilled with compacted structural fill. Our recommended parameters are as follows:

- Passive Pressure (Lateral Resistance)
  - 350 pcf, equivalent fluid weight, for structural fill or competent undisturbed native soil

- Coefficient of Friction (Friction Factor)
  0.35 for structural fill or competent undisturbed native soil.

Drainage

Water should not be allowed to stand in areas where footings, slabs, or pavements are to be constructed. Final site grades should provide drainage away from the deck structure.

Mercer Island Unified Land Development Code Geologically Hazardous Areas per Requirement 19.07.160.B

An evaluation of site-specific subsurface conditions demonstrates that the proposed development is not located in a landslide hazard area or seismic hazard area and the development is so minor as not to pose a threat to the public health, safety and welfare.

LIMITATIONS

The findings and recommendations stated herein are based on field observations, our experience on similar projects and our professional judgment. The recommendations presented herein are our professional opinions derived in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area and within the project schedule and budget constraints. No warranty is expressed or implied. In the event that site conditions are found to differ from those described in this report, we should be notified so that the relevant recommendations in this report can be reevaluated and modified if appropriate.

CLOSING

We appreciate the opportunity to provide you with geotechnical engineering services for this project. Please do not hesitate to contact us if you have any questions regarding this report.

Sincerely,

GEO Group Northwest, Inc.

Sophie Holt, G.I.T.
Staff Engineering Geologist

William Chang, P.E.
Principal Engineer

Attachments:

Plate 1 – Site Location Map
Plate 2 – Site Plan
Plate 3 – Critical Areas
Plate 4 – Critical Areas
Plate 5 – Typical Footing Drain
Appendix A – USCS Soil Classification Legend & Soil Boring Logs

Source: King County iMap, 2021

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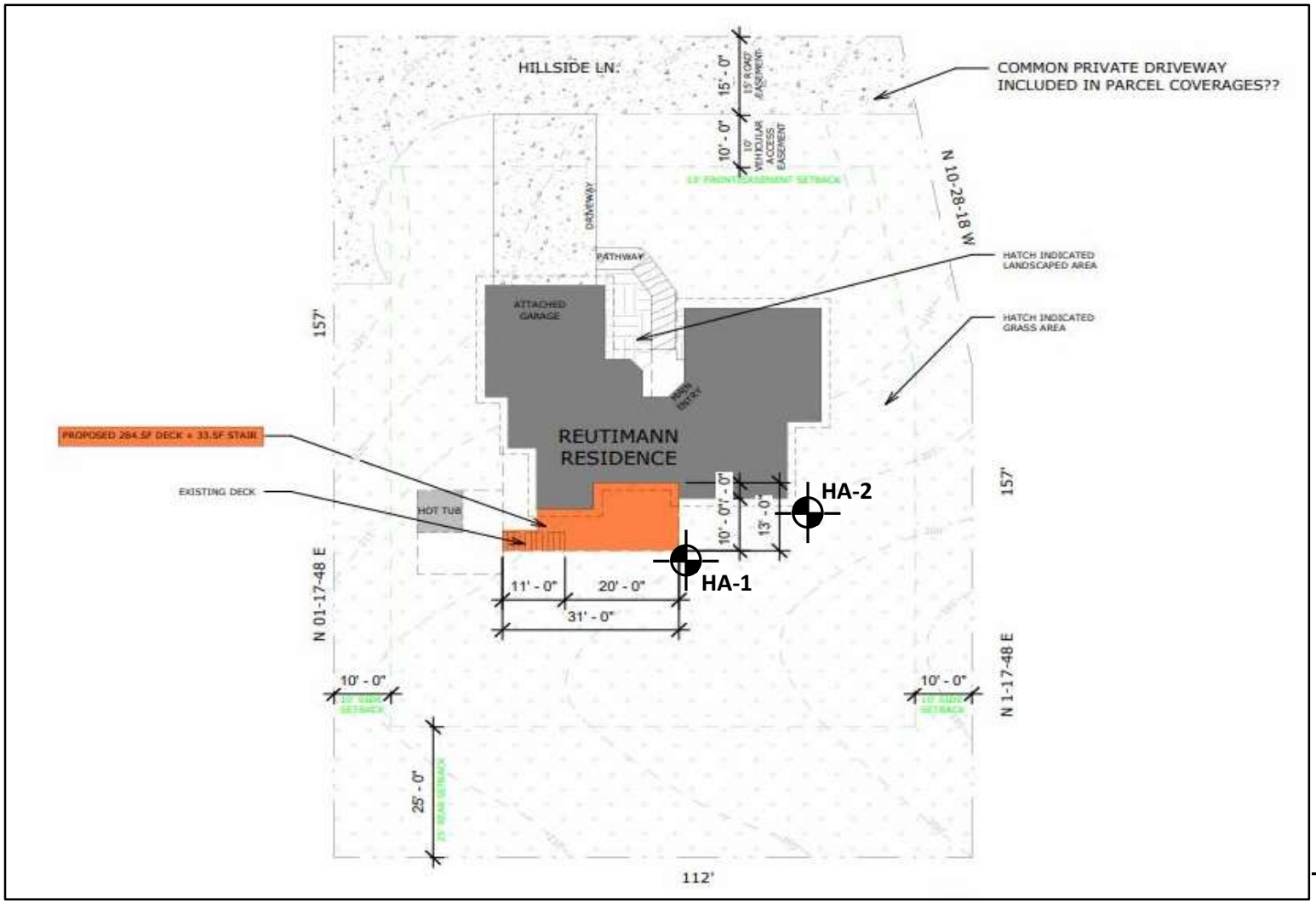
SITE LOCATION MAP

PROPOSED NEW GARAGE
6671 E MERCER WAY
MERCER ISLAND, WASHINGTON

SCALE	DATE	MADE	CHKD	JOB NO.	PLATE
NONE	10/27/2022	SH	WC	G-5781	1



LEGEND

HAND AUGER LOCATION

PROPOSED

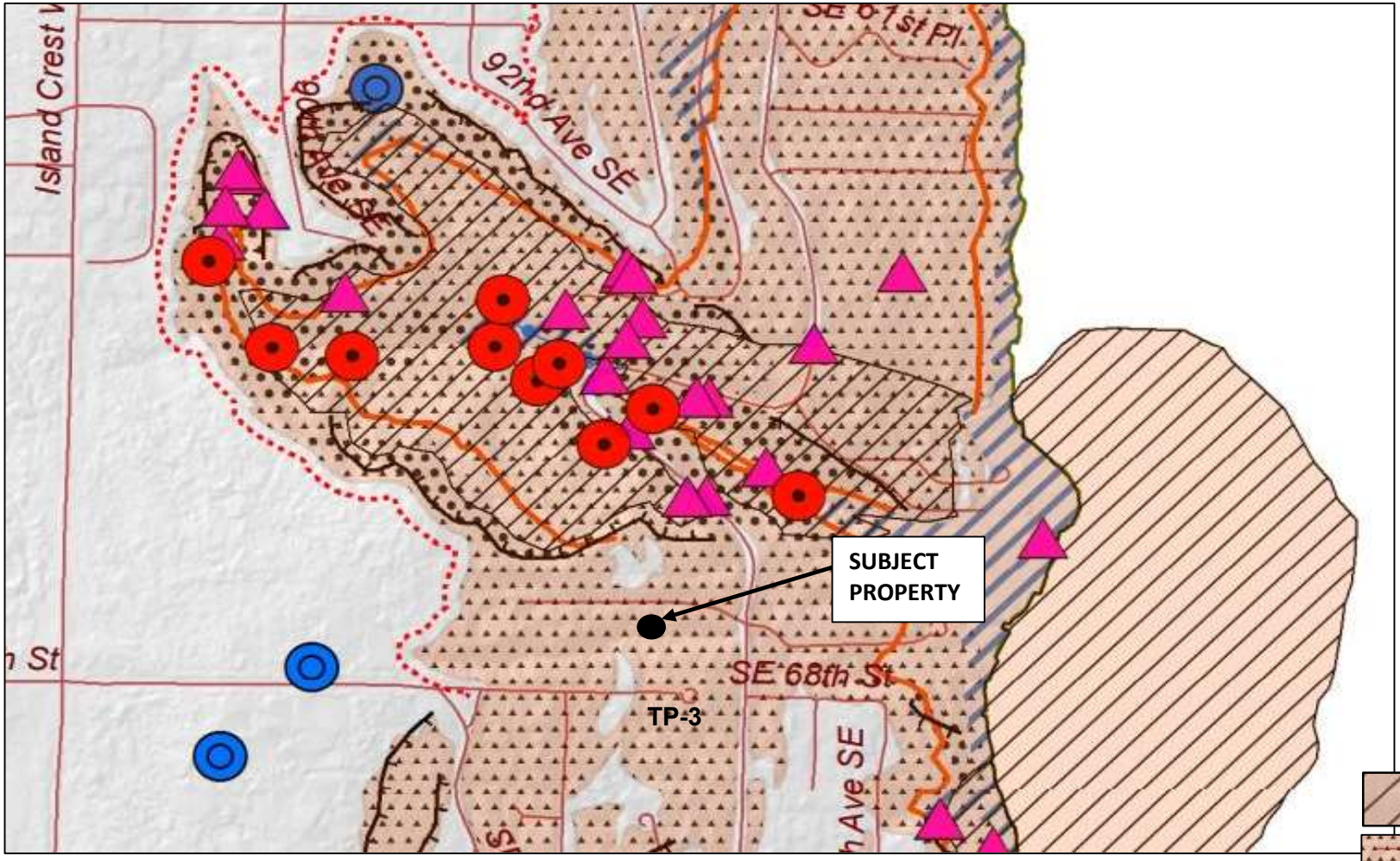
GEO Group Northwest, Inc.

Geotechnical Engineers, Geologists, & Environmental Scientists

SITE PLAN

PROPOSED NEW DECK AND STAIRS
6671 E MERCER WAY
MERCER ISLAND, WASHINGTON

SCALE:	NO SCALE	DRAWN:	SH	CHECKED:	WC	DATE:	10/27/2022	PROJECT NO.:	G-5781	PLATE	2



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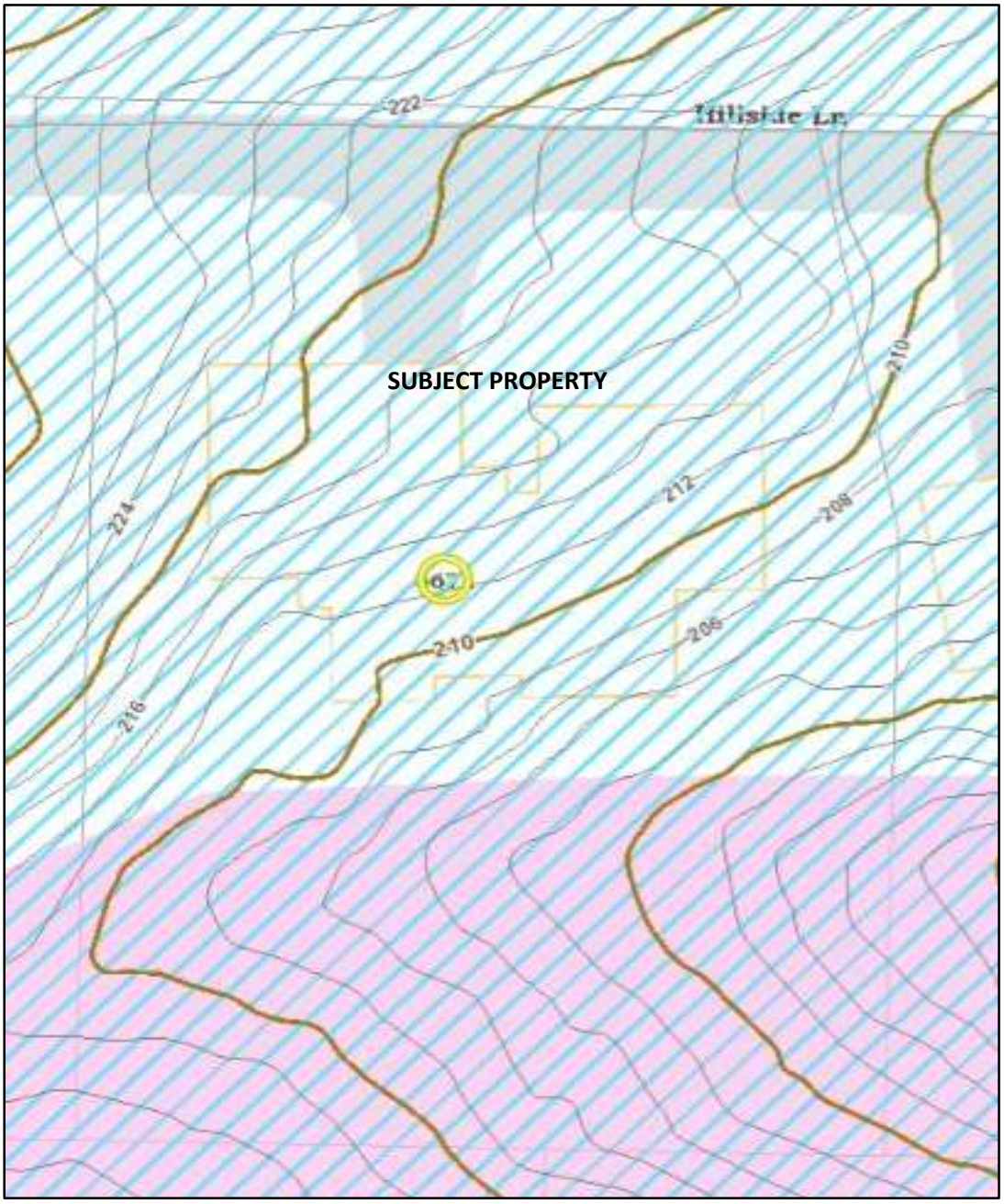
LANDSLIDE HAZARD
PROPOSED NEW DECK AND STAIRS
6671 E MERCER WAY
MERCER ISLAND, WASHINGTON

SCALE:	NO SCALE	DRAWN:	SH	CHECKED:	WC	DATE:	10/27/2022	PROJECT NO.:	G-5781	PLATE	3



LEGEND

POTENTIAL SLIDE

SEISMIC HAZARD

Source: City of Mercer Island GIS

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GEOLOGIC HAZARDOUS AREAS

PROPOSED NEW DECK AND STAIRS
6671 E MERCER WAY
MERCER ISLAND, WASHINGTON

SCALE	DATE	MADE	CHKD	JOB NO.	PLATE
NONE	10/27/2022	SH	WC	G-5781	4

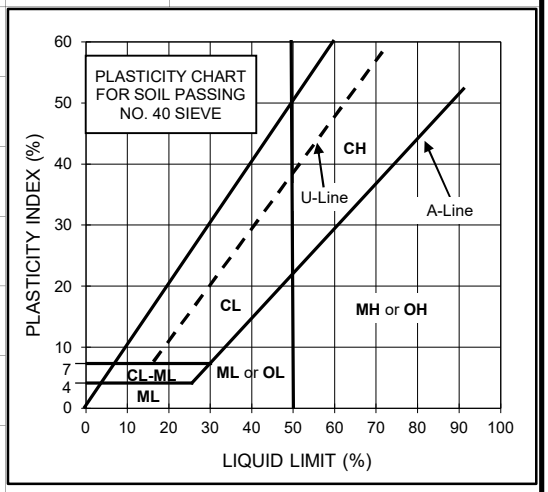
APPENDIX A

USCS Soil Classification Legend & Soil Boring Logs

SOIL CLASSIFICATION & PENETRATION TEST DATA EXPLANATION

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS	GRAVELS (More Than Half Coarse Fraction is Larger Than No. 4 Sieve)	CLEAN GRAVELS (little or no fines)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES	CONTENT OF FINES BELOW 5%	Cu = (D60 / D10) greater than 4 Cc = $(D30)^2$ / (D10 * D60) between 1 and 3
			GP	POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES LITTLE OR NO FINES		CLEAN GRAVELS NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (with some fines)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	GM: ATTERBERG LIMITS BELOW "A" LINE. or P.I. LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		GC: ATTERBERG LIMITS ABOVE "A" LINE. or P.I. MORE THAN 7
More Than Half by Weight Larger Than No. 200 Sieve	SANDS (More Than Half Coarse Fraction is Smaller Than No. 4 Sieve)	CLEAN SANDS (little or no fines)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	CONTENT OF FINES BELOW 5%	Cu = (D60 / D10) greater than 6 Cc = $(D30)^2$ / (D10 * D60) between 1 and 3
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES		CLEAN SANDS NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (with some fines)	SM	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE with P.I. LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE with P.I. MORE THAN 7
FINE-GRAINED SOILS	SILTS (Below A-Line on Plasticity Chart, Negligible Organics)	Liquid Limit < 50%	ML	INORGANIC SILTS, ROCK FLOUR, SANDY SILTS OF SLIGHT PLASTICITY		
		Liquid Limit > 50%	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOIL		
	CLAYS (Above A-Line on Plasticity Chart, Negligible Organics)	Liquid Limit < 50%	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS		
		Liquid Limit > 50%	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
Less Than Half by Weight Larger Than No. 200 Sieve (i.e., fines)	ORGANIC SILTS & CLAYS (Below A-Line on Plasticity Chart)	Liquid Limit < 50%	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
		Liquid Limit > 50%	OH	ORGANIC CLAYS OF HIGH PLASTICITY		
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS		



SOIL PARTICLE SIZE

FRACTION	U.S. STANDARD SIEVE			
	Passing		Retained	
	Sieve	Size (mm)	Sieve	Size (mm)
SILT / CLAY	#200	0.075		
SAND				
FINE	#40	0.425	#200	0.075
MEDIUM	#10	2.00	#40	0.425
COARSE	#4	4.75	#10	2.00
GRAVEL				
FINE	0.75"	19	#4	4.75
COARSE	3"	76	0.75"	19
COBBLES	76 mm to 203 mm			
BOULDERS	> 203 mm			
ROCK FRAGMENTS	> 76 mm			
ROCK	>0.76 cubic meter in volume			

GENERAL GUIDANCE FOR ENGINEERING PROPERTIES OF SOILS, BASED ON STANDARD PENETRATION TEST (SPT) DATA

SANDY SOILS				SILTY & CLAYEY SOILS		
Blow Counts N	Relative Density, %	Friction Angle ϕ, degrees	Description	Blow Counts N	Unconfined Strength q_u, tsf	Description
0 - 4	0 -15		Very Loose	< 2	< 0.25	Very soft
4 - 10	15 - 35	26 - 30	Loose	2 - 4	0.25 - 0.50	Soft
10 - 30	35 - 65	28 - 35	Medium Dense	4 - 8	0.50 - 1.00	Medium Stiff
30 - 50	65 - 85	35 - 42	Dense	8 - 15	1.00 - 2.00	Stiff
> 50	85 - 100	38 - 46	Very Dense	15 - 30	2.00 - 4.00	Very Stiff
				> 30	> 4.00	Hard

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists
13705 Bel-Red Road Bellevue, WA 98005
Phone (425) 649-8757 E-mail: info@geogrourpnw.com

PLATE A1

HAND-AUGER BORING: HA-1

LOGGED BY SH **LOG DATE:** 10/10/2022 **GROUND ELEV.**

DEPTH ft.	USCS	SOIL DESCRIPTION	SAMPLE No.	Water %	OTHER TESTS/ COMMENTS
1	SM	6 inch layer of topsoil, roots, loose sediment, sticks and leaves SILTY SAND, yellow-brown, cobbles and roots, dry, medium dense, approximately 15-20% fines	S1		-Probe 6"' at 1'
2	SM	SILTY SAND, yellow-brown, cobbles, dry-damp, dense-very dense, approximately 10%fines			-Probe 0.5"' at 2 '
3					
4					
5					
6					
7		**Total Depth: 1.75 feet bgs** **Groundwater encountered: No**			

HAND-AUGER BORING: HA-2

LOGGED BY SH **LOG DATE:** 10/7/2022 **GROUND ELEV.**

DEPTH ft.	USCS	SOIL DESCRIPTION	SAMPLE No.	Water %	OTHER TESTS/ COMMENTS
1	SM	Edge of garden bed, exposed soil SILTY SAND, yellow-brown, cobbles, dry-damp, dense, approximately 15% fines			-Probe 0" at 0.5'
2					
3					
4					
5					
6					
7					

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HAND AUGER BORING LOGS

PROPOSED NEW DECK AND STAIRS
6671 E MERCER WAY
MERCER ISLAND, WASHINGTON

JOB NO.	G-5781	DATE	10/24/22	APPEND.	A2