associated earth sciences incorporated

October 2, 2018
Project No. 180127E001

Ron Beresky
8100 SE 48th Street
Mercer Island, Washington 98040

Subject: Geotechnical Engineering Report
New Retaining Wall Feasibility
8100 SE 48th Street
Mercer Island, Washington

Dear Mr. Beresky:

This letter-report summarizes the findings of the subsurface exploration and geotechnical engineering study recently completed for the above-referenced project. Our work has been completed in general accordance with our proposal, dated March 9, 2018; discussions with you; and in accordance with generally accepted geotechnical engineering practices. This letter-report was prepared for the exclusive use of Mr. Ron Beresky and his authorized agents, for specific application to this project. No other warranty, express or implied is made.

SITE AND PROJECT DESCRIPTION

The project site is situated within an existing single-family residential property located at 8100 SE 48th Street in Mercer Island, Washington as shown on the "Vicinity Map," Figure 1. The lot is comprised of a relatively level portion where the residence is situated and a northwest-facing slope. The slope is up to approximately 45 feet tall, and is inclined at greater than 75 percent. The slope is completely covered with a dense cover of blackberry brambles with scattered small shrubs and deciduous trees. There is a deck and patio extending off the northwest side of the home at the top of the slope. The deck is connected to the house and supported by wooden posts on pad footings.

A portion of the slope near the northern third of the home has had a history of shallow landslides in 1997 and 2007. The 1997 landslide was remediated using a shotcrete facing with anchors (Figure 2). The 2007 landslide area was not remediated except for a segmental block wall that was constructed near the top of the slope to help protect the house foundation. In 2015, a subsequent project involving pin-pile-supported timber lagging wall was constructed in front of the segmental block wall and a deck post was underpinned.

Per the *Mercer Island Municipal Code* (MICC) Chapter 19.16.010 (recent revisions adopted May 3, 2016) the site is classified as a landslide hazard area due to the presence of slopes inclined at greater than 40 percent and the documented history of slope failures.

Based on discussions with you, we understand that there are concerns that a future slope failure like the previous events could occur below the existing deck. Consequently, you are considering constructing a wall or walls downslope of the deck on your property.

SITE EXPLORATION

Our field study included drilling two exploration borings in accessible portions at the top of the slope (Figure 2). The various types of sediments, as well as the depths where the characteristics of the sediments changed, are indicated on the exploration logs presented in Appendix A. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types. If changes occurred between sample intervals in our explorations, they were interpreted. Our explorations were approximately located in the field by measuring from known site features depicted on the topographic survey.

The conclusions and recommendations presented in this letter-report are based, in part, on the explorations completed for this study. The numbers, locations, and depths of the explorations were completed within site and budgetary constraints. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of variations between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to re-evaluate specific recommendations in this letter-report and make appropriate changes.

Exploration Borings

The exploration borings for this study (EB-1 and EB-2) were completed by advancing a 6.5-inch, outside-diameter, hollow-stem auger using a subcontracted portable Acker drill. During the drilling process, samples were generally obtained at 2½- to 5-foot-depth intervals. The borings were continuously observed and logged by an engineering geologist from our firm. The exploration logs presented in Appendix A are based on the field logs, drilling action, and observation of the samples collected.

Disturbed, but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *American Society for Testing and Materials* (ASTM) D-1586. This test and sampling method consists of driving a standard 2-inch, outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard

Penetration Resistance ("N") or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring log.

The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification.

SUBSURFACE CONDITIONS

Subsurface conditions on the project site were inferred from the field explorations conducted for this study, visual reconnaissance of the site, and a review of applicable geologic literature. As shown on the field logs, a general sequence of soils encountered at the site consisted of fill and pre-Olympia-age glacial till. The native deposits we encountered at the site are in general agreement with mapped geologic conditions presented on the *Geologic Map of Mercer Island, Washington*, by Kathy G. Troost and Aaron P. Wisher, dated October 2008. The following section presents more detailed subsurface information on the sediment types encountered at the site.

Stratigraphy

Fill

Fill soils (those not naturally placed), were encountered in boring EB-2 located at the top of the slope between the house and the pin-pile-supported timber lagging wall noted previously. The fill encountered in exploration boring EB-2 generally consisted of very loose, moist, olive to light brown sandy silt with some amounts of gravel.

Colluvium/Weathered Pre-Olympia Glacial Till

These sediments were observed mantling the steep slope area to the west of the deck and house during our geologic reconnaissance of the site. These units are formed by the in-place weathering action of water, organic (root) growth, and other factors over time. These sediments generally consist of loose to medium dense mixtures of silt, sand, and gravel similar in grain-size distribution to the underlying dense to very dense, unweathered pre-Olympia glacial till described below. The thickness of these loose sediments on the steep slope is estimated to be on the order of several feet based on the observed geomorphology of the slope and older shallow landslide features during our reconnaissance.

Pre-Olympia Glacial Till

Both exploration borings EB-1 and EB-2 encountered hard, moist, olive hue, sandy silt ranging to dense to very dense, very silty sand with some amounts of gravel, interpreted as pre-Olympia glacial till. Iron oxide staining was observed within the upper several feet of this unit.

Pre-Olympia Non-Glacial Deposits

This unit was not encountered during our subsurface exploration of the site, but is inferred to underlie the geologic units described above within the lower portion of the steep slope based on the published geologic map referenced above, and based on subsurface explorations performed by others for properties north and west of the site. Pre-Olympia non-glacial sediments generally consist of sand, gravel, silt, clay, and organics deposited prior to subsequent glacial advances into the Puget Sound region up to 70,000 years before present. Based on the subsurface explorations performed by others for properties north and west of the site, we infer the pre-Olympia non-glacial sediments underlying the site are likely comprised predominantly of very stiff to hard silt. Their high consistency is the result of being overridden by several episodes of glacial advance across the area of the site. The upper several feet of these sediments may become less dense and soft as a result of weathering as described above.

Hydrology

Groundwater was not observed in our exploration borings completed for this project at the time of drilling in June 2018. However, it should be noted that perched groundwater seepage may occur during the winter and spring months. Perched groundwater occurs when surface water infiltrates down through relatively permeable soils, such as the fill or the weathered portions of the glacial deposits and becomes trapped or "perched" atop a comparatively impermeable barrier, such as a silt interbed. This infiltration can occur at great distances from the area where the groundwater is encountered. It should be noted that fluctuations in the level of the groundwater may occur due to the time of year and variations in the amount of rainfall. The quantity and duration of flow from excavations made into the perched zone will vary depending on season, topography, and soil grain size.

SLOPE HAZARDS AND MITIGATION

The site is characterized by a relatively flat topography with a steep slope area along the west side of the site. The steep slope is underlain at the surface by very loose existing fill and weathered native glacial soils. These units are underlain at depth by dense to very dense pre-Olympia glacial till as described above. The interpreted subsurface distribution of these soil units is presented in Figure 3, "Geologic Cross Section A-A'." Based on the topographic survey provided to us, the sloping area northwest of the deck and home, where the retaining walls are planned, is very steeply inclined up to approximately 75 percent. Observations were made of the slopes during our subsurface exploration. No recent tension cracks, hummocky topography, or other indications of current slope instability were observed on the slope. However, it should be noted that our observations are very limited based on the presence of a dense mantle of vegetation as noted previously. We observed an arcuate-shaped topographic area northwest of the northern third of the residence near EB-2 where landslides have occurred in the recent past as noted previously. We observed very loose fill and/or weathered glacial sediments similar to that described above at the ground surface in the sloping area below the deck between borings EB-1 and EB-2. We were not able to determine the thickness of these very loose sediments. However, we interpret the thickness to be similar to that observed in boring EB-2. The existing slope area below the southern two thirds of the residence did not exhibit visual indications of recent slope instability or erosion.

Based on the observed soil conditions, reconnaissance observations, and documented history of landslides on this slope, it is our interpretation that the risk of future surficial landslides on the slope is moderate to high. AESI recommends construction of a retaining wall to provide additional lateral support to the deck foundations and reduce the risk of loss of ground associated with potential future shallow landslides.

EROSION HAZARDS AND MITIGATIONS

Project plans should include implementation of temporary erosion controls in accordance with local standards of practice. Control methods should include limiting earthwork to seasonally drier periods, typically April 1 to October 31, use of perimeter silt fences, and straw mulch in exposed areas. Removal of existing vegetation should be limited to those areas that are required to construct the project, and new landscaping and vegetation with equivalent erosion mitigation potential should be established as soon as possible after grading is complete. During construction, surface water should be collected as close as possible to the source to minimize silt entrainment that could require treatment or detention prior to discharge. Timely implementation of permanent drainage control measures should also be a part of the project plans, and will help reduce erosion and generation of silty surface water onsite.

CONCLUSIONS AND RECOMMENDATIONS

We evaluated various retaining wall types to satisfy the objective of protecting the deck foundations from damage due to a future shallow landslide and repairing the sloping area where the most recent landslide occurred in 2007. Options for a retaining wall system to protect the deck foundations are limited due to site access, steep slope conditions and proximity of the property boundary.

We prepared conceptual sketches of two possible retaining wall options for consideration that are included in Appendix B. Option 1 consisted of a two-tiered segmental block wall within the previous slide area keyed into dense native soils and a soldier pile wall with one row of tieback anchors along the property line below the existing deck embedded into dense native soils. Option 2 is similar to Option 1 except that instead of the soldier pile wall, a single-tier block wall would continue below the existing deck keyed into dense native soils. The single-tier wall would be located slightly onto the adjacent property owned by the City. We understand that you have met with representatives from the City to discuss the possibility of Option 2 that would involve a boundary line adjustment to allow construction of the single-tier segmental block wall below the deck. You informed us that the City is amenable to your request and have asked you to submit plans and engineering for your wall project. We have assumed that the segmental block walls will consist of Basalite units reinforced with geogrid. Walls will be a maximum of 5 feet tall.

CLOSURE

It has been a pleasure to assist you on this project. If you should have any questions, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

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Attachments:	Figure 1:	Vicinity Map
	Figure 2:	Site and Exploration Plan
	Figure 3:	Geologic Cross Section A-A'
	Appendix A:	Exploration Logs
	Appendix B:	Retaining Wall Conceptual Sketches