associated earth sciences incorporated

Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report

ARVIND RESIDENCE

Mercer Island, Washington

Prepared For:

SK DESIGNS, LLC

Project No. 20220409E001
March 10, 2023

Associated Earth Sciences, Inc.

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earth sciences
incorporated

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Project No. 20220409E001

SK Designs, LLC
16406 37th Drive SE
Bothell, Washington 98012

Subject: Subsurface Exploration, Geologic Hazard, and
Geotechnical Engineering Report
Arvind Residence
3655 73rd Avenue SE
Mercer Island, Washington 98040

Dear Shruthi Kantharaj

Associated Earth Sciences, Inc. (AESI) is pleased to present the enclosed copies of the above-referenced report. This report summarizes the results of our subsurface exploration, geologic hazard, and geotechnical engineering studies and offers geotechnical recommendations for the design and of the subject project.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions, or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Timothy J. Peter
____
Timothy J. Peter, L.E.G., L.Hg.
Senior Engineering Geologist

TJP/jh – 20220409E001-003

SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, AND GEOTECHNICAL ENGINEERING REPORT

ARVIND RESIDENCE

Mercer Island, Washington

Prepared for:
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March 10, 2023
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I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of our subsurface exploration, geologic hazard, and geotechnical engineering study for the proposed project. The location of the site is shown on the "Vicinity Map," Figure 1, and the approximate locations of the explorations accomplished for this study are presented on the "Site and Exploration Plan," Figure 2 and on the "Existing Wall Locations," Figure 3. In the event that any changes in the nature, design, or location of the proposed improvements are planned, the conclusions and recommendations contained in this report should be reviewed and modified, or verified, as necessary.

1.1 Purpose and Scope

The purpose of this study was to obtain subsurface data to be used in the design of concrete cast-in-place retaining walls recently constructed on the subject property. Our study included reviewing available geologic literature, drilling two exploration borings, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow groundwater conditions along the wall alignment. Limited geotechnical engineering studies were completed to assess geotechnical design parameters for the walls and geologic hazards associated with the project. This report summarizes our current fieldwork and provides the results of the geologic hazard assessment and recommendations for retaining wall design as requested by the City of Mercer Island.

1.2 Authorization

Our study was accomplished in general accordance with our scope of work and cost proposal, dated January 25, 2023. This report has been prepared for the exclusive use of SK Design, LLC and their agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The subject site is the existing single-family residential property located at 3655 73rd Avenue SE in Mercer Island, Washington (King County Parcel No. 287700125). The 0.37-acre parcel slopes down from 73rd Avenue SE to the western property boundary. We understand that the topography formerly steepened west (downslope) of the existing house. This area was terraced during the recent work with concrete retaining walls providing grade separation between terraces. Regional topographic data obtained from City of Mercer Island GIS Mapping Tool indicates that slope inclinations in this area prior to the recent grading ranged from approximately 15 to 30 percent with the steepest portions to the west of the existing residence. Gently to moderately sloping areas were observed to the north of the residence where inclinations ranged between 8 and 12 percent. The topographic contours shown in Figures 2 and 3 represent site topography prior to the recent grading activities.

The existing single-family residence, originally constructed in 1992, is located in the southeastern portion of the parcel and consists of a two-story structure with a daylight basement. The property is bounded by existing single-family residences to the north, south and west, and by 73rd Avenue SE to the east. The property is partially vegetated by large conifers and younger deciduous trees, as well as bushes and other small shrubs. At the time of our exploration, in areas where walls had been constructed, plastic had been placed over exposed soils to reduce the potential for erosion.

Recent work at the site, as shown on “Existing Wall Locations,” Figure 3, includes the construction of several cast-in-place concrete retaining walls in the yard west of the home (Wall 1 and Wall 2), north of the home (Wall 3, Wall 4, and Wall 5), northeast of the home (Wall 6), some concrete stairs in the yard south of the house, and some exterior improvements to the west side of the home. The retaining walls range in height from approximately 2 to 5 feet, with the tallest walls running north to south near the western property boundary (Wall 1 and Wall 2). Walls 1 and 2 were constructed on the formerly sloping area west of the existing residence. Shorter walls with approximate maximum exposed heights of 2 feet are present to the north of the existing residence (Wall 3, Wall 4, And Wall 5). Another wall approximately 4 feet tall exists to the northwest of the existing residence (Wall 6). Wall 3 and Walls 4 and 5 north of the existing residence are in areas where the topography is gently to moderately sloping with inclinations ranging from 8 to 12 percent with an overall vertical relief of approximately 6 feet. Wall 3 trends in a north south direction with a gap for stairs in the central portion of the wall. Walls 4 and 5 trend east to west with approximate exposed heights of 2 feet of less.

It is our understanding that the City placed a stop work order on the project due to the lack of proper permitting. Of particular concern is the area west of the home that may classify as a Landslide Hazard Area.

This report provides an assessment of geologic hazards associated with the project and recommended geotechnical parameters for design of the walls. The onsite walls are concrete cast-in-place retaining walls with conventional spread footings. From our onsite observations the Wall 1, adjacent to the western property boundary is founded on the medium dense mass to very stiff/hard wasting deposits as observed in the borings and beneath the exposed wall foundation at its southern and northern extent. Based on drilling observations and probe penetration depths, Wall 2 appears to be founded on compacted fill. Wall 3 through Wall 6 are likely founded on existing loose to medium dense fill. Due to the variability of the existing fill, the presence of a firm and unyielding wall foundation subgrade could not be confirmed across the lateral extent of Wall 3 through Wall 6. Based on conversations with the homeowner and our observations during our subsurface explorations, the walls were not constructed with a drainage blanket along the backside of the wall and no footing drains were provided. 4-inch diameter weep holes were observed near the base of the walls but were not visible along the entire length of each wall and no consistent spacing could be determined. Fill was observed behind these weepholes and no aggregate or other drainage material was present.

The subject site lies within Erosion, Seismic and Landslide Hazard Areas, as delineated in the City of Mercer Island *Geological Hazard Maps*. Subsurface explorations were conducted in the vicinity of the recently constructed cast-in-place concrete walls, on both northern and western sides of the existing residence to assess subsurface conditions in these areas.

3.0 SUBSURFACE EXPLORATION

The subsurface exploration and geologic site reconnaissance was conducted on February 8, 2023, and consisted of advancing two exploration borings to gain subsurface information about the site. The various types of materials and sediments encountered in the explorations, as well as the depths where characteristics of these materials changed, are indicated on the exploration boring logs presented in the Appendix. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types in the field. If changes occurred between sample intervals in our borings, they were interpreted. The locations of the exploration borings are shown on Figure 2 and Figure 3.

The conclusions and recommendations presented in this report are based on the exploration borings completed for this study. The locations and depths of the explorations were completed within site access and budgetary constraints. Because of the nature of exploratory work below ground, interpolation 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 any variations beyond 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 report and make appropriate changes.

3.1 Exploration Borings

For this study, two hollow-stem auger borings were drilled by CN Drilling, an independent firm working under subcontract to AESI, at the approximate locations shown on Figure 2. Logs of our exploration borings, labeled EB-1, and EB-2, are included with this report in the Appendix. The borings for this study were completed by advancing a 4.5-inch outer-diameter, hollow-stem auger with a dolly-mounted drill rig. During the drilling process, samples were obtained at generally 2.5- to 5-foot-depth intervals. After completion of drilling, each borehole was backfilled with bentonite chips and capped at the surface with onsite material.

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 blows is recorded at or before the end of 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 boring logs.

The exploration borings were continuously observed and logged by an experienced geologist from our firm. 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 and laboratory testing, as necessary. The exploration logs presented in the Appendix are based on the N-values, field observations, drilling action, and laboratory test results, if conducted.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the field exploration accomplished for this study, visual reconnaissance of the site, and review of applicable geologic literature. The following section presents more detailed subsurface information organized from the shallowest (youngest) to the deepest (oldest) sediment types.

4.1 Stratigraphy

Crushed Aggregate

A layer of gravel used for surfacing and erosion control was observed at the surface approximately 3 inches thick at the location of boring EB-1.

Fill

Existing fill was encountered below the crushed aggregate and directly below the ground surface at the locations of EB-1 and EB-2, respectively. The fill was observed to depths of 9.5 feet in EB-1 and 7 feet in EB-2. The existing fill was observed to be loose to medium dense and consisted of silty sand, some gravel, with abundant organics near the surface and becoming scattered with depth. Medium dense fill soil that are free of excessive quantities of organic debris and other deleterious materials and may be suitable for support of wall foundations. Excavated existing fill is suitable for reuse in structural fill applications if it is free of excessive quantities of organic debris or other deleterious materials and exhibits a moisture content compatible with achieving the specified level of compaction.

Mass Wasting Deposits

The natural sediments encountered below the existing fill in EB-1 and EB-2 generally consisted of medium dense/ very stiff to hard, fine to medium sand with some silt ranging to fine sandy silt with organic inclusions such as rootlets. These sediments displayed a disturbed or blocky texture and indistinct bedding. We interpreted these sediments to be representative of mass-wastage deposits. Mass wastage deposits consist of sediments deposited by past downslope movement of material. The mass-wastage deposits extended beyond the maximum depth explored of approximately 14 feet in EB-1 and EB-2. The medium dense/very stiff to hard mass wasting deposits are considered suitable for the support of the wall foundations.

4.2 Geologic Mapping

Review of the regional geologic map titled *The Geologic Map of Mercer Island, 2006* (K.G. Troost, A.P. Wisher, GeoMapNW, scale 1:12,000) indicates that the area of the subject site is underlain by Vashon advance outwash with pre-Olympia fine-grained glacial deposits mapped to the west. The geologic map also delineates an overprint of mass-wastage deposits, encompassing the subject site and adjacent parcels, and extending along the sloping terrain to the south, west and east of the subject site. Our interpretation of the sediments encountered at the subject site is in partial agreement with the regional geologic map in that we encountered mass-wastage deposits in our exploration borings, we did not encounter Vashon advance outwash.

Review of regional soils mapping (*Soil Survey of King County Area, Washington*, U.S. Department of Agriculture [USDA], Soils Conservation Service [SCS] now referred to as Natural Resources Conservation Service [NRCS]) on the NRCS *Web Soil Survey* indicates that the subject site is underlain by Arents Alderwood material, 6 to 15 percent slopes (AmC).

4.3 Hydrology

Groundwater seepage was not observed within our explorations at the time of drilling (February 8, 2023) within the maximum depths explored of approximately 14 feet. There is a potential for accumulation of perched groundwater within the existing fill atop the underlying fine grained mass wasting deposits. It should be noted that the occurrence and level of groundwater seepage at the site may vary in response to such factors as changes in season, precipitation, and on- and off-site land use.

II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic and ground water conditions as observed and discussed herein. Review of the City of Mercer Island *Geological Hazard Maps* indicates that the subject site lies within an area mapped as containing Erosion, Seismic and Landslide Hazard Areas.

5.0 LANDSLIDE HAZARDS AND RECOMMENDED MITIGATION

Section 19.16.010 of the Mercer Island City Code (MICC) defines Landslide Hazard Areas as the following.

Landslide hazard areas: Those areas subject to landslides based on a combination of geologic, topographic, and hydrologic factors, including:

1. Areas of historic failures;
2. Areas with all three of the following characteristics:
    a. Slopes steeper than 15 percent; and
    b. Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and
    c. Springs or ground water seepage;
3. Areas that have shown evidence of past movement or that are underlain or covered by mass-wastage debris from past movements;
4. Areas potentially unstable because of rapid stream incision and stream bank erosion; or
5. Steep slope. Any slope of 40 percent or greater calculated by measuring the vertical rise over any 30-foot horizontal run.

The subject site classifies as a Landslide Hazard Area because it is underlain by mass wasting deposits. In our opinion, the source of the mass wasting deposits is likely the slope to the northeast, which extends far beyond the subject site property line. The sloping area to the south and east of the subject site is considered a known slide area by the City of Mercer Island as shown on the *Mercer Island Landslide Hazard Assessment* map, with several identified landslide locations mapped across the slope.

5.1 Slope Reconnaissance

We completed a reconnaissance of the onsite slopes at the time of our exploration on February 8, 2023. The following is a summary of our observations.

- During our site reconnaissance, we found no visual evidence of tension cracks, emergent seepage, hummocky topography, or other indications of recent slope instability observed on any of the site slopes. We also observed that the trees located on the sloping area at the west of the project site were generally oriented vertically, suggesting that ongoing, deep-seated slope movement is not occurring at the subject site.
- Inclinations on the slope had changed from the topographic contours shown on Figures 2 and 3, where slope inclinations were approximately 32 percent, to its current condition where fill soils were retained behind cast-in-place concrete walls approximately 4 to 5 feet tall west of the existing residence.
- The toe of the slope in its current condition at the western property boundary is supported by an approximate 4- to 5-foot-high cast-in-place concrete retaining walls (Wall 1 and Wall 2). The vertical relief of the slope is approximately 8 feet from the base of the Wall 1 to the existing residence. The slope has been cleared with the exception of a large conifer with a 1.5’ diameter adjacent to Wall 2 west of the residence
- No springs were observed on the site.

No streams or other surface water bodies subject to streambank erosion, incision, or undercutting by wave action were observed on or adjacent to the property.

5.2 LiDAR Mapping

Light Detection and Ranging (LiDAR) is a remote sensing technology that can be used to generate a detailed expression of ground surface topography even in densely vegetated areas. For this reason, LiDAR-based topographic imagery can be helpful in distinguishing surface features (such as old landslide features) that may otherwise not be easily recognizable. A LIDAR-based shaded relief map of the subject site and surrounding area is included on Figure 4.

Based on our review of the Light Detection and Ranging (LiDAR) image, the slopes leading upward from the area of the subject site, north to the upland include several bowl-shaped slide features, including to the north of the subject site. Given the broad nature of the delineated landslide hazard area upslope of the subject site and neighboring parcels, the ability to mitigate risks associated with landslides occurring along these slopes, based on the relative size of the slope complex as compared to the subject site, is limited.

5.3 Landslide Hazard Mitigation

We anticipate that a concrete cast-in-place walls with conventional spread footings founded on the underlying very stiff/medium dense natural soils or medium dense fill, will provide mitigation for the risk of localized, shallow earth movement of the existing slope west of the residence. Design details for this wall are discussed within the “Design Recommendations” section of this report. This opinion is dependent upon site grading and construction practices being completed in accordance with the geotechnical recommendations presented in this report. There is a moderate risk of shallow landslides and slope erosion occurring on the sloped areas of the property outside the currently planned construction area, this risk can be mitigated by following the drainage and erosion mitigation recommendations contained in this report.

6.0 SEISMIC HAZARDS AND MITIGATION

The following discussion is a general assessment of seismic hazards that is intended to be useful to the project design team in terms of understanding seismic issues, and to the structural engineer for design.

All of Western Washington is at risk of strong seismic events resulting from movement of the tectonic plates associated with the Cascadia Subduction Zone (CSZ), where the offshore Juan de Fuca plate subducts beneath the continental North American plate. The site lies within a zone of strong potential shaking from subduction zone earthquakes associated with the CSZ. The CSZ can produce earthquakes up to magnitude 9.0, and the recurrence interval is estimated to be on the order of 500 years. Geologists infer the most recent subduction zone earthquake occurred in 1700 (Goldfinger et al., 2012[1]). Three main types of earthquakes are typically associated with subduction zone environments: crustal, intraplate, and interplate earthquakes. Seismic records in the Puget Sound region document a distinct zone of shallow crustal seismicity (e.g., the Seattle Fault Zone [SFZ]). These shallow fault zones may include surficial expressions of previous seismic events, such as fault scarps, displaced shorelines, and shallow bedrock exposures. The shallow fault zones typically extend from the surface to depths ranging from 16 to 19 miles. A deeper zone of seismicity is associated with the subducting Juan de Fuca plate. Subduction zone seismic events produce intraplate earthquakes at depths ranging from 25 to 45 miles beneath the Puget Lowland including the 1949, 7.2-magnitude event; the 1965, 6.5-magnitude event; and the 2001, 6.8-magnitude event) and interplate earthquakes at shallow depths near the Washington coast including the 1700 earthquake, which had a magnitude of approximately 9.0. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides or lateral spreading, 3) liquefaction, 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

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[1] Goldfinger, C., Nelson, C.H., Morey, A.E., Johnson, J.E., Patton, J.R., Karabanov, E., Gutierrez-Pastor, J., Eriksson, A.T., Gracia, E., Dunhill, G., Enkin, R.J, Dallimore, A., and Vallier, T.,2012, *Turbidite Event History—Methods and Implications for Holocene Paleoseismicity of the Cascadia Subduction Zone*: U.S. Geological Survey Professional Paper 1661–F, 170.

6.1 Surficial Ground Rupture

Seattle Fault

The site is located within the mapped limits of the SFZ. The SFZ is a broad east – west oriented zone that extends from approximately Issaquah to Alki beach, and is approximately 2.5 to 4 miles in width from north to south. The SFZ is speculated to contain multiple distinct fault "strands", some of which are well understood and some of which may be poorly understood or unknown. Mapping of individual fault strands is imprecise, as a result of pervasive modification of the land surface by development, which has obscured possible surficial expression of past seismic events. Studies by the U.S. Geological Survey and others have provided evidence of surficial ground rupture along strands of the Seattle Fault (USGS, 2010[2]; Pratt et al., 2015[3]; Haugerud, 2005[4]; Liberty et al., 2008[5]). According to USGS studies the latest movement of this fault was about 1,100 years ago when about 20 feet of surficial displacement took place. This displacement can presently be seen in the form of raised, wave-cut beach terraces along Alki Point in West Seattle and Restoration Point at the south end of Bainbridge Island. Based on our review of the Washington State Department of Natural Resources (WADNR) *Geologic Information Portal*, inferred fault traces associated with the SFZ are located about 500 feet south of the site. Due to the suspected long recurrence interval, the potential for surficial ground rupture along the SFZ is considered to be low during the expected life of the proposed structure.

6.2 Seismically Induced Landslides

Based on the topographic and subsurface conditions present, it is our opinion that the risk of damage to the subject project by seismically induced landsliding is low. Landslide hazards were discussed in greater detail in the Landslide Hazards and Mitigation section of this report.

6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil

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[2] U.S. Geological Survey, 2010, Quaternary fault and fold database for the United States, accessed November 10, 2010, from USGS web site: http://earthquake.usgs.gov/hazards/qfaults/

[3] Pratt, et al., 2015, Kinematics of shallow backthrusts in the Seattle fault zone, Washington State: Geosphere, v. 11, no. 6, p. 1-27).

[4] Haugerud, R.A., 2005, Preliminary geologic map of Bainbridge Island, Washington: U.S. Geological Survey Open-File Report 2005-1387, version 1.0, 1 sheet, scale 1:24,000.

[5] Liberty, Lee M.; Pratt, Thomas L., 2008, Structure of the eastern Seattle fault zone, Washington State -New insights from seismic reflection data: Bulletin of the Seismological Society of America, v. 98, no. 4, p. 1681-1695.

shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain loose to medium dense, sand and coarse silt accompanied by a shallow water table. It is our opinion that the risk of damage to the existing residence and site improvements by liquefaction is low based on the fine-grained texture of the natural sediments underlying the site, their high relative consistency, and the lack of adverse groundwater conditions. No mitigation of liquefaction is warranted.

6.4 Ground Motion

Structural design of the walls should follow 2018 International Building Code (IBC) standards. We recommend that the project be designed in accordance with Site Class "D" as defined in IBC Table 20.3-1 of *American Society of Civil Engineers* (ASCE) *7 - Minimum Design Loads for Buildings and Other Structures*.

7.0 EROSION HAZARDS AND MITIGATION

The sediments which underly the subject site contain significant quantities of silt and fine sand and are considered to be highly sensitive to disturbance when wet and erosion where it is present below sloping areas. The NRCS has mapped the soils on the site as Arents Alderwood material. The NRCS erosion hazard rating of this soil type is "moderate to severe" and therefore does not classify as an Erosion Hazard Area under the *Mercer Island City Code,* the onsite material contained a significant portion of fine material which can be sensitive to erosion.

In order to mitigate erosion hazards and the potential for off-site sediment transport, we recommend the following best management practices (BMPs):

1. To the extent practical, earthwork should be avoided during the wet season, October 1st through April 30th. In addition to the increased risk of erosion hazards during this timeframe, the City of Mercer Island requires a Seasonal Development Limitation Waiver for land clearing, grading, filling and foundation work taking place within an Erosion, Potential Slide, or Steep Slope Hazard area between October 1st and April 1st.

2. The winter performance of a site is dependent on a well-conceived plan for control of site erosion and stormwater runoff. The site plan should include ground-cover measures and staging areas. The contractor should be prepared to implement and maintain the required measures to reduce the amount of exposed ground.

3. Temporary erosion and sedimentation control (TESC) elements and perimeter flow control should be established prior to the start of grading.

4. During the wetter months of the year, or when significant storm events are predicted during the summer months, the work area should be stabilized so that if showers do occur, it can receive the rainfall without excessive erosion or sediment transport. The stabilization process should include establishing temporary stormwater conveyance channels through work areas to route runoff to the approved treatment/discharge facilities.

5. All areas of disturbed soil should be revegetated as soon as possible. If it is outside of the growing season, the disturbed areas should be covered with mulch. Straw mulch provides a cost-effective cover measure and can be made wind-resistant with the application of a tackifier after it is placed.

6. Surface runoff and discharge should be controlled during and following development. Uncontrolled discharge may promote erosion and sediment transport.

7. Soils that are to be reused around the site should be stored in such a manner as to reduce erosion from the stockpile. Protective measures may include, but are not limited to, covering stockpiles with plastic sheeting, or the use of silt fences around pile perimeters.

It is our opinion that with the proper implementation of the TESC plans and by field-adjusting appropriate erosion mitigation (BMPs) throughout construction, the potential adverse impacts from erosion hazards on the project may be mitigated. In our opinion, erosion control practices in place at the site at the time of our site visit were suitable for the site conditions.

8.0 STATEMENT OF RISK

Section 19.07.160.B.3 of the Mercer Island City Coderequires a statement of risk by the geotechnical engineer. It is Associated Earth Sciences, Inc.'s (AESI's) opinion that provided that the recommendations contained in this report are followed, the development practices proposed for the alteration would render the development as safe as if it were not located in a geologic hazard area and do not adversely impact adjacent properties.

III. DESIGN RECOMMENDATIONS

9.0 INTRODUCTION

It is our opinion that, from a geotechnical standpoint, the site is suitable for the subject project provided that the recommendations contained herein are properly followed. The near-surface soils consist of loose to medium dense existing fill with medium dense mass wasting deposits observed below. Foundation loads from the retaining Wall 1 appear to be founded on medium dense to very stiff/hard mass wasting deposits which were observed below the wall foundation to the south as well as at a depth of approximately 9.5 feet in EB-1 which correlates with the foundation elevation of Wall 1. Walls 2 through 6 appear to be founded on existing medium dense fill, mass wasting deposits were encountered at depths deeper than the observed wall foundation elevations.

10.0 SITE PREPARATION

It is our understanding that grading for the project has largely been completed, but some additional work may occur. The following sections provide recommendations for site preparation in those areas of the site where additional grading will be conducted.

Site preparation should include removal of all vegetation, topsoil, and any other deleterious materials. Any depressions below planned final grades resulting from demolition activities should be backfilled with structural fill, as discussed under the “Structural Fill” section of this report. After stripping of the surficial sod/topsoil horizon has been completed, any remaining roots and stumps should be removed from structural areas. All soils disturbed by stripping and grubbing operations should be recompacted as described below for structural fill.

10.1 Site Drainage and Surface Water Control

The site should be graded to prevent water from ponding in construction areas and/or flowing into excavations. Exposed grades should be crowned, sloped, and smooth drum-rolled at the end of each day to facilitate drainage. Accumulated water must be removed from subgrades and work areas immediately prior to performing further work in the area. Equipment access will be limited, and the amount of soil rendered unfit for use as structural fill may be greatly increased, if drainage efforts are not accomplished in a timely sequence.

Final exterior grades should always promote free and positive drainage away from the existing residence and site improvements. Water must not be allowed to pond or to collect adjacent to foundations or within the immediate building area.

10.2 Subgrade Protection

Consideration should be given to protecting access and staging areas with an appropriate section of crushed rock. Placement of an engineering stabilization fabric (such as Mirafi® 500X or approved equivalent) below the rock will reduce the potential of fine-grained materials pumping up through the crushed rock during wet weather and turning the area to mud. The fabric will also aid in supporting construction equipment, thus reducing the amount of crushed rock required. Crushed rock used for access and staging areas should have a particle size of at least 2 inches.

10.3 Subgrade Compaction

Following the recommended clearing, site stripping, and planned excavation, the stripped subgrade should be observed by the geotechnical engineer prior to structural fill placement to identify any soft/loose yielding soils or existing fills. If any loose natural sediments are encountered the contractor should attempt to recompact the subgrade to a firm and unyielding state. If loose/soft, yielding natural sediments or fill soils are encountered, they should be removed to a stable subgrade. The subgrade should then be recompacted to a firm and unyielding condition. Low areas and excavations may then be raised to the planned finished grade with compacted structural fill. Subgrade preparation and selection, placement, and compaction of structural fill should be performed under engineering-controlled conditions in accordance with the project specifications.

10.4 Wet Weather Conditions

Since site soils are moisture-sensitive and the site is located in a Landslide Hazard Area, we recommend that wet season construction be avoided if practical. If construction does proceed during an extended wet weather construction period, the moisture-sensitive site soils may become easily disturbed and too wet to use for structural fill. In addition to the City of Mercer Island requires a Seasonal Development Limitation Waiver for land clearing, grading, filling and foundation work taking place within an Erosion, Potential Slide, or Steep Slope Hazard area between October 1st and April 1st.

10.5 Temporary and Permanent Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction based on the local conditions encountered at that time. For planning purposes, we anticipate that temporary, unsupported cut slopes in areas of existing fill or very still mass-wastage sediments can be made at a maximum slope of 1.5H:1V (Horizontal:Vertical). Temporary, unsupported cut slopes within the dense or very stiff glacially consolidated sediments can be planned at a maximum slope of 1H:1V. Temporary vertical cuts up to 4 feet in height may be planned in all of these materials. Flatter inclinations may be recommended in areas of seepage. As is typical with earthwork operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. In addition, WISHA/OSHA regulations should be followed at all times.

Permanent cut and structural fill slopes should not exceed an inclination of 2H:1V.

10.6 Frozen Subgrades

If earthwork takes place during freezing conditions, all exposed subgrades should be allowed to thaw and then be recompacted prior to placing subsequent lifts of structural fill. Alternatively, the frozen material could be stripped from the subgrade to reveal unfrozen soil prior to placing subsequent lifts of fill. The frozen soil should not be reused as structural fill until allowed to thaw and adjusted to the proper moisture content, which may not be possible during winter months.

11.0 STRUCTURAL FILL

Placement of structural fill may be necessary to establish desired grades in some areas or to backfill utility trenches. All references to structural fill in this report refer to subgrade preparation, fill type, and placement and compaction of materials as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

11.1 Subgrade Compaction

After overexcavation/stripping has been performed to the satisfaction of the geotechnical engineer/engineering geologist, the exposed ground should be recompacted to a firm and unyielding condition. If the subgrade contains too much moisture, suitable recompaction may be difficult or impossible to attain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below.

After the exposed ground is approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades.

10.2 Structural Fill Compaction

Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to at least 95 percent of the modified Proctor maximum dry density using *ASTM International* (ASTM) D-1557 as the standard. Utility trench backfill should be placed and compacted in accordance with applicable municipal codes and standards. The top of the compacted fill should extend horizontally a minimum distance of 3 feet beyond footings or pavement edges before sloping down at an angle no steeper than 2H:1V. Fill slopes should either be overbuilt and trimmed back to final grade or surface-compacted to the specified density.

11.3 Moisture-Sensitive Fill

Soils in which the amount of fine-grained material (smaller than No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. The use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions. Excavated portions of the granular, onsite sediments, including the existing fill, are suitable for use as structural fill provided that they are free of roots, oversized rocks, and other deleterious materials and exhibit a moisture content at the time of construction compatible with achieving the recommended compaction specification. Because most of the onsite soils consist predominantly of silt, compaction of these sediments to the recommended minimum density will only be achievable over a narrow range of moisture contents and use of these materials for structural fill is not recommended. Maximum rock size for structural fill applications should be limited to diameters of approximately 6 inches or less.

Construction equipment traversing the site when the silty on-site sediments are very moist or wet can cause considerable disturbance. If fill is placed during wet weather or if proper compaction of the natural materials cannot be attained, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction.

11.4 Structural Fill Testing

The contractor should note that any proposed fill soils must be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material at least 3 business days in advance to perform a Proctor test and determine its field compaction standard.

A representative from our firm should observe the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses and any problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid the owner in developing a suitable monitoring and testing frequency.

12.0 FOUNDATIONS

Conventional spread footings may be used for wall support when founded either directly on the medium dense fill soils or the very stiff/ medium dense mass wasting deposits when properly prepared as described in this report, or on structural fill placed over these materials. Where loose fill soils underlie foundation areas, we recommend that the exposed, loose material be removed to reach the medium dense/ very stiff soils, the exposed subgrade should then be compacted in-place to a firm and unyielding condition prior to structural fill placement or foundation construction.

Spread footings that are supported on the mass wasting deposits, medium dense fill or on new structural fill as defined above, may be designed with an allowable foundation soil bearing pressure of 2,000 pounds per square foot (psf), including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading.

Footings should be buried stratum at least 18 inches into the surrounding soil for frost protection. However, all footings must penetrate to the prescribed bearing, and no footing should be founded in or above organic or loose soils. All footings should have a minimum width of 18 inches.

Anticipated settlement of footings founded on the native sediments and/or medium dense are estimated to be on the order of 1 inch or less, with differential settlements of approximately one-half of the total. However, disturbed or loose soil not removed from foundation excavations prior to concrete placement could result in increased settlements. All footing areas should be observed by AESI prior to placing forms, rebar, and concrete to verify that the design bearing capacity of the soils has been attained, including areas that required in-place compaction due to loose native sediments, and that construction conforms to the recommendations contained in this letter-report. A foundation drainage system should be provided, as discussed under the “Drainage Considerations” section of this letter-report.

13.0 LATERAL WALL PRESSURES

All backfill behind retaining walls or around foundation units should be placed as per our recommendations for structural fill and as described in this section of the report. Onsite walls at the time of our visit were horizontally backfilled, horizontally backfilled retaining walls that are free to yield laterally at least 0.1 percent of their height may be designed using an equivalent fluid equal to 35 pounds per cubic foot (pcf). This equivalent fluid pressure is based on drained soil conditions. Alternatively, the wall may be designed for saturated earth pressure conditions using and equivalent fluid pressure of 80 pounds per cubic foot (pcf).

In accordance with the 2018 IBC, permanent retaining wall design should include seismic design parameters. Based on the site soils and assumed wall backfill materials, we recommend a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. A rectangular pressure distribution of 11H and 14H psf (where H is the height of the wall in feet) should be included in design for "active" and "at-rest" loading conditions, respectively. The resultant of the rectangular seismic surcharge should be applied at the midpoint of the walls.

The lateral pressures presented above are based on the conditions of a uniform horizontal backfill consisting of the on-site, mass wasting deposits or existing fill compacted to 90 percent of ASTM:D 1557. A higher degree of compaction is not recommended, as this will increase the pressure acting on the wall.

Footing drains should be provided for all retaining walls, as discussed under the "Drainage Considerations" section of this report. It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against the walls. This would involve installation of a minimum, 1-foot-wide blanket drain to within 1 foot of the ground surface using imported, washed gravel against the walls placed to be continuous with the footing drain. If drainage is not present behind the walls the alternative saturated earth pressure may be used instead.

13.1 Passive Resistance and Friction Factors

Lateral loads can be resisted by friction between the foundation and the supporting sediments, or by passive earth pressure acting on the buried portions of the foundations. The foundations must either be backfilled with compacted structural fill or cast directly against the medium dense to very still/hard natural sediments to achieve the passive resistance provided below. We recommend the following design parameters:

- Passive equivalent fluid = 200 pcf
- Coefficient of friction = 0.30

The above values are allowable.

14.0 DRAINAGE CONSIDERATIONS

All retaining walls should be provided with a drain at the base of the footing elevation. Drains should consist of rigid, perforated, polyvinyl chloride (PVC) pipe surrounded by washed pea gravel. The level of the perforations in the pipe should be set at or slightly below the bottom of the footing, and the drains should be constructed with sufficient gradient to allow gravity discharge away from the building. In addition, all cast-in-place retaining walls should be lined with a minimum, 12-inch-thick, washed gravel blanket that extends to within 1 foot of the surface and is continuous with the foundation drain, unless designed for the saturated earth pressure as discussed in section 13.0 "Lateral Wall Pressures". Roof and surface runoff should not discharge into the foundation drain system, but should be handled by a separate, rigid, tightline drain.

15.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

We are available to provide geotechnical engineering and monitoring services during construction. The City of Mercer Island will likely require geotechnical special inspections during construction. The integrity of the wall depends on proper site preparation and construction procedures. Engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this current scope of work. If these services are desired, please let us know, and we will prepare a proposal.

We have enjoyed working with you on this study and are confident that these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Brendan Young

Brendan Young, L.G.
Senior Staff Geologist

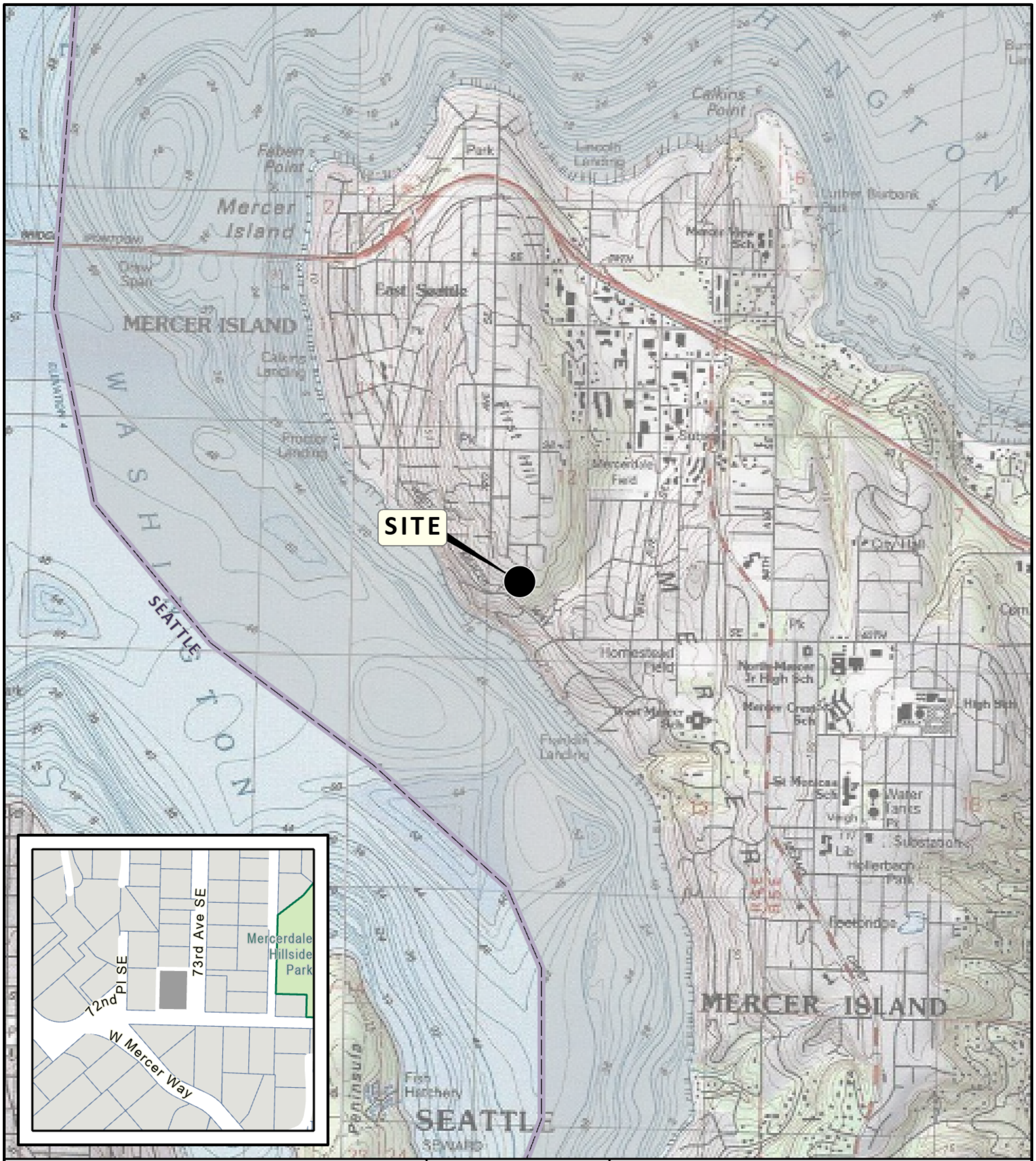
Matthew A. Miller
30284
03/13/2023

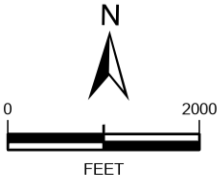
Timothy J. Peter

Timothy J. Peter, L.E.G., L.Hg.
Senior Engineering Geologist

Matthew A. Miller, P.E.
Principal Geotechnical Engineer

Attachments:	Figure 1:	Vicinity Map
	Figure 2:	Existing Site and Exploration Plan
	Figure 3:	Existing Wall Locations
	Figure 4:	Existing Site on LiDAR
	Appendix:	Exploration Logs





DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NGS 2013
KING CO: STREETS 5/22, PARCELS 4/22, CITY LIMITS, PARKS 9/21
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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VICINITY MAP

ARVIND RESIDENCE
KING COUNTY, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20220409E001	3/23	1

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LEGEND

🟨 SITE

● EXPLORATION BORING

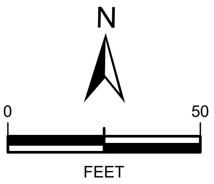
☐ PARCEL

— CONTOURS 2 FT

— CONTOURS 10 FT

TOPOGRAPHIC CONTOURS REPRESENT PRE-CONSTRUCTION CONDITIONS

DATA SOURCES / REFERENCES:
WADNR WGS: WA LIDAR PORTAL
KING CO. 2021, USGS 3DEP, GRID CELL SIZE 1.5', FLOWN 4/2021
CONTOURS DERIVED FROM LIDAR
KING CO: STREETS, PARCELS, 4/22
AERIAL: PICTOMETRY INT. 2021
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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EXISTING SITE AND EXPLORATION PLAN

ARVIND RESIDENCE
KING COUNTY, WASHINGTON

PROJ NO. 20220409E001

DATE: 3/23

FIGURE: 2

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LEGEND

▭ SITE	▭ PARCEL
● EXPLORATION BORING	CONTOURS 2 FT
RETAINING WALL ALIGNMENT	CONTOURS 10 FT

TOPOGRAPHIC CONTOURS REPRESENT PRE-CONSTRUCTION CONDITIONS

DATA SOURCES / REFERENCES:
WADNR WGS: WA LIDAR PORTAL
KING CO. 2021, USGS 3DEP, GRID CELL SIZE 1.5', FLOWN 4/2021
CONTOURS DERIVED FROM LIDAR
KING CO: STREETS, PARCELS, 4/22
AERIAL: PICTOMETRY INT. 2021
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

N

0 50
FEET

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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EXISTING WALL LOCATIONS

ARVIND RESIDENCE
KING COUNTY, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20220409E001	3/23	3

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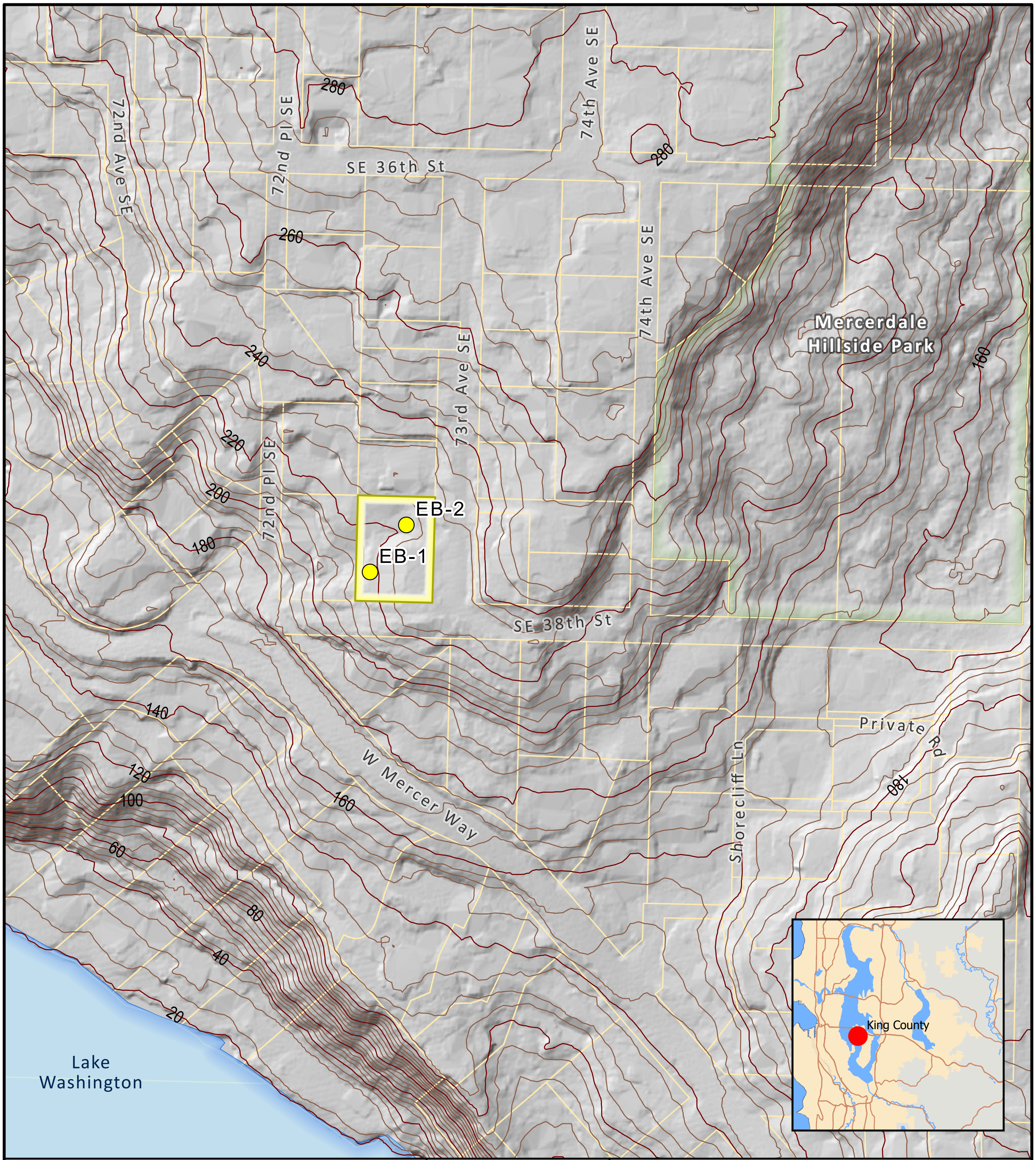


LEGEND

▭ SITE

● EXPLORATION BORING

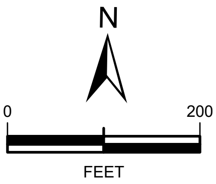
▭ PARCEL

🟩 PARK

— CONTOURS 5 FT

— CONTOURS 20 FT

DATA SOURCES / REFERENCES:
WADNR WGS: WA LIDAR PORTAL
KING CO. 2021, USGS 3DEP, GRID CELL SIZE 1.5', FLOWN 4/2021
CONTOURS DERIVED FROM LIDAR
KING CO: STREETS, PARCELS, 4/22
AERIAL: PICTOMETRY INT. 2021
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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EXISTING SITE ON LIDAR

ARVIND RESIDENCE
KING COUNTY, WASHINGTON

PROJ NO. 20220409E001

DATE: 3/23

FIGURE: 4

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APPENDIX

Exploration Logs

Coarse-Grained Soils - More than 50%(1) Retained on No. 200 Sieve	Gravels - More than 50%(1) of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines(5)	▨	**GW**	Well-graded gravel and gravel with sand, little to no fines
			▨	**GP**	Poorly-graded gravel and gravel with sand, little to no fines
		≥12% Fines(5)	▨	**GM**	Silty gravel and silty gravel with sand
			▨	**GC**	Clayey gravel and clayey gravel with sand
	Sands - 50%(1) or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines(5)	▨	**SW**	Well-graded sand and sand with gravel, little to no fines
			▨	**SP**	Poorly-graded sand and sand with gravel, little to no fines
		≥12% Fines(5)	▨	**SM**	Silty sand and silty sand with gravel
			▨	**SC**	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50%(1) or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		▨	**ML**	Silt, sandy silt, gravelly silt, silt with sand or gravel
			▨	**CL**	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			▨	**OL**	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		▨	**MH**	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			▨	**CH**	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			▨	**OH**	Organic clay or silt of medium to high plasticity
Highly Organic Soils			▨	**PT**	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT(2) blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

	Consistency	SPT(2) blows/foot
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

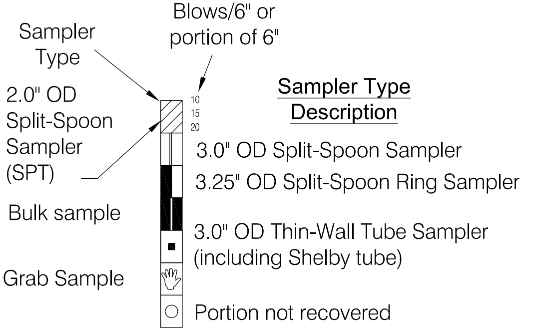
(3) Estimated Percentage

Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

Moisture Content

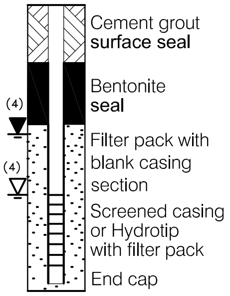
Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols



Sampler Type Description

- 3.0" OD Split-Spoon Sampler
- 3.25" OD Split-Spoon Ring Sampler
- 3.0" OD Thin-Wall Tube Sampler (including Shelby tube)
- Portion not recovered



(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)

(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

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EXPLORATION LOG KEY

FIGURE A1

blocks \ dwg \ log_key.dwg LAYOUT: Layout 4 -2014 Qty Chng associated earth sciences incorporated

Exploration Boring

EB-1

Arvind Residence

Sheet: 1 of 1

Mercer Island, WA	Start Date: 2/8/23	Logged By: BCY
20220409E001	Ending Date: 2/8/23	Approved By: JHS

Driller/Equipment: CN Drilling/Acker H.S.A.
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 4
▼ Groundwater Depth ATD (ft): Not encountered

Total Depth (ft): 14
Ground Surface Elevation (ft): ≈219
Datum: NAVD88
▽ Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot 10 20 30 40 50+	Other Tests
0		1			**Gravel - 3 inches** **Fill** Very moist, brown to tan, silty, fine SAND, some gravel; abundant organics (rootlets/tree debris); occasional construction debris (tarp) (SM).		2 2 3	5	
2.5		2			Very moist, brown to dark brown, silty to very silty, fine SAND, some gravel; abundant organics (roots/rootlets/other fine organics); occasional construction debris (brick) (SM). Driller added water to move past gravel.		1 1 2	3	
5		3			Slightly moist to moist, brown becoming tan with depth, silty, fine SAND, some gravel; poor recovery. (SM).		8 13 14	27	
7.5		4			No recovery; driller notes large cobbles from 5 to 7.5 feet.		7 9 8	17	
10		5			**Mass Wasting Deposits** Slightly moist, tan with occasional gray and faint oxidation staining, fine sandy, SILT; rare rootlet; massive (ML).		5 9 16	25	
12.5		6			Slightly moist, tannish gray, very silty, fine SAND to fine sandy, SILT; rare rootlet; rare lense of gray silt; blocky texture (SM/ML).		6 14 20	34	
					No groundwater encountered.				
15									
17.5									

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Exploration Boring **EB-2**

Arvind Residence — Sheet: 1 of 1

Mercer Island, WA	Start Date: 2/8/23	Logged By: BCY
20220409E001	Ending Date: 2/8/23	Approved By: JHS

Driller/Equipment: CN Drilling/Acker H.S.A.
Hammer Weight/Drop: 140#/30"
Hole Diameter (in): 4
▼ Groundwater Depth ATD (ft): Not encountered

Total Depth (ft): 14
Ground Surface Elevation (ft): 222
Datum: NAVD88
▽ Groundwater Depth Post Drilling (ft) (Date): ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
0		1			**Fill** Moist, brown, silty, fine to medium SAND, some gravel; inclusions of gray sand; occasional organics (rootlets) (SM).		2 2 6	8	
2.5		2			Moist, brown to dark brown, silty, fine to medium SAND, some gravel; scattered organics; poor recovery (SM).		1 4 5	9	
5		3			Moist, tan, silty, fine SAND; occasional inclusions of dark brown, silty, fine SAND; poor recovery (SM). Driller notes pushing rock.		4 6 8	14	
7.5		4			**Mass Wasting Deposits** Moist, brown to tan brown with minor oxidation staining, fine to medium SAND, some silt, some gravel; inclusions of gray silt (SM).		10 12 13	25	
10		5			Moist, tan mixed with gray, fine sandy, SILT; some organics (rootlets); blocky texture (ML).		5 6 17	23	
12.5		6			Slightly moist to moist, gray, SILT, some fine sand; blocky texture; fractured along angular planes (ML).		6 12 15	27	
					No groundwater encountered.				
15									
17.5									