Associated Earth Sciences, Inc.

Serving the Pacific Northwest Since 1981

August 8, 2012
Project No. KE120280A

Select Homes, Inc.
16531 13th Avenue West, Suite A-107
Lynnwood, Washington 98037

Attention: Mr. Craig Pierce

Subject: Subsurface Exploration, Geologic Hazard, and
Geotechnical Engineering Report
Eaglemont
Monroe, Washington

Dear Mr. Pierce:

We are 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 recommendations for the preliminary design and development of the proposed project. Our recommendations are preliminary in that construction details have not been finalized at the time of this report.

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

Jon N. Sondergaard, L.G., L.E.G.
Senior Principal Geologist

CITY OF MONROE
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EXHIBIT# M4

Associated Earth Sciences, Inc.

Serving the Pacific Northwest Since 1981

Subsurface Exploration, Geologic Hazard, and
Geotechnical Engineering Report

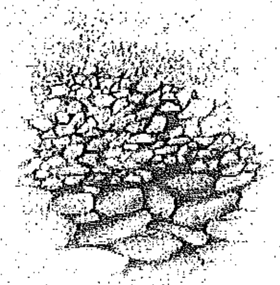
EAGLEMONT

Monroe, Washington

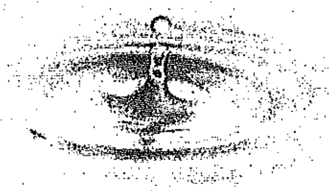
Prepared for

Select Homes, Inc.

Project No. KE120280A
August 8, 2012



Geotechnical Engineering



Water Resources

Environmental Assessments and Remediation

Sustainable Development Services

Geologic Assessments

SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, AND GEOTECHNICAL ENGINEERING REPORT

EAGLEMONT

Monroe, Washington

Prepared for:
Select Homes, Inc.
16531 13th Avenue West, Suite A-107
Lynnwood, Washington 98037

Prepared by:
Associated Earth Sciences, Inc.
911 5th Avenue, Suite 100
Kirkland, Washington 98033
425-827-7701
Fax: 425-827-5424

August 8, 2012
Project No. KE120280A

I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of Associated Earth Sciences, Inc.'s (AESI's) subsurface exploration, geologic hazard, and geotechnical engineering study for Eaglemont, located on 197th Avenue SE off of Chain Lake Road in Monroe, Washington (Figure 1). The site boundaries, topographic contours, the proposed lot and road layout, and the approximate locations of the explorations accomplished for this study are presented on the "Site and Exploration Plan," Figure 2.

The recommendations in this report are considered to be preliminary because construction details were not finalized at the time of this study. Once development plans are substantially complete, the conclusions and recommendations in this report should be reviewed and modified, or verified, as appropriate.

1.1 Purpose and Scope

The purpose of this study was to provide subsurface data to be used in the preliminary design and development of the subject project. Our study included a review of available geologic literature, excavating seven exploration pits, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow ground water conditions. Geotechnical engineering studies were also conducted to assess the type of suitable foundation, allowable foundation soil bearing pressures, temporary cut slope recommendations, anticipated settlements, basement/retaining wall lateral pressures, floor support recommendations, and drainage recommendations. This report summarizes our current fieldwork and offers development recommendations based on our present understanding of the project.

1.2 Authorization

Written authorization to proceed with this study was granted by Mr. Randy Clark of Select Homes, Inc. Our study was accomplished in general accordance with our proposal dated July 6, 2012. This report has been prepared for the exclusive use of Select Homes, Inc., 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

2.1 Site and Project Description

The subject site consists of an irregular-shaped parcel of approximately 35 acres. The property straddles 197th Avenue SE between Rainier View Road and Chain Lake Road in Monroe, Washington. The location of the subject site is shown on the "Vicinity Map," Figure 1. With the exception of a couple of extremely dilapidated, unoccupied buildings, the property is undeveloped and vegetated by mixed coniferous/deciduous forest with thick natural brush. The northern portion of the property is relatively flat-lying, but becomes gently to moderately sloping down toward the south in the southern portion of the site. Review of topographic contours shown on the attached "Site and Exploration Plan" indicate that slope inclinations in the southern portion of the site range from approximately 5 to 25 percent.

It is our understanding that project plans include subdividing the property into 149 residential parcels and constructing single-family homes on the lots with associated roads and utilities. The proposed lot and road layout is shown on the "Site and Exploration Plan," Figure 2.

3.0 SUBSURFACE EXPLORATION

Our field study included excavating a series of ten exploration pits to gain subsurface information about the site. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented in the Appendix. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types. Our explorations were approximately located in the field relative to known site features shown on the attached site plan.

The conclusions and recommendations presented in this report are based, in part, on the exploration pits completed for this study. The number, 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. Due to the random nature of deposition and the alteration of topography by past grading and/or filling, subsurface conditions may vary outside of the areas of the explorations. The nature and extent of any variations between the field explorations may not become fully evident until construction. If variations in subsurface conditions are observed at the time of construction, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

3.1 Exploration Pits

Exploration pits were excavated with a small track-mounted excavator. The pits permitted direct, visual observation of subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by an engineering geologist from our firm. Selected samples were then transported to our laboratory for further visual classification and testing, as necessary.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the explorations completed for this study, our visual reconnaissance of the site, and review of applicable geologic literature. As shown on the exploration logs, the exploration pits generally encountered granular glacial sediments with high quantities of silt and moderate to high quantities of gravel. The following section presents more detailed subsurface information organized from the shallowest (youngest) to the deepest (oldest) sediment types.

4.1 Stratigraphy

Topsoil

An organic topsoil layer capped with either sod or forest duff was encountered at each of the exploration locations. The topsoil layer ranged in thickness from approximately 6 to 12 inches. Because of its relatively loose condition and high organic content, the topsoil is not considered suitable for foundation support or for use in a structural fill.

Vashon Lodgment Till

Sediments encountered directly below the topsoil layer at each of the exploration pit locations generally consisted of an unsorted mixture of loose to medium dense, reddish brown to tan, silty sand with gravel and scattered cobbles and boulders. Below depths ranging from approximately 2 to 4 feet, these sediments became dense to very dense and grayish tan. We interpret these sediments to be representative of Vashon lodgment till. The Vashon lodgment till consists of an unsorted mixture of silt, sand, and gravel that was deposited directly from basal, debris-laden glacial ice during the Vashon Stade of the Fraser Glaciation, approximately 12,500 to 15,000 years ago. The high relative density characteristic of the lodgment till is due to its consolidation by the massive weight of ice from which it was deposited. The reduced density and reddish brown to tan coloration observed in the upper portion of the till is interpreted to be due to weathering. At the locations of our explorations, the Vashon till extended beyond the maximum depths explored of approximately 5 to 6 feet.

Review of the regional geologic map of the area titled *Geologic Map of the Skykomish River 30- by 60-Minute Quadrangle, Washington*, compiled by Tabor, Frizzell, Booth, Waitt, Whetten, and Zartman (1993) indicates that the area of the project site is underlain by Vashon lodgment till. Our interpretation of the sediments encountered in our explorations is in agreement with the regional geologic map.

4.2 Hydrology

Thin zones of slow, perched, ground water seepage were encountered within the till at the locations of exploration pits EP-5 and EP-8 at depths of approximately 3 feet and 4 feet, respectively. At the locations of exploration pit EP-5, the seepage was present at the base of the weathered till horizon. At the location of exploration pit EP-8, the seepage was limited to a thin, sandy zone within the till at a depth of approximately 4 feet. It should be noted that the occurrence and level of ground water seepage at the site may vary in response to such factors as changes in season, amount of precipitation, and site use.

II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic, slope, and shallow ground water conditions as observed and discussed herein and our review of the *City of Monroe Municipal Code* (MMC) for Critical Areas Title 20.05.

5.0 SEISMIC HAZARDS AND MITIGATIONS

Earthquakes occur in the Puget Lowland with great regularity. The vast majority of these events are small and are usually not felt by people. However, large earthquakes do occur, as evidenced by the 1949, 7.2-magnitude event; the 2001, 6.8-magnitude event; and the 1965, 6.5-magnitude event. 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 in the Puget Sound area 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, 3) liquefaction, and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below. In our opinion, the site is not a seismic hazard area according to MMC 20.05.

5.1 Surficial Ground Rupture

The nearest known fault traces to the project site are the South Whidbey Island Fault Zone (SWIFZ), located approximately 13 miles southwest of the site, and the Seattle Fault Zone, located approximately 19 miles to the south.

A 2005 study by the U.S. Geological Survey (USGS) (Sherrod, et al. 2005, *Holocene Fault Scarps and Shallow Magnetic Anomalies Along the Southern Whidbey Island Fault Zone near Woodinville, Washington*, Open-File Report 2005-1136, March 2005) reported that "strong" evidence of prehistoric earthquake activity has been observed along two fault strands thought to be part of the southeastward extension of the SWIFZ. The study suggests as many as nine earthquake events along the SWIFZ may have occurred within the last 16,400 years. The recognition of this fault splay is relatively new, and data pertaining to it are limited with the studies still ongoing. The recurrence interval of movement along this fault system is still unknown, although it is hypothesized to be in excess of one thousand years.

Studies of the Seattle Fault Zone by the USGS (e.g., Johnson, et al. 1994, *Origin and Evolution of the Seattle Fault and Seattle Basin, Washington*, Geology, v. 22, pp. 71-74; and Johnson, et al. 1999, *Active Tectonics of the Seattle Fault and Central Puget Sound*

Washington - Implications for Earthquake Hazards, Geological Society of America Bulletin, July 1999, v. 111, n. 7, pp. 1042-1053) have provided evidence of surficial ground rupture along a northern splay of the Seattle Fault. According to the 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. The recurrence interval of movement along this fault system is still unknown, although it is hypothesized to be in excess of several thousand years.

Due to the suspected long recurrence intervals for both fault zones, the potential for surficial ground rupture is considered to be low during the expected life of the proposed structures.

5.2 Seismically Induced Landslides

It is our opinion that the risk of damage to the proposed structures by landsliding under both static and seismic conditions is low due to the lack of steep slopes on the subject site and adjoining areas. No mitigation of landslide hazards is warranted. In our opinion, the site is not a landslide hazard area according to MMC 20.05.

5.3 Liquefaction

It is our opinion that the sediments underlying the site present a low risk of liquefaction due their dense state and the lack of adverse ground water conditions. No mitigation of liquefaction hazards is warranted.

5.4 Ground Motion

Structural design of the building should follow 2009 *International Building Code* (IBC) standards using Site Class "C" as defined in Table 1613.5.2. The 2009 IBC seismic design parameters for short period (S_S) and 1-second period (S_1) spectral acceleration values were determined from the latitude and longitude of the project site using the USGS National Seismic Hazard Mapping Project website (http://earthquake.usgs.gov/hazmaps/). These values are based on Site Class "B". Based on the more current 2002 data, the USGS website interpolated ground motions at the project site to be 1.092g and 0.367g for building periods of 0.2 and 1.0 seconds, respectively, with a 2 percent chance of exceedance in 50 years. These values correspond to site coefficients $F_a = 1.00$ and $F_v = 1.433$, and a peak horizontal acceleration of 0.29g. The F_a, F_v, and peak horizontal acceleration values have been corrected for Site Class "C" in accordance with the IBC.

6.0 EROSION HAZARDS AND MITIGATIONS

The natural glacial sediments underlying the site generally contain a high percentage of silt and fine sand and are sensitive to erosion; however, the potential for erosion at the site is moderated by the fairly flat topography. In order to control erosion and reduce the amount of sediment transport off the site during construction, the following recommendations should be followed.

1. Properly embedded silt fencing should be placed around the lower perimeter of the cleared area(s). The fencing should be periodically inspected and maintained, as necessary, to ensure proper function.

2. The construction entrance should be stabilized with gravel pads to minimize tracking sediment off-site.

3. If possible, construction should proceed during the drier periods of the year.

4. Areas stripped of vegetation during construction should be mulched and hydroseeded, replanted as soon as possible, or otherwise protected. During winter construction, hydroseeded areas should be covered with clear plastic to facilitate grass growth.

5. If excavated soils are to be stockpiled on the site for reuse, measures should be taken to reduce the potential for erosion from the stockpile. These could include, but are not limited to, limiting stockpiled soil to the flatter areas of the site, covering stockpiles with plastic sheeting, and the use of straw bales/silt fences around pile perimeters.

Review of the U.S. Department of Agriculture Natural Resources Conservation Service (formerly known as the Soil Conservation Service) soil survey for the subject area, indicates that mapped soil types for the site include Tokul gravelly loam, 0 to 8 percent slopes, and Tokul gravelly loam 8 to 15 percent slopes. The mapped soil types are consistent with the sediments encountered in our explorations. Given presence of this soil type, the site does not classify as an erosion hazard area under MMC 20.05

III. PRELIMINARY DESIGN RECOMMENDATIONS

7.0 INTRODUCTION

Our exploration indicates that, from a geotechnical standpoint, the parcel is suitable for the proposed development provided the recommendations contained herein are properly followed. The foundation bearing stratum is relatively shallow and conventional spread footing foundations may be utilized. Consequently, foundations bearing on either the medium dense to very dense, natural glacial sediments or on structural fill placed over these sediments are capable of providing suitable building support.

8.0 SITE PREPARATION

8.1 Clearing and Stripping

Following demolition of the existing structures, any underground utilities located within the proposed building areas should be removed or relocated. The resulting depressions should be backfilled with structural fill as discussed under the "Structural Fill" section of this report. Any remaining foundation elements that will not be incorporated into the new buildings should also be removed. Site preparation of the planned building areas should also include removal of all trees, brush, debris, and any other deleterious materials. These unsuitable materials should be properly disposed of off-site. Additionally, all organic topsoil within the proposed building areas, road areas, or areas to receive structural fill should be removed and the remaining roots grubbed. Areas where loose surficial soils exist due to grubbing operations should be considered as fill to the depth of disturbance and treated as subsequently recommended for structural fill placement. Any existing fill soils below footing areas should be stripped down to the underlying, medium dense to very dense natural till sediments. These sediments were encountered in our explorations at depths of approximately 1.5 to 3 feet.

8.2 Proof-Rolling

After stripping of the organic topsoil layer and removal of roots, we recommend that the soil exposed in proposed roadway areas be recompacted to a firm and unyielding condition using a 20-ton (minimum) vibratory roller. The recompacted area should then be proof-rolled with a fully loaded tandem-axle dump truck. Any soft or yielding areas identified during proof-rolling should be overexcavated and backfilled with structural fill.

8.3 Temporary and Permanent Cut 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 the loose to medium dense weathered native soils can be made at a maximum slope of 1.5H:1V (Horizontal:Vertical). Temporary cut slopes within the dense to very dense, unweathered till sediments can be planned up to a 1H:1V inclination. Flatter inclinations may be recommended in areas of seepage. In the dense to very dense till sediments, temporary vertical cuts no greater than 4 feet in height may also be constructed. 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 or fill slopes should not exceed an inclination of 2H:1V.

8.4 Site Disturbance

The site soils contain a high percentage of fine-grained material, which makes them moisture-sensitive and subject to disturbance when wet. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened. If disturbance occurs, the softened soils should be removed and the area brought to grade with structural fill. If crushed rock is considered for the access and staging areas, it should be underlain by stabilization fabric (such as Mirafi 500X or approved equivalent) to reduce the potential of fine-grained materials pumping up through the rock and turning the area to mud. The fabric will also aid in supporting construction equipment, thus reducing the amount of crushed rock required. We recommend that at least 10 inches of rock be placed over the fabric; however, due to the variable nature of the near-surface soils and differences in wheel loads, this thickness may have to be adjusted by the contractor in the field. Crushed rock used for access and staging areas should be of at least 2-inch size.

9.0 STRUCTURAL FILL

Placement of structural fill may be necessary to establish desired grades in some areas. 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.

9.1 Subgrade Compaction

After overexcavation/stripping has been performed to the satisfaction of the geotechnical engineer/engineering geologist, the upper 12 inches of 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 recompacted, exposed ground is tested and approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades.

9.2 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 *American Society for Testing and Materials* (ASTM):D 1557 as the standard. Roadway and 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.

9.3 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. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions. The on-site, natural glacial sediments are suitable for use as structural fill; however, they contain significant amounts of silt and are considered highly moisture-sensitive. At the time of our exploration, portions of the till sediments encountered in our exploration pits exhibited moisture contents in excess of the optimum for achieving maximum compaction. These soils are described on the attached exploration logs as "very moist" or "wet". These soils would require moisture conditioning prior to their use as structural fill. Such moisture conditioning could consist of spreading out and aerating the soil during periods of warm, dry weather.

Construction equipment traversing the site when the soils are very moist or wet can cause considerable disturbance. If fill is placed during wet weather or if proper compaction 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.

9.4 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.

10.0 FOUNDATIONS

10.1 Allowable Soil Bearing Pressure

Spread footings may be used for building support when founded either directly on the medium dense to very dense, natural glacial sediments, or on structural fill placed over these materials. For footings founded either directly upon the medium dense to very dense glacial sediments, or on structural fill as described above, we recommend that an allowable bearing pressure of 2,000 pounds per square foot (psf) be used for design purposes, including both dead and live loads. For foundations founded totally upon dense to very dense unweathered till, a recommended allowable soil bearing pressure of 4,000 psf may be used. We recommend that the footing subgrade be recompacted to a firm and unyielding condition prior to footing placement. An increase in the allowable bearing pressure of one-third may be used for short-term wind or seismic loading. If structural fill is placed below footing areas, the structural fill should extend horizontally beyond the footing edges a distance equal to or greater than the thickness of the fill.

10.2 Footing Depths

Perimeter footings for the proposed buildings should be buried a minimum of 18 inches into the surrounding soil for frost protection. No minimum burial depth is required for interior footings; however, all footings must penetrate to the prescribed stratum, and no footings should be founded in or above loose, organic, or existing fill soils.

10.3 Footings Adjacent to Cuts

The area bounded by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area that has not been compacted to at least 95 percent of ASTM:D 1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus footings should not be placed near the edges of steps or cuts in the bearing soils.

10.4 Footing Settlement

Anticipated settlement of footings founded as described above should be on the order of 1 inch or less. However, disturbed soil not removed from footing excavations prior to footing placement could result in increased settlements.

10.5 Footing Subgrade Bearing Verification

All footing areas should be observed by AESI prior to placing concrete to verify that the exposed soils can support the design foundation bearing capacity and that construction conforms with the recommendations in this report. Foundation bearing verification may also be required by the governing municipality.

10.6 Foundation Drainage

Perimeter footing drains should be provided as discussed under the "Drainage Considerations" section of this report.

11.0 LATERAL WALL PRESSURES

All backfill behind walls or around foundations should be placed following our recommendations for structural fill and as described in this section of the report. Horizontally backfilled walls, which 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). Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an equivalent fluid of 55 pcf. Walls that retain sloping backfill at a maximum angle of 50 percent should be designed for 45 pcf for yielding conditions and 65 pcf for restrained conditions. If parking areas or driveways are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces.

11.1 Wall Backfill

The lateral pressures presented above are based on the conditions of a uniform backfill consisting of either the on-site glacial sediments or imported sand and gravel compacted to 90 to 95 percent of ASTM:D 1557. A higher degree of compaction is not recommended, as this will increase the pressure acting on the walls. A lower compaction may result in unacceptable settlement behind the walls. Thus, the compaction level is critical and must be tested by our firm during placement. The recommended compaction of 90 to 95 percent of ASTM:D 1557 applies to any structural fill placed behind the wall within a distance equal to the wall height and up to the elevation of the top of the wall. Structural fill used to construct slopes above retaining walls should be compacted to at least 95 percent of ASTM:D 1557 if the fill is placed above the elevation of the top of the wall. Surcharges from adjacent footings, heavy construction equipment, or sloping ground must be added to the above recommended lateral pressures. Footing drains should be provided for all retaining walls, as discussed under the "Drainage Considerations" section of this report.

11.2 Wall Drainage

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 for the full wall height using imported, washed gravel against the walls. If drainage mat is used it should be installed according to the manufacturer's specifications.

11.3 Passive Resistance and Friction Factor

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

- Passive equivalent fluid = 250 pcf
- Coefficient of friction = 0.30

The above values are allowable.

11.4 Seismic Surcharge

As required by the 2009 IBC, retaining wall design should include a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. Considering the site soils and the calculated peak horizontal acceleration of 0.29g, we recommend a seismic surcharge pressure of 9H to 12H where H is the wall height in feet for the "active" and "at-rest" loading conditions, respectively. The seismic surcharge should be modeled as a rectangular distribution with the resultant applied at the midpoint of the wall.

12.0 FLOOR SUPPORT

Slab-on-grade floors may be constructed either directly on the medium dense to very dense natural sediments, or on structural fill placed over these materials. Areas of the slab subgrade that are disturbed (loosened) during construction should be recompacted to an unyielding condition prior to placing the pea gravel, as described below.

If moisture intrusion through slab-on-grade floors is to be limited, the floors should be constructed atop a capillary break consisting of a minimum thickness of 4 inches of washed pea gravel, washed crushed rock, or other suitable material approved by the geotechnical engineer. The capillary break should be overlain by a 10-mil (minimum thickness) plastic vapor retarder.

13.0 DRAINAGE CONSIDERATIONS

The natural glacial sediments encountered in our explorations generally contained significant amounts of silt and are considered to be highly moisture-sensitive. Traffic from vehicles, construction equipment, and even foot traffic across these sediments when they are very moist or wet will result in disturbance of the otherwise firm stratum. Therefore, prior to site work and construction, the contractor should be prepared to provide drainage and subgrade protection, as necessary.

13.1 Wall/Foundation Drains

All retaining and perimeter footing walls should be provided with a drain at the footing elevation. The 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 approximately 2 inches below the bottom of the footing, and the drains should be constructed with sufficient gradient to allow gravity discharge away from the buildings. All retaining walls should be lined with a minimum, 12-inch-thick, washed gravel blanket provided to within 1 foot of finish grade, and which ties into the footing drain. If drainage mat is used it should be installed according to the manufacturer's specifications. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain.

Exterior grades adjacent to walls should be sloped downward away from the structures to achieve surface drainage. Final exterior grades should promote free and positive drainage away from the buildings at all times. Water must not be allowed to pond or to collect adjacent to the foundation or within the immediate building area. It is recommended that a gradient of at least 3 percent for a minimum distance of 10 feet from the building perimeter be provided, except in paved locations. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structures. Additionally, pavement subgrades should be crowned to provide drainage toward catch basins and pavement edges.

14.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

We are available to provide additional geotechnical consultation as the project design develops and possibly changes from that upon which this report is based. If significant changes in grading are made, we recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, our earthwork and foundation recommendations may be properly interpreted and implemented in the design. This plan review is not included in our current scope of work and budget.

We are also available to provide geotechnical engineering and monitoring services during construction. The integrity of the foundations depends on proper site preparation and construction procedures. In addition, 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

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

MATTHEW A. MILLER
STATE OF WASHINGTON
30284
REGISTERED
PROFESSIONAL ENGINEER
8-9-12

Jon N. Sondergaard, L.G., L.E.G.
Senior Principal Geologist

Matthew A. Miller, P.E.
Principal Engineer

Attachments: Figure 1: Vicinity Map
Figure 2: Site and Exploration Plan
Appendix: Exploration Logs

REFERENCE: USGS TOPO!

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

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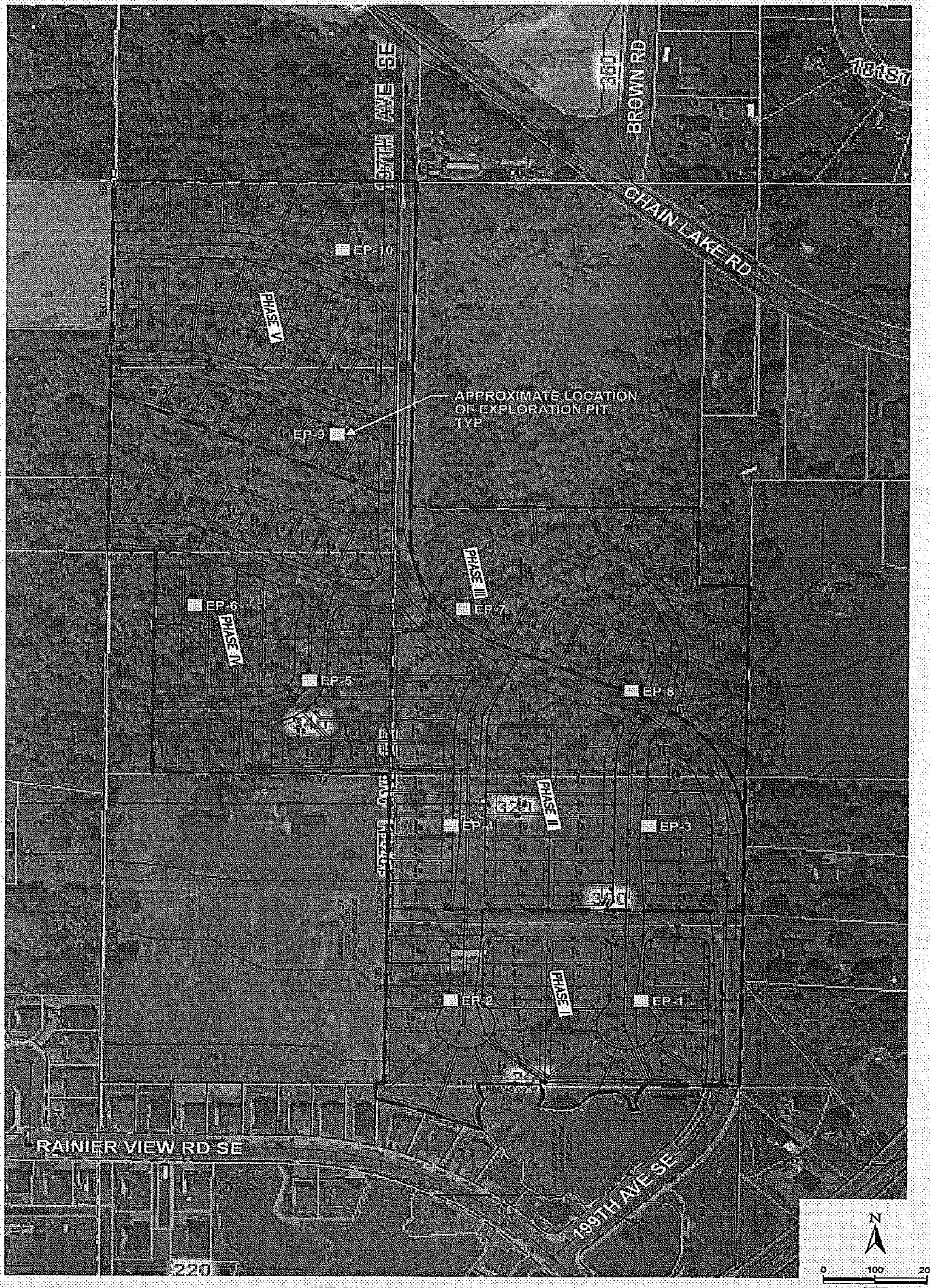
VICINITY MAP
EAGLEMONT
MONROE, WASHINGTON

FIGURE 1
DATE 7/12
PROJ. NO. KE120280A

Project Vicinity.cdr



REFERENCE: CLIENT

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

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SITE AND EXPLORATION PLAN
EAGLEMONT
MONROE, WASHINGTON

FIGURE 2
DATE 7/12
PROJ. NO. KE120280A

APPENDIX

Exploration Logs

Major Division	Subdivision	Fines	Symbol	Description
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
		≥15% 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
		≥15% 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
Few	5 to 10
Little	15 to 25
With	- Non-primary coarse constituents: ≥ 15% - Fines content between 5% and 15%

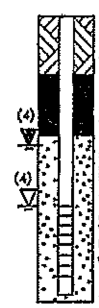
Moisture Content

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
Blows/6" or portion of 6"

	Sampler Type Description
2.0" OD Split-Spoon Sampler (SPT)	3.0" OD Split-Spoon Sampler
	3.25" OD Split-Spoon Ring Sampler
Bulk sample	3.0" OD Thin-Wall Tube Sampler (including Shelby tube)
Grab Sample	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 15%

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

blocksilog_key.dwg LAYOUT: Layout2

LOG OF EXPLORATION PIT NO. EP-1

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Sod / Topsoil
1	**Weathered Vashon Lodgement Till** Loose, moist, reddish brown, silty SAND, with gravel, scattered roots, scattered cobbles.
2	Becomes medium dense and tan, with no roots below 1.5 feet.
3	**Vashon Lodgement Till**
4	Very dense, moist, grayish tan, silty SAND, with gravel (SM).
5	
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7	Bottom of exploration pit at depth 6 feet No seepage. No caving.
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KCTP3 120280.GPJ July 12, 2012

Eaglemont
Monroe, WA

Associated Earth Sciences, Inc.

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Project No. KE120280A

7/10/12

LOG OF EXPLORATION PIT NO. EP-2

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Sod / Topsoil
1	**Weathered Vashon Lodgement Till**
2	Loose, moist, reddish brown, silty SAND, with gravel (SM); scattered cobbles; abundant roots from 0 to 2 feet.
3	Becomes medium dense ant tan below 2.5 feet.
4	**Vashon Lodgement Till**
5	Very dense, moist, grayish tan, silty SAND, with gravel (SM).
6	
7	Bottom of exploration pit at depth 6 feet No seepage. No caving.
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Monroe, WA

Associated Earth Sciences, Inc.

Logged by: TJP
Approved by: TJP

Project No. KE120280A

7/10/12

LOG OF EXPLORATION PIT NO. EP-3

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Sod / Topsoil
1	**Weathered Vashon Lodgement Till**
2	Loose, moist, reddish brown, silty SAND, with gravel (SM).
3	Becomes medium dense and tan below 2.5 feet.
	Vashon Lodgement Till
4	Very dense, moist, grayish tan, silty SAND, with gravel, scattered cobbles.
5	
6	Bottom of exploration pit at depth 5.5 feet No seepage. No caving.
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LOG OF EXPLORATION PIT NO. EP-4

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
0–0.5	**Sod / Topsoil**
0.5–3	**Weathered Vashon Lodgement Till** Loose, moist, reddish brown, silty SAND, with gravel (SM). Becomes medium dense and tan below approximately 2 feet, scattered cobbles.
3–5	**Vashon Lodgement Till** Very dense, moist, grayish tan, silty SAND, with gravel (SM); scattered cobbles.
5	Bottom of exploration pit at depth 5 feet No seepage. No caving.

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

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LOG OF EXPLORATION PIT NO. EP-5

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Forest Duff / Topsoil
	Weathered Vashon Lodgement Till
1	Loose, very moist, brown, silty SAND, with gravel, abundant roots (SM).
2	
3	Wet at base.
	Vashon Lodgement Till
4	Very dense, very moist, grayish tan, silty SAND, with gravel (SM). Becomes moist, contains scattered cobbles and boulders.
5	
6	Bottom of exploration pit at depth 5.5 feet Slow seepage at 3 feet. No caving.
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LOG OF EXPLORATION PIT NO. EP-6

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Forest Duff / Topsoil
	Weathered Vashon Lodgement Till
1	Loose, very moist, reddish brown, silty SAND, with gravel, abundant roots (SM).
2	Wet at base.
	Vashon Lodgement Till
3	Very dense, very moist, grayish tan, silty SAND, with gravel, scattered cobbles (SM).
4	
5	
6	Bottom of exploration pit at depth 5.5 feet No seepage but sediments at base of weathered soil horizon (2.5 feet depth) appear close to saturated. No caving.
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LOG OF EXPLORATION PIT NO. EP-7

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Forest Duff / Topsoil
1	**Weathered Vashon Lodgement Till** Loose, very moist, reddish brown, silty SAND, with gravel (SM).
2	Becomes very moist below 1.5 feet. Abundant roots from 0 to 2.5 feet.
3	**Vashon Lodgement Till** Dense to very dense, very moist, grayish tan, silty SAND, with gravel, scattered cobbles (SM).
4	
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6	Bottom of exploration pit at depth 5.5 feet No seepage. No caving.
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LOG OF EXPLORATION PIT NO. EP-8

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Forest Duff / Topsoil
	Weathered Vashon Lodgement Till
1	Loose, very moist, reddish brown, silty SAND, with gravel, scattered cobbles (SM).
	Abundant roots from 0 to 2 feet.
2	Becomes medium dense and tan below 2 feet.
	Vashon Lodgement Till
3	Very dense, very moist, grayish tan, silty SAND, with gravel, scattered cobbles (SM).
4	Becomes wet at approximately 4 feet.
5	
6	
7	Bottom of exploration pit at depth 6.5 feet Slow seepage at 4 feet. No caving.
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LOG OF EXPLORATION PIT NO. EP-9

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Forest Duff / Topsoil
1	**Weathered Vashon Lodgement Till**
	Loose, very moist, reddish brown, silty SAND, with gravel, scattered cobbles (SM).
2	Abundant roots from 0 to 2 feet.
	Becomes medium dense and tan below 2 feet.
3	**Vashon Lodgement Till**
	Very dense, very moist, grayish tan, silty SAND, with gravel, scattered cobbles, and boulders (SM).
4	
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7	Bottom of exploration pit at depth 6 feet No seepage. No caving.
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LOG OF EXPLORATION PIT NO. EP-10

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Forest Duff / Topsoil
	Weathered Vashon Lodgement Till
1	Loose, moist to very moist, reddish brown, silty SAND, with gravel, abundant roots (SM).
2	**Vashon Lodgement Till**
3	Very dense, very moist, grayish tan, silty SAND, with gravel, scattered cobbles (SM).
4	
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6	Bottom of exploration pit at depth 5.5 feet No seepage. No caving.
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