Ages Engineering

A Geotechnical Engineering Services Company

P.O. Box 935
Puyallup, WA. 98371

(253) 845-7000

www.agesengineering.com

GEOTECHNICAL REPORT

Sebay Tam Residence

4215 Holly Lane
Mercer Island, Washington

Project No. A-1705

Prepared For:

Cem Sebay and Minh Tam
4215 Holly Lane
Mercer Island, WA 98040

August 20, 2024

Ages Engineering

A Geotechnical Engineering Services Company

P.O. Box 935
Puyallup, WA. 98371

Main (253) 845-7000

www.agesengineering.com

August 20, 2024
Project No. A-1705

Cem Sebay and Minh Tam
4215 Holly Lane
Mercer Island, WA 98040

Subject: Geotechnical Report
Sebay Tam Residence
4215 Holly Lane
Mercer Island, Washington
Parcel Number: 7389000040

Dear Cem and Minh,

As requested, we have conducted a geotechnical study for the subject project. The attached report presents our findings and recommendations for the geotechnical aspects of project design and construction.

Our field exploration indicates the site is generally underlain with either Old Fill soils or topsoil overlying sand with silt and gravel consistent with Pre-Olympia Outwash. We did not encounter groundwater seepage in any of our explorations.

In our opinion, the soil and groundwater conditions at the site are suitable for the planned development. The new structure can be supported on either Pin Piles or typical spread footing foundations bearing on the organic-free native soils observed at 1.0 to 3.0 feet below surface grades. The development storm water should discharge to the existing storm water system on the site.

Detailed recommendations addressing these issues and other geotechnical design considerations are presented in the attached report. We trust the information presented is sufficient for your current needs. If you have any questions or require additional information, please call.

Respectfully Submitted,

Ages Engineering

BERNARD P. KNOLL II
STATE OF WASHINGTON
38917
REGISTERED
PROFESSIONAL ENGINEER

8-20-2024

Bernard P. Knoll, II
Principal

BPK:bpk

TABLE OF CONTENTS

Figures

Appendix

Geotechnical Report
Sebay Tam Residence
4215 Holly Lane
Mercer Island, Washington

1.0 PROJECT DESCRIPTION

The project will consist of a residential development. We were provided with 31 sheets of project plans showing the planned development. Based on the plan provided to us, we understand the existing single-family residence on the site will be remodeled and expanded. The new foundations will be constructed between the two structures and new walls will join the two structures on the site. The development storm water will discharge to the existing storm water system located on the subject site.

The conclusions and recommendations presented in this report are based on our understanding of the above-stated site and the planned project design features. If actual site conditions differ, the planned project design features are different than we expect, or if changes are made, we should review them in order to modify or supplement our conclusions and recommendations as necessary.

2.0 SCOPE

On August 13, 2024, we excavated two hand-augured test holes to a maximum depth of 5.0 feet below surface grades. Using the information obtained from our subsurface exploration, we developed geotechnical design and construction recommendations for the project. Specifically, this Geotechnical Report addresses the following:

- Reviewing the available geologic, hydrogeologic and geotechnical data for the site area, and conducting a geologic reconnaissance of the site area.
- Addressing the appropriate geotechnical regulatory requirements for the planned site development, including a Geologic Hazard evaluation.
- Advancing two hand-augured test holes in the planned new development area to a maximum depth of approximately 5.0 feet below surface grades.
- Providing geotechnical recommendations for site grading including site preparation, subgrade preparation, fill placement criteria, suitability of on-site soils for use as structural fill, temporary and permanent cut and fill slopes, and drainage and erosion control measures.
- Providing geotechnical recommendations for design and construction of new foundations and floor slabs, including allowable bearing capacity and estimates of settlement.
- Providing geotechnical recommendations for lower-level building or retaining walls, including backfill and drainage requirements, lateral design loads, and lateral resistance values.
- Providing preliminary recommendations for the discharge of the development storm water.

- Providing recommendations for site drainage.

3.0 SITE CONDITIONS

3.1 Surface

The subject site is a 0.57-acre irregularly shaped residential parcel located at 4215 Holly Lane in Mercer Island, Washington. The site is currently occupied with a single-family residence located in the approximate center of the site, and a detached structure to the north of the residence. The subject site is bordered by residential parcels to the west and south, and by Holly Lane to the north and east. The location of the site is shown on the Site Vicinity Map provided in Figure 1. The current site layout is shown on the Exploration Location Plan provided in Figure 2.

In general surface grades in the vicinity of the site slope down to the west. Surface grades on the subject site slope down to the west at inclinations ranging from 10 to 25 percent. Site vegetation around the residence that occupies the site consists of typical landscape bushes and trees with various native medium sized evergreen and deciduous trees.

3.2 Mapped Soils

According to *The Geologic Map of Seattle- A Progress Report,* by Kathy Goetz Troost, Derek B. Booth, Aaron P. Wisher, and Scott A. Shimel, the surface soils in the vicinity of the site are mapped as Pre-Olympia Glacial Diamict (Qpogd). The Glacial Diamict was deposited during glacial events that occurred before the most recent Fraser Glaciation and the Olympia Glaciation. The Glacial Diamict was consequently overridden by the glacial ice mass associated with the most recent Vashon Stade of the Frasier Glaciation. The Glacial Diamict will typically be found in a very dense condition where undisturbed. The near surface soils at the site have been disturbed by natural weathering processes that have occurred since their deposition. No springs or groundwater seepage was observed on the surface of the site at the time of our site visit. A copy of the Geologic Map for the subject site is provided in Figure 3.

The United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) maps the soils in the vicinity of the site as Kitsap Silt Loam (KpD) soils that form on 15 to 30 percent slopes. According to the USDA NRCS, the site soil will have a moderate potential erosion when exposed. A copy of the USDA NRCS Map for the subject site is provided in Figure 4.

3.3 Soils

The soils we observed at the site generally consist of 1.0 to 3.0 feet of either topsoil or old fill soils overlying sand with silt and gravel consistent with coarse grained glacial outwash deposits.

The soils observed in Test Hole TH-1, located between the residence and the detached structure, consist of 12 inches of topsoil overlying native tan and reddish orange sand with silt and gravel consistent with older pre-Olympia outwash soils. This soil was in a moist and medium dense condition.

In Test Hole TH-2, located to the east of the detached structure, we encountered 3.0 feet of Old Fill soils consisting of brown silty sand with gravel. Below 3.0 feet, we encountered native tan and reddish-orange, medium dense to dense, sand with silt and gravel consistent with older pre-Olympia outwash soils. This soil was in a moist and medium dense condition.

Figures A-1 and A-2 present more detailed descriptions of the subsurface conditions encountered in the test holes. The approximate test hole locations are shown on the Exploration Location Plan provided in Figure 2.

3.4 Groundwater

We did not encounter groundwater during our site explorations. We expect a seasonal perched water table develops beneath the site during periods of wet weather. The groundwater levels and flow rates will fluctuate seasonally and typically reach their highest levels during and shortly following the wet winter months (October through May).

4.0 GEOLOGIC HAZARDS

4.1 General

According to Section 19.16 in the City of Mercer Island Municipal Code, geologic hazard areas are defined as "Areas susceptible to erosion, sliding, earthquake, or other geological events based on a combination of slope (gradient or aspect), soils, geologic material, hydrology, vegetation, or alterations, including landslide hazard areas, erosion hazard areas and seismic hazard areas".

4.2 Landslide

According to Section 19.16 in the City of Mercer Island municipal code, Landslide Hazard Areas are defined as, "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."

During our site visit and subsurface exploration, we did not observe any evidence of past site movement or areas of historic failures. We did observe slopes steeper than 15 percent on the site, however, no groundwater seepage. We did not observe relatively permeable sediment overlying a relatively impermeable sediment or bedrock. We did not observe any areas that have shown evidence of past movement or that are underlain or covered by mass wastage debris from past movements. We did not observe any areas of rapid stream incision. We did not observe areas sloping 40 percent or greater on the site. Based on these factors, according to the city of Mercer Island municipal code, the site is not classified as having landslide hazard areas.

4.3 Erosion

According to Section 19.16 in the City of Mercer Island municipal code, Erosion Hazard areas are defined as, "Those areas greater than 15 percent slope and subject to a severe risk of erosion due to wind, rain, water, slope and other natural agents including those soil types and/or areas identified by the U.S. Department of Agriculture's Natural Resources Conservation Service as having a "severe" or "very severe" rill and inter-rill erosion hazard."

The site does have areas sloping steeper than 15 percent on the site. Based on our subsurface exploration, the site is underlain with soils having a "moderate" potential for erosion when exposed. Therefore, according to the City of Mercer Island municipal code, the site is not classified as having erosion hazard areas.

In our opinion, regardless of the erosion hazard classification at the site, Temporary Erosion and Sediment Control (TESC) measures should be in place prior to the start of construction activities at the site. In our opinion, the potential for erosion is not a limiting factor in site development. Erosion hazards can be mitigated by applying Best Management Practices (BMPs) outlined in the Washington State Department of Ecology's (Ecology) *Stormwater Management Manual for Western Washington.* TESC measures, as required by the City of Mercer Island, should be in place prior to the start of construction activities at the site.

4.4 Seismic

According to Section 19.16 in the City of Mercer Island Municipal Code, seismic hazard areas are defined as, "areas subject to severe risk of damage as a result of earthquake induced ground shaking, slope failure, settlement, soil liquefaction or surface faulting."

We observed no site features indicating past seismic disturbance. The site is located within the Seattle Fault Zone. Structures constructed on this site using the seismic criteria provided in the City of Mercer Island municipal code and the International Building Code (IBC) will have no greater chance of seismic damage during an earthquake than any other residential structure in the Puget Sound area.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in pore water pressure. The increase in water pressure is typically induced by vibrations such as those associated with earthquakes. Liquefaction mainly affects geologically recent deposits of loose, fine-grained sands that are below the groundwater table. Due to the site being underlain with glacially consolidated relatively coarse-grained soils that are in a medium dense to dense condition, it is our opinion, the liquefaction potential of the site should be considered very low.

The state of Washington has adopted the International Building Code (IBC). Based on the soil conditions encountered and the local geology, site class "D" can be used in structural design. This is based on the inferred range of SPT (Standard Penetration Test) blow counts for the upper 100 feet of the site relative to hand excavation progress and probing with a ½-inch diameter steel probe rod. The presence of glacially consolidated soil conditions are assumed to be representative for the site conditions beyond the depths explored.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 General

Based on our study, in our opinion, soil and groundwater conditions at the site are suitable for the proposed development. The new addition can be supported on either Pin Piles or conventional spread footing foundations bearing on the existing native soils observed at 1.0 to 3.0 feet beneath the site surface. The development storm water should discharge to the existing storm water system on the site.

The native soils encountered at the site contain a high enough percentage of fines (silt and clay-size particles) that will make them difficult to compact as structural fill when too wet. Accordingly, the ability to use the soils from site excavations as structural fill will depend on their moisture content and the prevailing weather conditions at the time of construction. If grading activities take place during the winter season, the owner should be prepared to import free-draining granular material for use as structural fill and backfill.

The following sections provide detailed recommendations regarding these issues and other geotechnical design considerations. These recommendations should be incorporated into the final design drawings and construction specifications.

5.2 Site Preparation and Grading

To prepare the site for construction, all vegetation, organic surface soils, and other deleterious materials including any existing structures, foundations or abandoned utility lines should be stripped and removed from the new development areas. Organic topsoil will not be suitable for use as structural fill but may be used for limited depths in non-structural areas. The topsoil and Old Fill soil observed in the upper 1.0 to 3.0 feet of the site will not be suitable for supporting structural elements. Prior to construction these soils should be removed from under new foundation and slab areas.

Once clearing and stripping operations are complete, cut and fill operations can be initiated to establish desired grades. To achieve proper compaction of structural fill, and to provide adequate foundation and floor slab support, the existing subgrade must be in a stable condition. Due to the depth and consistency of the fill underlying the site, compaction of structural fill will be very difficult. If structural fill is necessary, it will likely have to be placed on a prepared subgrade surface consisting of either reinforcement fabric or quarry rock, or a combination of both. Once final design details become evident, we can provide specific recommendations for any structural fill on the site.

Our study indicates the native surface soils encountered at the site contain a sufficient percentage of fines (silt and clay-size particles) that will make them difficult to compact as structural fill when too wet. Accordingly, the ability to use the soil from site excavations as structural fill will depend on their moisture content and the prevailing weather conditions at the time of construction. If grading activities are planned during the wet winter months, or the on-site soil becomes too wet to achieve adequate compaction, the owner should be prepared to import a wet-weather structural fill. For wet weather structural fill, we recommend importing a granular soil that meets the following gradation requirements:

U. S. Sieve Size	Percent Passing
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

* Based on the ¾ inch fraction

Prior to use, Ages Engineering should examine and test all materials to be imported to the site for use as structural fill.

Structural fill should be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soils' laboratory maximum dry density as determined by American Society for Testing and Materials (ASTM) Test Designation D-1557 (Modified Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this same ASTM standard. In non-structural areas, the degree of compaction can be reduced to 90 percent.

<u>5.3 Excavations</u>

General,

The inclination for a safe and stable excavation slope cut is determined based on two factors, the current Washington State Safety and Health Administration (WSHA) regulations for confined spaces and global stability of the slope cut. Most often, the WSHA regulations are more conservative than the global stability requirements.

According to WAC 296-809-099, a confined space is defined as: "A space that is all of the following:

(a) Large enough and arranged so an employee could fully enter the space and work.

(b) Has limited or restricted entry or exit. Examples of spaces with limited or restricted entry are tanks, vessels, silos, storage bins, hoppers, vaults, excavations, and pits.

(c) Not primarily designed for human occupancy."

In the context of site excavation and grading, the Washington State Department of Labor and Industries considers a confined space as a space in which a worker enters an excavation that is tall enough and/or narrow enough to inundate the worker and cause bodily harm if a cave-in occurs. This does not include excavations that are less than 4.0 feet in depth.

WSHA Approved Slope Cuts,

All excavations at the site associated with confined spaces, such as utility trenches and lower level building and retaining walls, must be completed in accordance with local, state, and/or federal requirements. Based on current Washington State Safety and Health Administration (WSHA) regulations, the existing Old Fill and the upper portion of the native soils are classified as Type C soils. The deeper unweathered glacially consolidated soils are classified as Type B soils.

According to WSHA, for temporary excavations of less than 20 feet in depth, the side slopes in Type C soils should be laid back at a slope inclination of 1.5:1 (Horizontal:Vertical) or flatter from the toe to the crest of the slope and the side slopes in Type B soils should be laid back at a slope inclination of 1:1 (Horizontal:Vertical) or flatter from the toe to the crest of the slope. All exposed slope faces should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation. These guidelines assume that all surface loads are kept at a minimum distance of at least one half the depth of the cut away from the top of the excavation slope and that significant seepage is not present on the slope face. Flatter cut slopes will be necessary where significant raveling or seepage occurs, or if construction materials will be stockpiled along the slope crest. If these safe temporary slope inclinations cannot be achieved due to property line constraints, shoring may be necessary.

This information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Ages Engineering assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

Global Stability Excavations,

Based on the composition and consistency of the site soils, stable slope cuts to provide adequate global stability can be steeper than WSHA standards in areas that are not considered confined spaces. Excavations into the native glacial till soils on the site that will not result in WSHA regulated confined spaces can be cut to an inclination of 0.5:1. Some raveling of the gravel and cobbles exposed on the slope surface may occur at an inclination of 0.5:1. Due to the potential for raveling to occur, and to prevent erosion, the slope face should be covered with durable plastic sheeting.

This information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Ages Engineering assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

5.4 Foundations

Based on our evaluation, to prevent post-construction differential settlements from affecting the new addition, we recommend using Pin Piles to support the new foundation loads. The post-construction settlements for new foundations constructed over pin piles will be zero. Post-construction settlements over new foundations constructed as conventional spread footing foundations supported on the native soils may have settlements of up to ½ inch total and up to ¼ inch differential. If these settlements can be tolerated, then spread footing foundations can be utilized. If post construction foundation settlement is not tolerable, pin piles should be used.

Pin Piles,

Based on the depth of topsoil and old fill, and the consistency and geologic nature of the native soils underlying the site, we recommend utilizing either 2-inch or 3- inch diameter Pin Piles. Pin Piles larger than 2 inches in diameter will typically require load testing prior to installation, and performance testing during installation.

Small diameter steel pipe piles are commonly referred to as Pin Piles, due to their relatively thin width in relation to their long length. Very little site or subgrade preparation is necessary when supporting a foundation on Pin Piles. Pin Piles are hollow steel pipes that are mechanically driven into the ground along the outside of the existing foundation line with either a pneumatic device that essentially vibrates the pipe into the ground, or by a pneumatic hammer that successively pounds the pile into the ground. The piles are driven until their progress slows down to a pre-determined rate that is based on the pile size and pile driving mechanism. After installation, the piles are capped and connected to the existing foundation with either a steel anchor, or additional rebar and concrete. Pin Piles require a minimum embedment depth of at least 10.0 feet to achieve their design capacities. Due to the existence of topsoil, old fill and medium dense sandy native soils underlying the development area, we expect pile embedment depths of 10.0 to 15.0 feet will be necessary.

The structural engineer should be contacted to provide the exact pile diameter, location, number, and spacing, and to determine how many and where the battered piles, if any, will be necessary. With the anticipated building loads, we expect building settlements will be negligible. The allowable pile capacities for each pile size are provided in the following table.

Pin Pile Options		
Pile Diameter (inches)	**Pile Type**	**Pile Capacity (kips)**
2	Schedule 80 Steel	4
3	Schedule 40 Steel	12
4	Schedule 40 Steel	20

Conventional Spread Footing Foundations,

The new residential foundations may be supported on conventional spread footing foundations bearing on the existing organic-free native soils, or on new structural fill placed above the existing site soils. Foundation subgrades should be prepared as recommended in the "Site Preparation and Grading" section of this report. As discussed in the "Site Preparation and Grading" section of this report, the existing topsoil and fill observed in the upper 1.0 to 3.0 feet of the site will not be suitable for support of structural elements. Prior to construction, this topsoil and old fill soil should be removed from under new foundation areas.

Perimeter foundations exposed to the weather should bear at a minimum depth of 1.5 feet below final exterior grades for frost protection. Interior foundations can be constructed at any convenient depth below the floor slab. We recommend designing new foundations for a net allowable bearing capacity of 2,500 pounds per square foot (psf). For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used. With the anticipated loads and this bearing stress applied, building settlements should be less than one-half inch total and one-quarter inch differential.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressures acting on the sides of the footings can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 300 pounds per cubic foot (pcf). We recommend not including the upper 12 inches of soil in this computation because it can be affected by weather or disturbed by future grading activity. This value assumes the foundations will be constructed neat against competent soil and backfilled with structural fill, as described in the "Site Preparation and Grading" section of this report. The values recommended include a safety factor of 1.5.

Foundation Parameter Summary	
Description	***Design Value**
Net Allowable Bearing Capacity	2,500 psf
Friction Coefficient	0.35
Lateral Resistance	300 pcf

*Details regarding the use of these parameters are provided in the section above.

5.5 Slab-On-Grade

Slab-on-grade floors should be supported on subgrades prepared as recommended in the "Site Preparation and Grading" section of this report. As discussed in the "Site Preparation and Grading" section of this report, the existing topsoil and fill observed in the upper 1.0 to 3.0 feet of the site will not be suitable for support of structural elements. Prior to construction, this topsoil and old fill soil should be removed from under new slab areas.

Immediately below the floor slab, we recommend placing a four-inch-thick capillary break layer of clean, free-draining, coarse sand or fine gravel that has less than three percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slabs. The drainage material should be placed in one lift and compacted to a firm and unyielding condition.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and aid in uniform curing of the concrete slab. It should be noted that if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will not assist in uniform curing of the slab and may serve as a water supply for moisture transmission through the slab and affecting floor coverings. Additionally, if the sand is too dry, it can effectively drain the fresh concrete, thereby lowering its strength. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided.

5.6 Lower Level and Building Walls

The magnitude of earth pressure development on below-grade walls, such as basement or retaining walls, will greatly depend on the quality of the wall backfill and the wall drainage. We recommend placing and compacting wall backfill as structural fill. Wall backfill below structurally loaded areas, such as pavements or floor slabs, should be compacted to a minimum of 95 percent of its maximum dry density, as determined by ASTM Test Designation D-1557 (Modified Proctor). In unimproved areas, the relative compaction can be reduced to 90 percent.

To guard against hydrostatic pressure development, drainage must be installed behind the wall. We recommend that wall drainage consist of a minimum 12 inches of clean sand and/or gravel with less than three percent fines placed against the back of the wall. In addition, a drainage collector system consisting of 4-inch perforated PVC pipe should be placed behind the wall to provide an outlet for any accumulated water. The drains should be provided with cleanouts at easily accessible locations. These cleanouts should be serviced at least once every year. The wall drainage material should be capped at the ground surface with 1-foot of relatively impermeable soil to prevent surface intrusion into the drainage zone. Alternatively, the 12-inch wide drainage layer placed against the back of the wall can be replaced with a Mirafi G100N Drainage Board, or an approved equivalent. If drainage board is used, the 4-inch perforated PVC pipe should be covered with at least 12 inches of clean washed gravel and the drainage board should be hydraulically connected to drainpipe and surrounding gravel.

With wall backfill placed and compacted as recommended and the wall drainage properly installed, unrestrained walls can be designed for an active earth pressure equivalent to a fluid weighing 35 pcf. For restrained walls, an additional uniform lateral pressure of 100 psf should be included. These values assume a horizontal backfill condition and that no other surcharge loading, such as traffic, sloping embankments, or adjacent buildings, will act on the wall. If such conditions exist, then the imposed loading must be included in the wall design. Friction at the base of the wall foundation and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in the "Foundations" section of this report.

Lower Level Building and Retaining Wall Parameter Summary		
Description	**Condition**	***Design Value**
Earth Pressure	Unrestrained	35 pcf
Earth Pressure	Restrained	Additional 100 psf
Earth Pressure	Surcharge	Dependant upon magnitude

*Details regarding the use of these parameters are provided in the section above.

5.7 Storm Water

The development storm water should discharge to the existing storm water system located on the subject site.

5.8 Permanent Slopes and Embankments

All permanent cut and fill slopes should be graded with a finished inclination of no greater than 2:1 (Horizontal:Vertical). Upon completion of grading, the slope face should be appropriately vegetated or provided with other physical means to guard against erosion. Final grades at the top of the slope must promote surface drainage away from the slope crest. Water must not be allowed to flow in an uncontrolled fashion over the slope face. If it is necessary to direct surface runoff towards the slope, it should be controlled at the top of the slope, piped in a closed conduit installed on the slope face, and taken to an appropriate point of discharge beyond the toe.

All fill used for slope and embankment construction should meet the structural fill requirements described in the Site Preparation and Grading section of this report. In addition, if new fills will be placed over existing slopes of 20 percent or greater, the structural fill should be keyed and benched into competent slope soils.

5.9 Site Drainage

Surface,

Final exterior grades should promote free and positive drainage away from the building area. All ground surfaces, pavements, and sidewalks should be sloped away from the structure. We recommend providing a gradient of at least three percent for a minimum distance of ten feet from the building perimeter, except in paved locations. In paved locations, a minimum gradient of one percent should be provided, unless provisions are included for collection and disposal of surface water adjacent to the structure.

Subsurface,

We recommend installing a continuous drain along the lower outside edge of the perimeter building foundation. The foundation drain should be tightlined to an approved point of controlled discharge. The roof drain should not be connected to the footing drains unless a backflow device will be installed, or an adequate gradient will prevent backflow into the footing drains.

Subsurface drains must be laid with a gradient sufficient to promote positive flow to the point of discharge. All drains should be provided with cleanouts at easily accessible locations. These cleanouts should be serviced at least once every year.

6.0 ADDITIONAL SERVICES

Ages Engineering should review the final project designs and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and incorporated into project design. If changes are made in the loads, grades, locations, configurations or types of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as necessary.

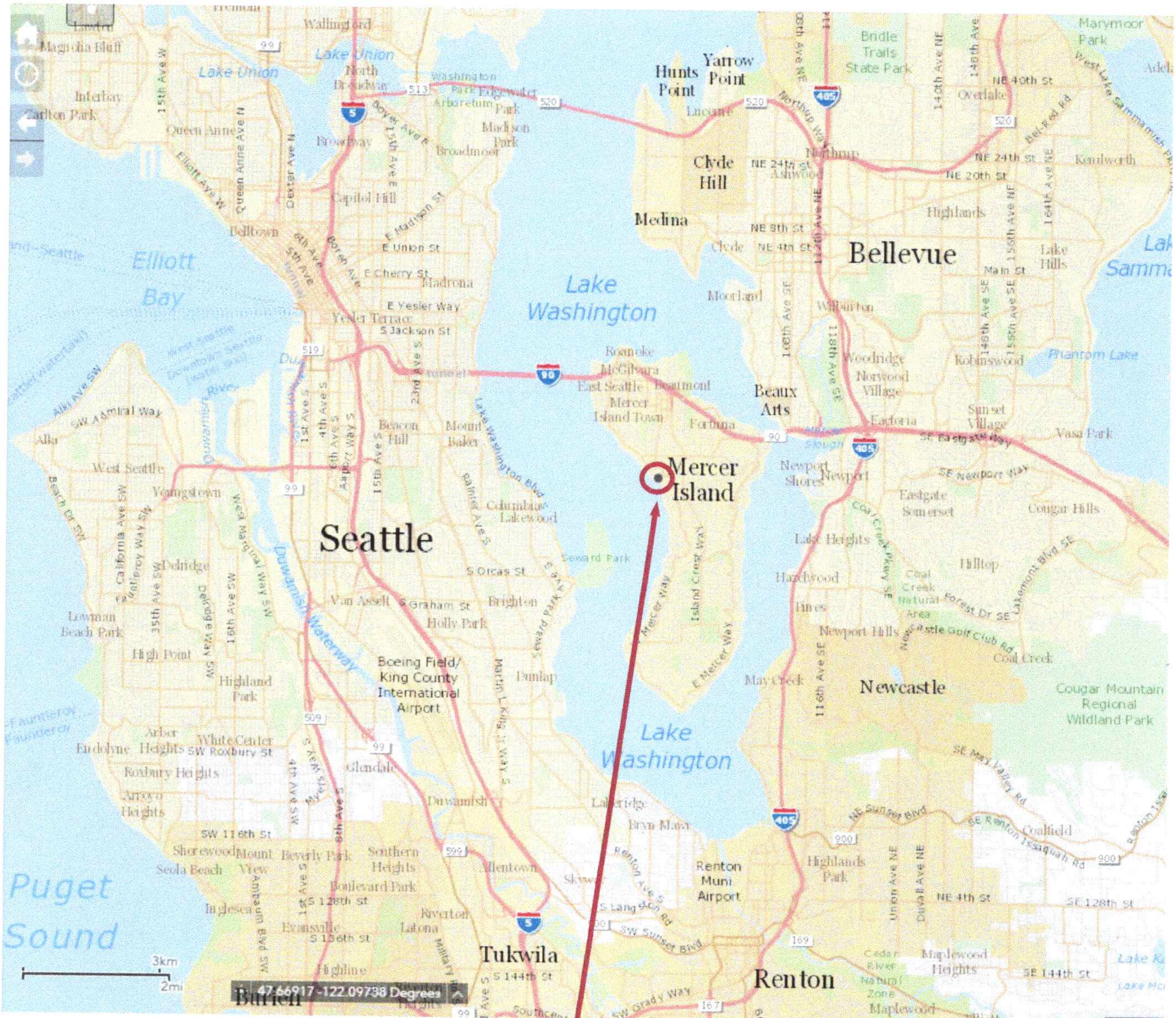
We should also provide geotechnical services during construction to observe compliance with our design concepts, specifications, and recommendations. This will allow for expedient design changes if subsurface conditions differ from those anticipated prior to the start of construction.

7.0 LIMITATIONS

We prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made. This report is the copyrighted property of Ages Engineering and is intended for the exclusive use of Cem Sebay and Minh Tam, and their authorized representatives for use in the design, permitting, and construction portions of this project.

The analysis and recommendations presented in this report are based on data obtained from others and our site explorations and should not be construed as a warranty of the subsurface conditions. Variations in subsurface conditions are possible. The nature and extent of which may not become evident until the time of construction. If variations appear evident, Ages Engineering should be requested to reevaluate the recommendations in this report prior to proceeding with construction. A contingency for unanticipated subsurface conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated during our exploration, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.



Approximate Site Location

Ages Engineering P. O. Box 935 Puyallup, WA. 98371 Main (253) 845-7000 www.agesengineering.com	**Site Vicinity Map** Sebay Tam Residence 4215 Holly Lane Mercer Island, Washington		
	Project No.: A-1705	August 2024	**Figure 1**

KEY:

APPROXIMATE LOCATION OF TEST HOLE — TH-1

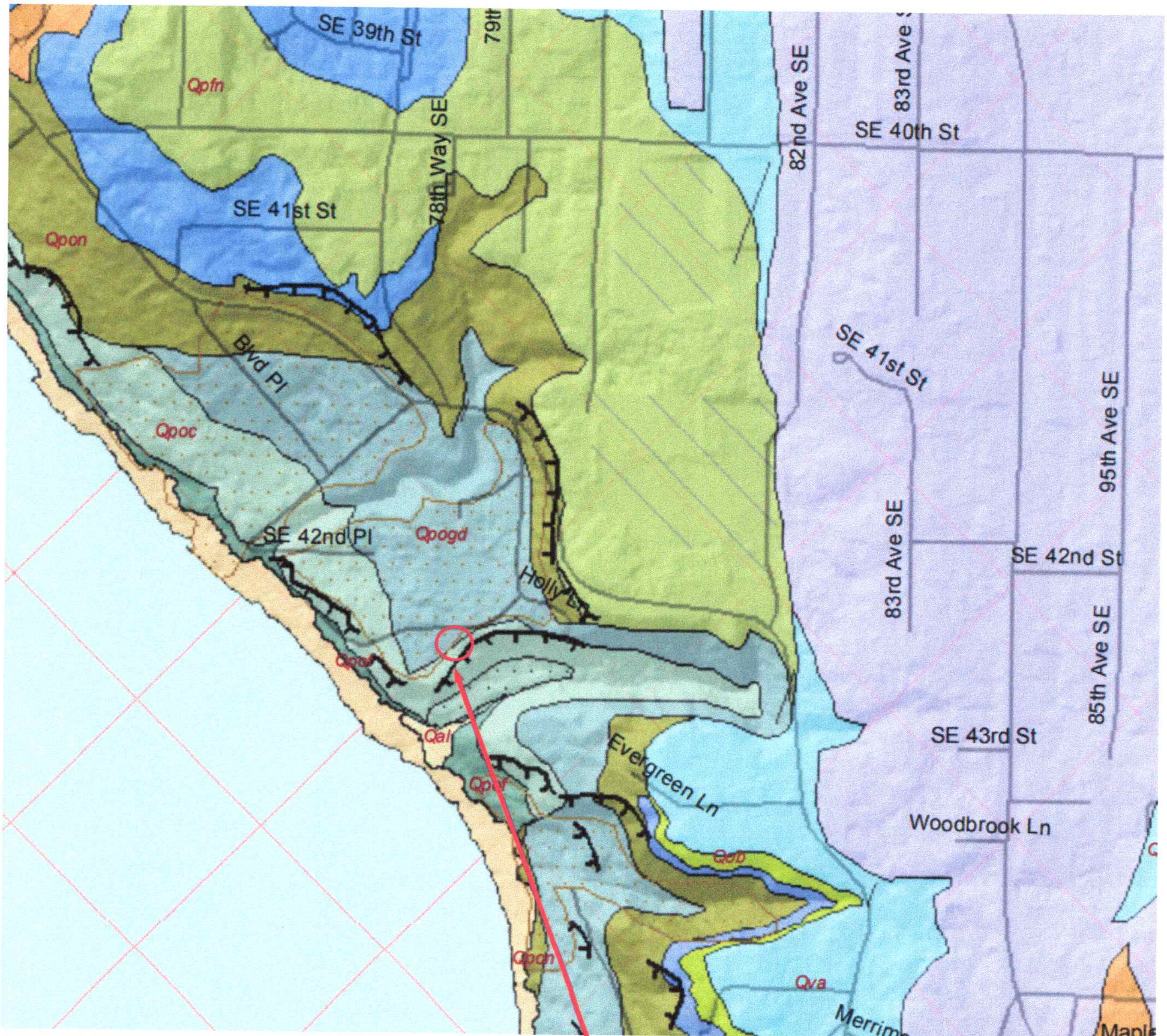
Ages Engineering
P. O. Box 935
Puyallup, WA. 98371

Main (253) 845-7000
www.agesengineering.com

Exploration Location Plan

Sebay Tam Residence
4215 Holly Lane
Mercer Island, Washington

Project No.: A-1705	August 2024	**Figure 2**



Approximate Site Location

Ages Engineering
P. O. Box 935
Puyallup, WA. 98371

Main (253) 845-7000
www.agesengineering.com

Geologic Map
Sebay Tam Residence
4215 Holly Lane
Mercer Island, Washington

Project No.: A-1705	August 2024	**Figure 3**

Approximate Site Location

Ages Engineering P. O. Box 935 Puyallup, WA. 98371 Main (253) 845-7000 www.agesengineering.com	**USDA NRCS Map** Sebay Tam Residence 4215 Holly Lane Mercer Island, Washington		
	Project No.: A-1705	August 2024	**Figure 4**

APPENDIX A

FIELD EXPLORATION AND LABORATORY TESTING

Sebay Tam Residence
Mercer Island, Washington

On August 13, 2024 we explored subsurface conditions at the site by excavating two hand-augured test hole to a maximum depth of 5.0 feet below surface grades. The approximate location of the site is shown on the Site Vicinity map provided in Figure 1. The approximate test hole locations are shown on the Exploration Location Plan provided in Figure 2.

A geotechnical engineering representative from our office conducted the field exploration, maintained a log of each test hole and classified the soils encountered, collected representative soil samples, and observed pertinent site features. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS) described on Figure A-1. The test hole logs are presented on Figure A-2.

Representative soil samples obtained from the test holes were placed in sealed containers and taken to our laboratory for further examination and testing. The moisture content of each sample was measured and is reported on the test hole logs.

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	GRAVEL WITH < 5 % FINES	GW	Well-Graded GRAVEL
			GP	Poorly-Graded GRAVEL
		GRAVEL WITH BETWEEN 5 AND 15 % FINES	GW-GM	Well-Graded GRAVEL with silt
			GW-GC	Well-Graded GRAVEL with clay
			GP-GM	Poorly-Graded GRAVEL with silt
			GP-GC	Poorly-Graded GRAVEL with clay
		GRAVEL WITH > 15 % FINES	GM	Silty GRAVEL
			GC	Clayey GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	SAND WITH < 5 % FINES	SW	Well-Graded SAND
			SP	Poorly-Graded SAND
		SAND WITH BETWEEN 5 AND 15 % FINES	SW-SM	Well-Graded SAND with silt
			SW-SC	Well-Graded SAND with clay
			SP-SM	Poorly-Graded SAND with silt
			SP-SC	Poorly-Graded SAND with clay
		SAND WITH > 15 % FINES	SM	Silty SAND
			SC	Clayey SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY	Liquid Limit Less than 50	ML	Inorganic SILT with low plasticity
			CL	Lean inorganic CLAY with low plasticity
			OL	Organic SILT with low plasticity
		Liquid Limit 50 or more	MH	Elastic inorganic SILT with moderate to high plasticity
			CH	Fat inorganic CLAY with moderate to high plasticity
			OH	Organic SILT or CLAY with moderate to high plasticity
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

(1) Soil descriptions are based on visual field and laboratory observations using the classification methods described in ASTM D-2488. Where laboratory data are available, classifications are in accordance with ASTM D-2487.

(2) Solid lines between soil descriptions indicate a change in the interpreted geologic unit. Dashed lines indicate stratigraphic change within the unit.

(3) Fines are material passing the U.S. No. 200 Sieve.

Ages Engineering
P. O. Box 935
Puyallup, WA. 98371

Main (253) 845-7000
www.agesengineering.com

Unified Soil Classification System (USCS)
Sebay Tam Residence
4215 Holly Lane
Puyallup, Washington

Project No.: A-1705	August 2024	**Figure A-1**

P.O. Box 935
Puyallup, WA. 98371
Office (253) 845-7000

Test Hole TH-1

DATE: August 13, 2024 LOGGED BY: BPK ELEV:

Depth (feet)	Soil Description	Notes M%	Notes Other
0	12 inches **TOPSOIL**		
	Tan and Reddish-orange **SAND** with silt and gravel, rounded gravel, medium dense, moist. (SP-SM)		
5	Test Hole terminated at a depth of 4.0 feet below surface grades. No groundwater seepage encountered.		

Test Hole TH-2

DATE: August 13, 2024 LOGGED BY: BPK ELEV:

Depth (feet)	Soil Description	Notes M%	Notes Other
0	**FILL:** Tan, gray and brown silty sand with gravel, cobbles to 10 inches, loose, moist. (SM)		
	Tan and Reddish-orange **SAND** with silt and gravel, rounded gravel, medium dense, moist. (SP-SM)		
5	Test Hole terminated at a depth of 5.0 feet below surface grades. No groundwater seepage encountered.		

Figure A-2