August 30, 2022 G-5713

Mr. Sam R. Franklin
4408 Thackeray Pl. NE
Seattle, Washington 98105

Subject: Geotechnical Engineering Investigation
New Residence
3064 – 68th Avenue SE,
Mercer Island, Washington

Dear Mr. Franklin:

GEO Group Northwest, Inc. is pleased to present our geotechnical engineering report for a proposed new residence at the above-subject location on Mercer Island, Washington.

SITE DESCRIPTION

The project site is located in a residential area on Mercer Island, Washington, as illustrated in Plate 1 – Site Location Map. The project site consists of a trapezoidal-shaped lot that has general dimensions of approximately 150 feet by 60 feet, and encompasses an area of approximately 8,800 square feet. A single-family residence, consisting of a house with a main floor and a finished daylight basement floor and a detached carport/garage structure, are present on the site. The property has a series of gentle to moderate slopes, mostly west-facing except along the north and south property lines, and a relatively flat rear yard area. The site configuration and the existing topography and improvements are illustrated in Plate 2 – Site Plan.

Adjacent properties to the north, east, and south consist of developed residential lots. Existing surface grades on the north and south adjacent lots are generally similar or lower relative to existing project site grades. Surface grades on the east adjacent lot rise moderately toward the east. The right of way for 68th Avenue SE is located along the west side the site.

PROPOSED PROJECT

We understand that you plan to demolish much of the above-ground portion of the existing residence and the existing detached carport/garage structure. An essentially new residence then will be constructed. The existing daylight basement portion of the existing residence may remain and be incorporated into the new layout. We anticipate that the renovated residence will have two floors plus a daylight basement/garage level.

GEOLOGIC OVERVIEW

According to published geologic mapping for the area[1], the site is underlain with non-glacial fine-grained deposits dating from before the Vashon Glaciation (the most recent glacial advance through the Seattle area). These soils commonly consist of silt and clay which may include lesser sandy beds, and occasional peat and cemented iron-oxide layers. Their stratification ranges from laminated to massive; and they typically are hard or very dense where they have not been affected by weathering, groundwater, or disturbance.

The geologic mapping also indicates that these soils on the site and adjacent areas to the north east are overlain with landslide or mass-wasting deposits. The eastern, upslope extent of the landslide deposits abuts a mapped west-facing scarp feature that is located about 90 feet east-northeast from the project site. We interpret the scarp and landslide deposits to be associated with long-past (pre-historical) landslide activity.

[1] Troost, K.G., and A.P. Wisher, Geologic Map of Mercer Island, Washington, October 2006.

SITE INVESTIGATION

Surface Conditions

A geologist from our firm completed a reconnaissance of the visible soil and topographic conditions at the site. We observed that the site features were essentially similar to those indicated in a recent topographic survey that was provided to us. We observed no indications of slope instability or soil movement on the site property. A minor amount of water seepage was observed along the base of a low concrete block retaining wall which runs along the east edge of the rear yard. We observed a slight rotation of the existing concrete retaining wall near the northeast corner of the site.

We observed that exposed portions of the exterior concrete footings around the perimeter of the existing residence and the detached garage/carport did not show cracks or other signs of structural distress. However, the concrete slab in the garage/carport exhibited multiple cracks and relative settlement near the north and south stem walls of the garage.

Subsurface Exploration

A geologist from our firm oversaw the drilling of three exploratory soil borings (B-1, B-2, and B-3) at the site. The borings were completed by a licensed drilling contractor using a manually-portable drilling rig equipped with hollow-stem augers. The borings were drilled to depths of approximately 20 to 25 feet below ground surface. The boring locations are illustrated in Plate 2 – Site Plan.

We recorded the soil conditions encountered in the borings, and monitored the borings for the presence of groundwater or seepage during drilling. Soil density and consistency were evaluated by performing Standard Penetration Tests in the borings during drilling. Samples of the soils encountered were collected for examination and for moisture content testing at our office. Logs of the soil and groundwater conditions encountered in the borings are provided in Attachment A to this report.

Findings

Soils encountered in the borings typically consisted of an upper layer of loose silt and sandy silt and medium stiff to stiff clayey silt to depths ranging from approximately 5 feet below ground surface (bgs) at boring B-1 to approximately 12 feet bgs at boring B-2. The underlying soils typically were found to consist of medium dense to dense silt, sandy silt and silty sand and very stiff clayey silt to the bottom of the borings.

Groundwater seepage was encountered in boring B-1 in the eastern part of the site at approximately 10 feet bgs, 19 feet bgs, and 24 feet bgs. Groundwater seepage was encountered in boring B-2 in the middle part of the site at approximately 9 feet bgs and at approximately 18 feet bgs. No groundwater or seepage was encountered in boring B-3 located in the western part of the site.

SLOPE STABILITY ANALYSIS

We completed an analysis of the potential slope stability impact of the proposed project by using topographic and grading information in project plans and the findings from our soil explorations. The location of the slope profile used for the analysis is shown in Plate 2 – Site Plan. The profile sections for the existing profile and the schematic proposed profile, and the analysis input parameters are provided in Attachment B.

The analyses were performed using the computer analysis program Slide 7.0 published by Rocscience, Inc. This program analyzes slope stability via various methods. For this study, Bishop's Modified Method of Slices was used to perform the analyses.

The calculated stability is represented as a factor of safety (FS) against slope failure. The FS value is dimensionless and is defined as the value of the resisting forces mobilized from the soil mass divided by the driving forces toward movement of the soil. An FS value of 1.0 represents a situation where both forces are equivalent, and the potential for movement of the soil is at or near its threshold. An FS value slightly above 1.0 indicates a slope with minimal stability. For the purposes of this study, an FS value of at least 1.5 is considered to indicate a sufficiently stable condition for the slope under permanent, static conditions. An FS value of at least 1.2 is considered sufficiently stable for a short-term dynamic condition such as seismic loading during an earthquake.

Analysis Parameters

The surface and subsurface soil types encountered in our soil explorations were categorized into discrete soil units, based on soil type classification and relative density or consistency. Analysis parameters for these soil units (unit weight, cohesion, friction angle) were obtained from published correlations with standard penetration test (SPT) data or other density and consistency observations, soil grain-size properties; typical friction angle and cohesion values published in technical literature; and our experience with past stability analyses involving similar soil types. The soil parameters developed from this analysis are summarized in the following table.

Soil Unit Descriptions and Parameters

Unit	Soil Description	Unsaturated Unit Weight (pcf)	Internal Cohesion (psf)	Friction Angle (deg)
I	Loose SILT and SANDY SILT; Medium Stiff to Stiff CLAYEY SILT	105	100	28
II	Medium Dense SILT and SANDY SILT	112.5	100	33
III	Medium Dense SILT and Very Stiff CLAYEY SILT	110	400	32
IV	Dense SANDY SILT to SILTY SAND	125	100	38

Analysis Results

Minimum failure surfaces calculated from the analyses are illustrated in the plots provided in Attachment A to this letter. In cases where the minimum failure surface has an FS value at or above 1.5 for the static case or 1.2 for the seismic case, only the minimum surface is illustrated. For cases where failure surfaces having FS values below 1.5 for the static case or 1.2 for the seismic case are calculated, each of those surfaces is illustrated.

Existing Profile

A minimum FS value of 2.44 was calculated for potential failure surfaces during static site conditions. A minimum FS value of 1.54 was calculated for potential failure surfaces during seismic conditions. The FS values for the static and seismic conditions exceed the minimum criteria of 1.5 and 1.2, respectively, for indicating acceptable stability of the slope profile. The

Schematic Post-Construction Profile

A schematic post-construction profile which includes a lower/basement floor elevation that is approximately 1.5 feet lower than the elevation of the lower floor of the existing residence was used for our analysis. An FS value of 2.65 was calculated for the minimum failure surface for the static case, and an FS value of 1.69 was calculated for the seismic case. These FS values meet the minimum criteria for indicating acceptable stability of the slope profile. Further lowering of the elevation of the lower floor of the western part of the new residence would further increase the calculated FS values, if lower elevations are proposed for the project.

GEOLOGIC HAZARD AREA REVIEW

We reviewed available geologic hazard areas information on the City of Mercer Island Information and Geographic Services (IGS) website. The information indicates that the project site is located within erosion, potential landslide, and seismic hazard critical areas. According to the IGS information, no documented landslides are identified on the project site. An undocumented landslide is indicated to have occurred on the east part of the north adjacent property (3058 – 68th Avenue SE); however, no details about this landslide (such as date, size, type, or cause) were found in the IGS information. The IGS mapping of the potential landslide and soil erosion hazard areas at the site property and immediate vicinity is illustrated in Plates 3A and 3B – Geologic Hazard Areas Mapping.

Potential Landslide Hazard Area

Identification of Potential Landslide Hazard Area

During our investigation, we observed no indications of soil instability or erosion on the site property. As noted in our reconnaissance findings, we observed minor water seepage at the ground surface on the eastern part of the site property. Also, as discussed above, groundwater seepage was encountered in borings B-1 and B-2 located in the east and middle parts of the site. Saturated soils also were encountered at depths of approximately 17 to 19 feet in these borings.

A recent topographic survey of the site property indicates that an area with slopes steeper than 40 percent grade and higher than 10 feet is present on the east side of the site property. This steep slope area has a maximum height of approximately 12 feet and a maximum inclination of approximately 52 percent grade. This slope area does not appear to extend upward onto the adjacent property to the east, but does appear to extend laterally onto adjacent property to the south. The approximate extent of this slope area is illustrated in Plate 2 – Site Plan.

Based on the conditions described above, the site property meets the criteria to be designated as a potential landslide hazard area because of the presence of apparent mass wasting or landslide deposits, water seepage, and subsurface water seepage or groundwater zones.

Evaluation of Potential Landslide Hazard

Based on the findings from our soil exploration activities and slope stability analysis, it is our opinion that the proposed project has minimal risk to adversely affect the stability of the site or of adjacent property, provided that the design and construction of the proposed residence conforms with the recommendations in this report and substantially conforms with the anticipated post-construction profile used in our stability analysis.

Mitigation of Potential Landslide Hazard

The potential landslide hazard for the site can be mitigated by 1) lowering of the grade in the western part of the new residence footprint by approximately 2 feet or more; 2) supporting the new residence on a system of small-diameter steel pipe piles that are embedded into the underlying dense soils, 3) using engineered retaining walls to minimize the extent of graded slopes to accommodate grade changes; 3) collecting drainage behind basement walls and other retaining walls and directing it via tightline to an approved discharge location; and 4) minimizing temporary and permanent unsupported excavations in the eastern part of the site, consistent with the recommendations in this report.

<u>Seismic Hazard Area</u>

IGS mapping indicates that the project site is located within a seismic hazard area. In our opinion, however, the site has minimal susceptibility to soil liquefaction or lateral soil spreading due to seismic events based on the presence of predominantly silty, medium dense to dense soils and minor amount of water seepage observed in some of the borings from our exploration activities. Therefore, no supplemental, site-specific geotechnical measures are recommended for mitigation of seismic hazard for the project.

Soil Erosion Hazard Area

Identification of Soil Erosion Hazard Area

IGS mapping indicates that the project site is located within a seismic hazard area. Based on the slope conditions on the site, the eastern and western portions of the site (generally east and west of the existing residence) have conditions which meet the criteria for being designated as soil erosion hazard areas.

Evaluation of Soil Erosion Hazard

In our opinion, the potential risk from soil erosion at the site in the existing condition is low because of the existing developed and landscaped conditions on the site and the predominantly fine-grained character of the soils. However, exposure of the soils by construction activity, can increase the potential for soil erosion if appropriate controls are not implemented and maintained.

Mitigation of Soil Erosion Hazard

It is our opinion that the recommended temporary and permanent erosion and sediment controls and excavation recommendations presented in this report will mitigate the risk of soil erosion at the site to minimal levels. These measures should include re-stabilization of areas where soils have been exposed or disturbed during construction, such as by re-vegetating or re-surfacing.

Sequence of Geologic Hazard Areas Mitigation Measures

We have reviewed the proposed project with respect to the mitigation sequencing approach described in MICC 19.07.110. In our opinion, the proposed project should include the following sequence of measures to mitigate the potential impact to the potential landslide hazard and soil erosion hazard areas on the site and adjacent property:

- Install temporary erosion controls prior to the start of clearing and earthwork on the site;

- Temporary unsupported excavations that are located in the eastern and middle portions of the site and more than 2.5 feet in height should be sloped no steeper than 1.5H:1V unless evaluated and approved by the geotechnical engineer. Temporary unsupported excavations on the western part of the site and more than 2.5 feet in height should be sloped no steeper than 1H:1V unless evaluated and approved by the geotechnical engineer.

- Temporary and permanent unsupported excavations more than 2.5 feet in height should be located a minimum of 5 feet from the existing concrete retaining wall and the existing modular concrete block wall in the eastern part of the site if these walls are to remain in place for the project;

- Exposed slopes and stockpiled soils should be covered with plastic sheeting when not being worked for more than seven days (but should be covered at all times when not being worked during wet weather). The sheeting should be secured against weather or other possible disturbance; and

- Ground disturbance associated with construction for the proposed project should be restabilized by installing new landscaping and vegetation typical of residential projects.

- Remove temporary erosion controls after re-stabilization of exposed soils is completed.

SITE SEISMIC DESIGN CLASSIFICATION

In our opinion, the project site can be assigned Seismic Site Class D (Medium Dense Soil Profile), per the International Building Code 2018 Edition (IBC 2018). Our determination is based upon the findings from our subsurface investigation activities and our knowledge and understanding of the typical deeper subsurface soil conditions in the site vicinity.

The seismic design parameters applicable for the site based on this site class per IBC 2018 are as follows:

$S_s = 1.408g$ $S_{ms} = 1.408g$ $S_{ds} = 0.939g$
$S_1 = 0.490g$ $S_{m1} = null$ $S_{d1} = null$

The peak ground acceleration for the site adjusted for site class effects is = 0.663g

RECOMMENDATIONS

The soils encountered in the soil borings from our investigation were found to include loose soils to depths of approximately 5 to 12 feet below ground surface. In our opinion, these soils are susceptible to settlement during and after application of loading from either 1) an additional building story on existing footings, and from 2) loads on new footings. The amount of potential settlement of the existing footings and of new footings is largely dependent upon the amount and distribution of new applied loads and potential local variations in underlying soil density or consistency. As a general estimate, it is our opinion that settlement in the range of up to approximately 1 to 2 inches as either total or differential settlement could occur, with new footings having relatively greater settlement than existing footings. Due to the predominantly silty nature of the soils, this settlement may not be completed during construction and may continue over the span of many years. Based on these considerations, we recommend that the existing foundations and new footings be supported on small-diameter steel pipe piles.

Our recommendations regarding these and other geotechnical aspects for the proposed project are presented below in the following sections of this report.

Earthwork

Site Clearing and Erosion Control

The area where construction work will be performed should be cleared of vegetation, topsoil, organics, debris, and any other deleterious materials that are found. These materials should be hauled off site or used for landscaping, as appropriate; they should not be used as structural fill or retaining wall backfill for the project.

Temporary erosion and sedimentation controls (TESCs) should be installed as part of site clearing activities. TESCs for the project can include using silt fences, check dams, straw mulch, hay bales, and a stabilized construction entrance. The silt fences or other barrier controls should be placed along the cross-slope and down-slope boundaries of the disturbed areas to prevent sediment-laden runoff from being discharged off site. Exposed soils, including stockpiled soils, should be covered with plastic sheeting when they are not being worked.

Surface runoff should not be allowed to flow over the top of slopes into excavations. During wet weather, exposed slopes should be covered with plastic sheeting to prevent erosion or softening.

Excavations and Slopes

Temporary excavation slopes should not be greater than the limits specified in local, state and federal government safety regulations, unless approved on-site by the geotechnical engineer. Temporary cuts in proximity to property lines or to structures should be sloped at inclinations no steeper than 1.25H:1V (Horizontal: Vertical). In other situations, we recommend that cuts which are greater than 4 feet in height should be sloped at inclinations no steeper than 1.25H:1V (Horizontal: Vertical). Permanent unreinforced or unsupported slopes on the site should be inclined no steeper than 2.5H:1V.

During our site exploration activities, water seepage was observed at the base of the concrete block retaining wall east of the existing residence, and also at depths of approximately 8 to 10 feet bgs in borings B-1 and B-2 in the east and middle parts of the site. Based on these findings, there is a potential for encountering water seepage in excavations made for the project. In situations where water seepage or other adverse conditions are observed, excavations may need to be sloped to shallower inclinations than those recommended above. We recommend that a GEO Group Northwest representative be on site during excavation of cut slopes to verify anticipated geologic conditions and to evaluate slope stability, particularly if water seepage, caving soils, fills, or other adverse conditions are encountered. If adequate space is not available to maintain open cuts per the recommendations in this report, engineered support may be required to provide lateral support to these excavations.

Subgrade Preparation

After the completion of site clearing and excavation, soils in areas to receive structural fill, concrete slabs, sidewalks, or pavements, should be prepared to a firm, unyielding condition. The prepared subgrade should be observed and approved by the geotechnical engineer. Any detected soft spots or disturbed areas should be compacted or excavated and replaced with compacted structural fill or crushed rock as directed by the geotechnical engineer.

Temporary Excavation Dewatering

As discussed above, there is a potential for encountering water seepage in excavations made for the project. We anticipate that the rate of seepage, if encountered, will be relatively low and can be managed by using temporary drainage swales and collection sumps in the excavation. The water collected by the sumps can then be tightlined to an approved temporary discharge point via a sediment interceptor. Additional dewatering measures or sizing design, if needed, can be provided by a civil engineer.

Structural Fill

Fill material used to support foundations, floors, sidewalks, driveways, and patios, constitutes structural fill. Material used as structural fill should have the following characteristics:

- Be a predominantly granular material;
- Be free of organic material and other deleterious substances;
- Have a maximum particle size of three (3) inches in diameter.

The material should be placed at or near its optimum moisture content. The optimum moisture content is the water content in the material that enables it to be compacted to the maximum dry density for a given compaction effort. Materials which contain moisture significantly greater or lesser than the optimum content cannot be effectively compacted to an acceptable dense condition.

We anticipate that the site soils which are excavated for the project will not be practical to use as structural fill, due to their silty character and elevated moisture content. We recommend that the project contractor should anticipate needing to use an acceptable imported material instead of the site soils for structural fill.

Structural fill material should be placed in horizontal lifts not exceeding 10 inches in loose thickness, and each lift should be compacted to at least 92 percent of the material maximum density, as determined by ASTM Test Designation D-1557-91 (Modified Proctor Test), with the exception that the top one foot of fill below exterior slabs and pavements should be compacted to at least 95 percent of its maximum dry density.

The geotechnical engineer should evaluate in advance the suitability of materials that are proposed for use as structural fill. During wet weather, an imported granular material containing no more than five (5) percent fines (i.e., particles passing a U.S. No. 200 mesh sieve) is recommended for use as structural fill, because it will provide uniformity in character and be relatively easy to compact to structural fill specifications. We recommend that the geotechnical engineer monitor the placement and compaction of structural fill in order to verify conformance with the above recommendations.

Wet Weather Earthwork Considerations

We recommend that the following measures be implemented in supplement to or in replacement to the standard erosion and sediment control recommendations for earthwork performed during the wet weather season.

- Cut and fill slopes exposed during construction should be covered with plastic sheeting when they are not being worked. Soil stockpiles also should be covered when not being worked.

- Structural fill should consist of free-draining material with not more than 5% of the material passing a #10 sieve.

- Earthwork should not be performed during periods of heavy precipitation, in order to minimize rutting and tracking of soils by construction equipment traffic. Equipment that has lower potential to cause rutting or other soil disturbance should be used.

- Soil subgrades in areas where footings or slabs are to be built should be protected from softening due to standing water or to disturbance if they will be left exposed for a prolonged period. Plastic sheeting can be used for untrafficked areas. A layer of clean crushed 1.25”-size gravel, can be used in areas where light construction traffic cannot be avoided.

- Erosion control measures, such as silt fences, straw bales and wattle, etc., should be arranged to control soil erosion and sediment travel as appropriate within the project limits as well as along its downslope and cross-slope perimeter.

- Temporary excavation dewatering measures, consistent with the recommendations provided in the Earthwork section of this report, should be implemented if seepage newly develops. The measures should be reviewed and modified as necessary to accommodate changes in the rate of seepage or degree of needed treatment prior to discharge.

- Earthwork should be performed in a sequence of limited areas, where feasible, to limit the extent of exposed soil during the project.

- We recommend that we visit the project site upon completion of the installation of the perimeter erosion controls to verify their suitability. During earthwork for construction, we recommend that we visit the site if precipitation greater than 0.5 inches in a 24-hour period occurs, in order to monitor the performance of the TESC measures and monitor excavation stability. We also recommend that we visit the site during backfilling work to observe that materials are being used are appropriate for wet weather conditions and are being properly placed and compacted.

Foundations

Based on the findings from our subsurface investigation activities, we recommend that the new residence, including existing footings that will support increased loads, be supported on small-diameter steel pipe piles that are embedded into the deeper medium dense and dense soils, as discussed below.

<u>Small-Diameter Pipe Piles</u>

Driven small-diameter steel pipe piles (also known as pin piles) can be used to support new or existing foundations for the proposed project. The piles are driven until the resistance of the subsurface soils sufficiently retards or terminates the advancement of the piles; this condition typically is called “refusal”. The depth at which refusal is achieved is dependent upon the specific combination of pipe and driving hammer that are used, and the characteristics of the subsurface soils that the pile encounters.

The following table presents design criteria for commonly-available combinations of driving hammers and pipe sizes. The allowable bearing capacities include a factor of safety of 2.

Pipe Pile Design Criteria

Pipe Diameter	**Pipe Wall Thickness**	**Hammer Weight Class**	**Hammer Type**	**Refusal Criteria***	**Allowable Capacity**
2 inch	Schedule 80	90 pound	jackhammer	60 sec/inch	3 tons
2 inch	Schedule 80	140 pound	Rhino hammer	60 sec/inch	3 tons
3 inch	Schedule 40	650 pound	TB225†	12 sec/inch	6 tons
3 inch	Schedule 40	850 pound	TB325†	10 sec/inch	6 tons
4 inch	Schedule 40	850 pound	TB325†	16 sec/inch	10 tons
4 inch	Schedule 40	1100 pound	TB425†	10 sec/inch	10 tons

* = Maximum penetration rate to be sustained through at least 3 time cycles of continuous driving.
† = Teledyne hydraulic hammer model number, or equivalent.

The soil conditions encountered in the borings for our investigation are considered to be potentially corrosive due to the observation of saturated soil intervals. Therefore, it is our opinion that the piles (and pile couplers) should consist of galvanized pipe.

We estimate the allowable settlement of the pipe piles to be up to one-quarter (1/4) inch for the allowable capacities presented in the table above. No reduction in the pile capacities is required if the pile spacing is at least three times the pile diameter. A one-third increase in the above allowable pile capacities can be used when considering short-term transitory wind or seismic loads.

By themselves, pipe piles do not generate lateral capacities. Lateral forces can be resisted by the passive earth pressures developed from friction between grade beams and the subgrade soils, or from using battered pipe piles or helical anchors. An allowable passive soil pressure of 300 pcf equivalent fluid weight, and coefficient of friction of 0.35 for the soil subgrade and the footings can be used to design the footings or grade beams for lateral resistance. The use of battered piles or helical anchors should be designed by a structural engineer.

The performance of pipe piles is dependent on how and to what bearing stratum the piles are installed. Since a completed pile in the ground cannot be observed, it is critical that judgment and experience be used as a basis for determining the driving refusal and acceptability of a pile. Therefore, we recommend that we monitor the pile installation operation, collect and interpret installation data and verify achievement of pile driving refusal. We also suggest that the contractor's equipment and installation procedures be reviewed by us prior to pile installation to help mitigate problems which may delay the progress of the work.

Slab-on-Grade Floors

We recommend that new slab-on-grade floors be supported on compacted medium dense native soils or on structural fill that is placed on a subgrade of compacted medium dense native soils. Alternatively, the floors can be structurally supported by 1) connection to adjacent footings or grade beams and reinforcement with a grid of #4 steel rebar having 12" spacing on center. Structurally supported floors should be designed by a structural engineer.

To avoid moisture build-up on the subgrade, floor slabs should be placed on a capillary break, which is in turn placed on the prepared subgrade. The capillary break should consist of a layer, at least 6 inches thick, of free-draining crushed rock or gravel containing no fines and no more than five percent material finer than a No. 4 sieve. A vapor barrier should be placed over the capillary break to reduce upward transmission of water vapor through the slab, if such transmission is undesirable.

Conventional Concrete Basement and Retaining Walls

The following recommendations regarding conventional concrete basement walls and retaining walls are provided below for use if the construction of conventional concrete basement or retaining walls up to approximately 10 feet in height is proposed.

Basement walls and conventional retaining walls that are 4 feet or more in height should be supported on conventional footings or small-diameter pipe piles as discussed in the foundation recommendations presented above in this report and should be designed by a structural engineer.

These walls also should be fully drained to prevent the development of hydrostatic pressure against these walls.

Conventional concrete retaining walls which are free to rotate on top (unrestrained) are considered capable of yielding and should be designed using an active earth pressure. Concrete retaining walls which are restrained horizontally at the top (such as basement walls) are considered unyielding and should be designed using an at-rest earth pressure. Our recommended soil engineering parameters for fully-drained retaining wall design are as follows:

Active Earth Pressure

- 35 pcf, equivalent fluid pressure, for level ground behind the walls;
- 50 pcf, equivalent fluid pressure, for wall backslope of 2H:1V

At-Rest Earth Pressure

- 45 pcf, equivalent fluid pressure, for level ground behind the walls;
- 60 pcf, equivalent fluid pressure, for wall backslope of 2H:1V

Passive Earth Pressure

- 350 pcf, equivalent fluid pressure, for undisturbed, medium dense native soil or structural fill, and level ground in front of the wall for a distance of two times the wall height;

Base Friction

- 0.35 for competent, native soil or structural fill

Surcharge loads imposed on walls due to driveways and traffic (including that during construction), upward sloping ground, or other conditions that could impose loads against the walls, should be added to the active and at-rest earth pressures stated above. Also, downward sloping ground in proximity to the walls should be evaluated, as it may have the effect of reducing the value of the allowable passive earth pressure stated above.

To prevent the buildup of hydrostatic pressure behind conventional basement or retaining walls, we recommend that a vertical drain mat, such as Miradrain 6000 or similar product, be used to facilitate drainage adjacent to the wall. The drain mat should extend from near the finished surface grade, downward to the bottom of the wall. A drainage collection pipe consisting of rigid 4”-diameter perforated PVC pipe surrounded with gravel and geotextile filter fabric (Mirafi 140NL, or equivalent) should be laid alongside the base of the wall and sloped to an acceptable tightline connection.

In addition to the drain mat, we recommend that a zone of free-draining backfill material at least 12 inches wide should be placed against the back of the wall. This backfill should extend downward to the drainage collection pipe. A layer of non-woven geotextile filter fabric should separate the free-draining backfill material from adjacent soils or fills. These recommendations are schematically illustrated in Plate 4 – Typical Retaining Wall Drainage Detail.

The top 12 inches of the fill behind the wall can consist of topsoil if desired. This material can be separated from the underlying more granular drainage material by a geotextile fabric, if desired. Alternatively, the surface can be sealed with asphalt or concrete paving. Nearby final grades should be sloped to drain away from the wall, or other measures (such as strip or ribbon drains) should be used to intercept surface water that flows toward the wall.

The backfill for conventional concrete retaining walls should be compacted to a dense condition to mitigate the potential for later ground settlement or excessive saturation. Wall backfill that also will support structures or slab should be placed and compacted as structural fill. We recommend that restrained walls not be backfilled until their restraint has been completed, unless approved by the project structural engineer. The compacting machinery that is used should be compatible with the wall's resistance capacity against the temporary loading effects produced by operation of the machinery. In this respect, the contractor should exercise care if heavy machinery such as a vibratory roller or hoe pack is used.

Surface Drainage

During construction, water should not be allowed to stand in areas where footings, slabs, or pavements are to be constructed. We recommend that ground surfaces be sealed at the end of the day by tracking over them with a piece of construction equipment or by compacting them, to reduce the potential for moisture infiltration which can degrade soil quality.

We recommend that storm water drainage from building roof areas and driveways be collected into a tightline system that conveys the water to an approved discharge location. Storm water should not be allowed to develop into concentrated flows on the ground surface, because concentrated flow can lead to soil erosion and rutting. Concentrated surface water also should not be allowed to onto the steep slope area on site and should not be directed onto adjacent properties. Final site grades should direct surface water away from buildings.

Subsurface Drainage

We recommend footing drains should be installed alongside new perimeter foundations and basement walls. The drains should consist of a 4-inch minimum diameter, perforated, rigid PVC drain pipe laid at the bottom of the footing or wall with the perforations facing downward. The drain line should be bedded on, surrounded by, and covered with a washed rock or gravel. The drain rock and pipe also should be wrapped with a layer of durable non-woven geotextile fabric. These recommendations are schematically illustrated in Plate 5 – Typical Footing Drain Detail.

The footing drain lines should be sloped at sufficient gradient to generate flow and should be tight-lined to an appropriate stormwater discharge location or collection sump system. The subsurface drainage lines should not be connected to roof downspout or other surface drainage lines.

LIMITATIONS

This report has been prepared for the specific application to this site for the exclusive use of Mr. Sam R. Franklin and his authorized assignees or agents. Any other use of this report is solely at the user's own risk. We recommend that this report be included in its entirety in the project contract documents for reference during construction.

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

CLOSING

We appreciate this opportunity to provide you with geotechnical engineering services. Please feel free to contact us if you have any questions regarding this report or desire additional services.

Sincerely,

GEO Group Northwest, Inc.

8/30/2022

Keith Johnson
Project Geologist

8/30/2022

William Chang, PE
Principal Engineer

Plates and Attachments:

- Plate 1 – Site Location Map
- Plate 2 – Site Plan
- Plate 3A – Geologic Hazard Areas Mapping
- Plate 3B – Landslide Hazard Area Detail Mapping
- Plate 4 – Typical Retaining Wall Drainage Detail
- Plate 5 – Typical Footing Drain Detail

- Attachment A – Boring Logs
- Attachment B – Slope Stability Analysis Data

Source: King County GIS, 2021.

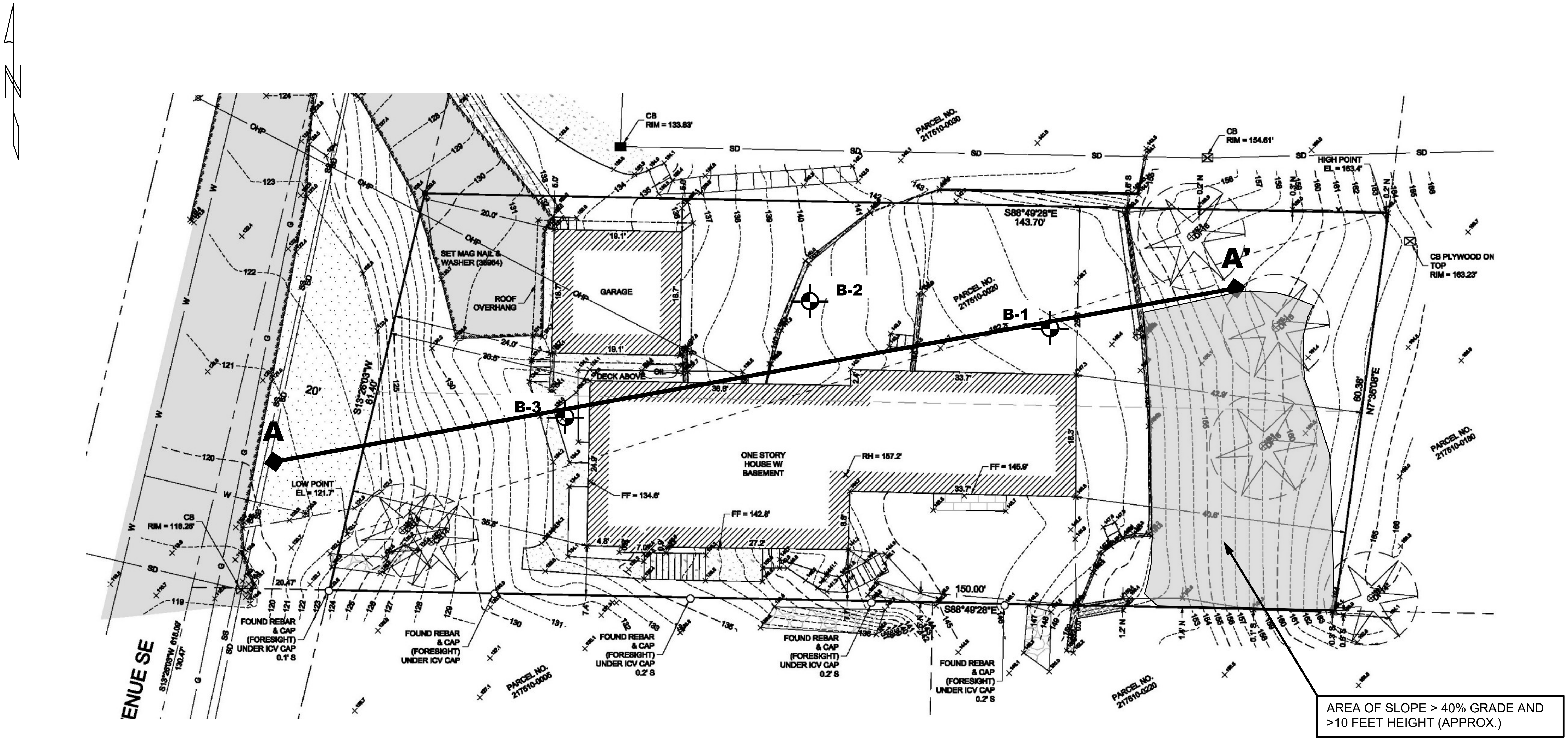
GEO Group Northwest, Inc.

Geotechnical Engineers, Geologists, & Environmental Scientists

SITE LOCATION MAP

PROPOSED RESIDENCE
3064 - 68TH AVENUE SE
MERCER ISLAND, WASHINGTON

SCALE:	1" = 2000'	**DATE:**	8/26/2022	**MADE:**	KJ	**CHKD:**	WC	**JOB NO:**	G-5713	**PLATE**	1



LEGEND

B-1 — EXPLORATORY BORING LOCATION (APPROXIMATE)

A — A' — LINE OF SITE PROFILE FOR

0 15 30

SCALE: 1 INCH = 15 FEET

Source: Topographic Survey for Sam Franklin, by Site Surveying, Inc., dated 5/4/2022.

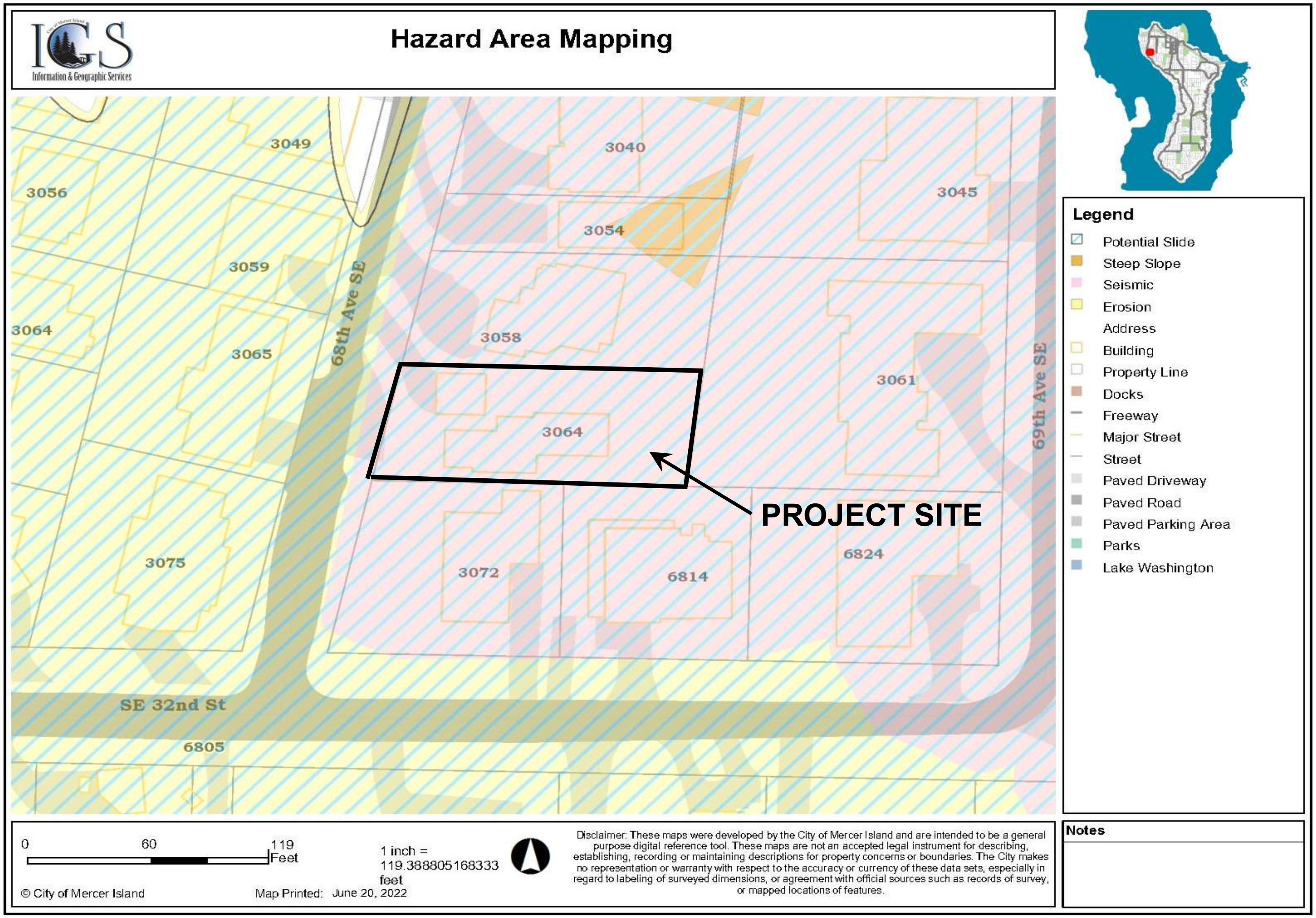
GEO Group Northwest, Inc.

Geotechnical Engineers, Geologists, & Environmental Scientists

SITE PLAN

PROPOSED RESIDENCE
3064 - 68TH AVENUE SE
MERCER ISLAND, WASHINGTON

SCALE	1" = 15'	DRAWN BY	KJ	CHECKED BY	WC	DATE	8/26/2022	PROJECT NO.	G-5713	PLATE	2



Source: City of Mercer Island IGS, retrieved June 2022.

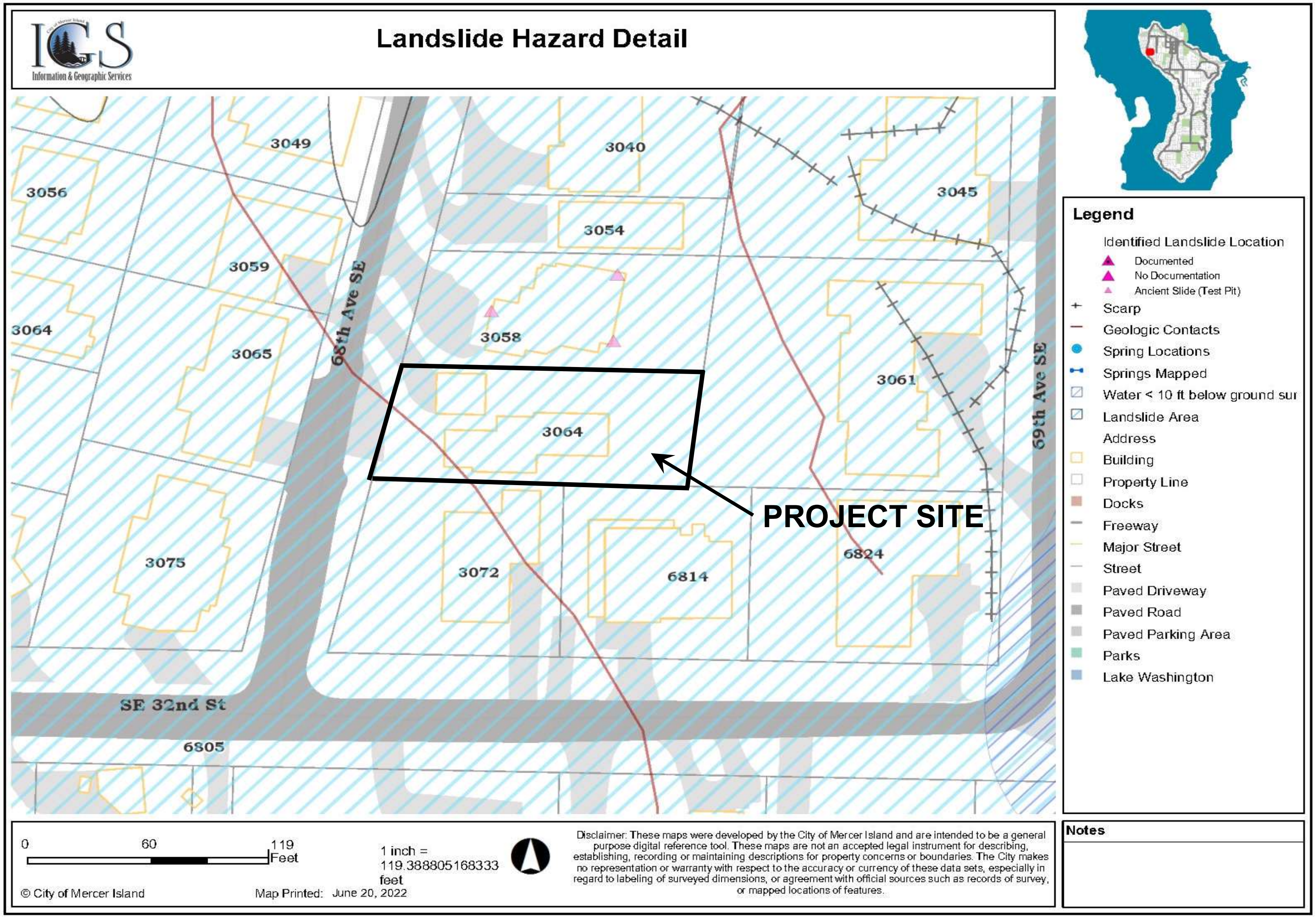
GEO Group Northwest, Inc.

Geotechnical Engineers, Geologists, & Environmental Scientists

GEOLOGIC HAZARD AREAS MAPPING

PROPOSED RESIDENCE
3064 - 68TH AVENUE SE
MERCER ISLAND, WASHINGTON

SCALE:	As Shown	**DRAWN:**	KJ	**CHECKED:**	WC	**DATE:**	8/26/2022	**PROJECT NO.:**	G-5713	**PLATE**	3A



Source: City of Mercer Island IGS, retrieved June 2022.

GEO Group Northwest, Inc.

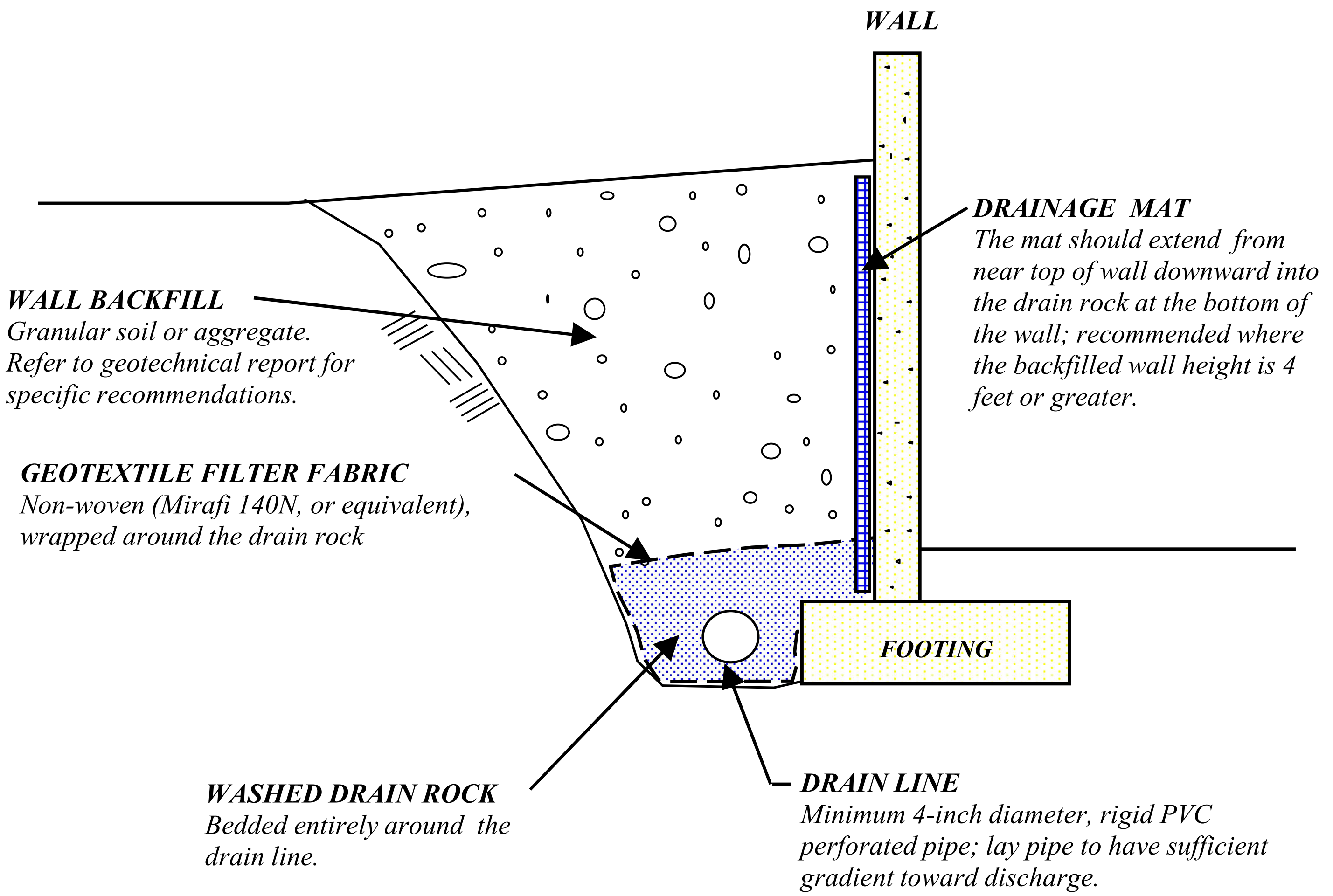
Geotechnical Engineers, Geologists, & Environmental Scientists

GEOLOGIC HAZARD AREAS MAPPING

PROPOSED RESIDENCE
3064 - 68TH AVENUE SE
MERCER ISLAND, WASHINGTON

SCALE:	As Shown	DRAWN:	KJ	CHECKED:	WC	DATE:	8/26/2022	PROJECT NO.:	G-5713	PLATE	3B

TYPICAL RETAINING WALL DRAINAGE DETAIL



NOT TO SCALE

NOTES:

1.) Do not substitute rigid PVC pipe with flexible corrugated pipe.

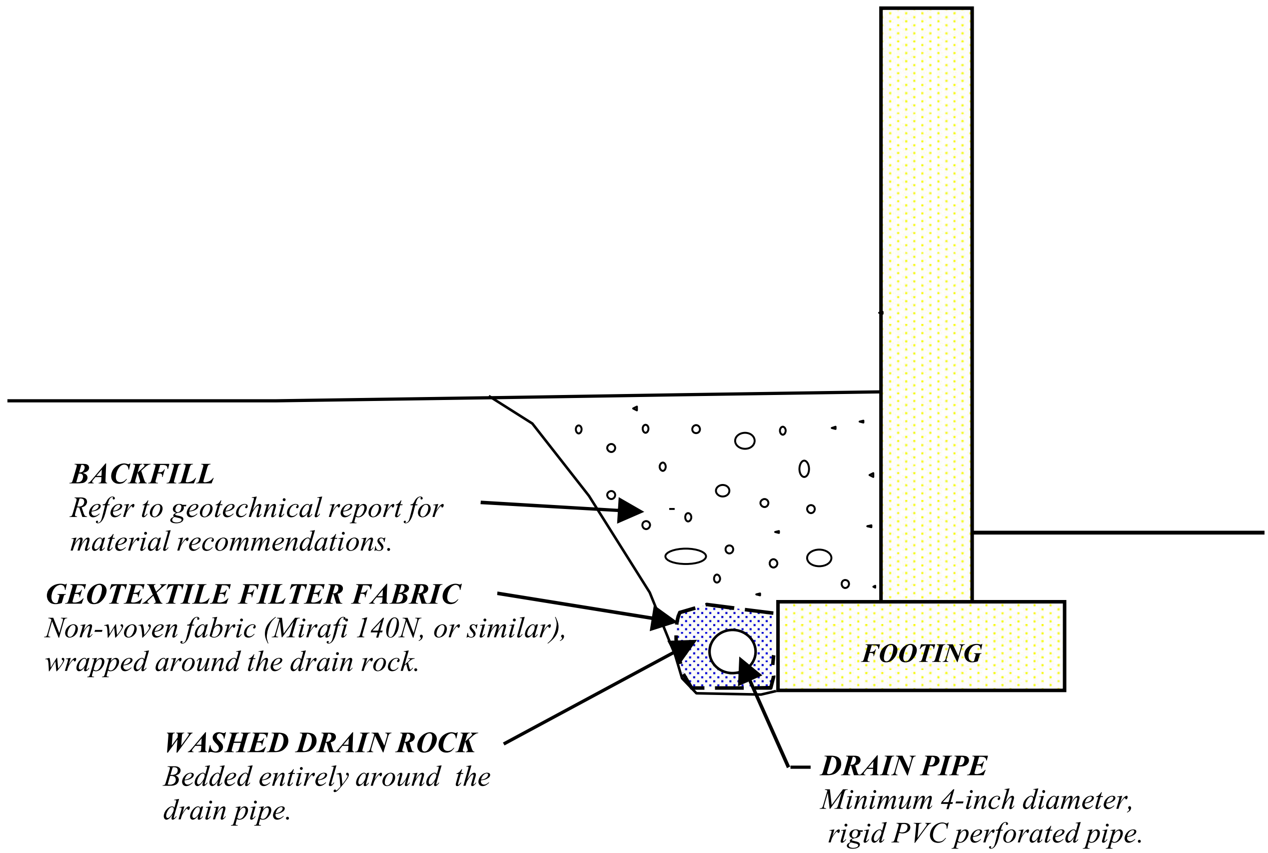
2.) Perforated PVC pipe should be tight jointed and laid with perforations oriented downward. The pipe should be gently sloped to provide flow toward the tightline or discharge location.

3.) Do not connect other drainage lines into the wall drainage system.

4.) Backfill should meet structural fill specifications if it will support driveways, sidewalks, patios, or other structures. Refer to the geotechnical engineering report for structural fill recommendations.

GEO Group Northwest, Inc. Geotechnical Engineers, Geologists, & Environmental Scientists			TYPICAL RETAINING WALL DRAINAGE DETAIL PROPOSED RESIDENCE 3064 - 68TH AVENUE SE MERCER ISLAND, WASHINGTON		
SCALE NONE	**DATE** 8/26/2022	**MADE** KJ	**CHKD** WC	**JOB NO.** g-5713	**PLATE** 4

TYPICAL FOOTING DRAIN DETAIL



NOT TO SCALE

NOTES:

1.) Do not substitute rigid PVC pipe with flexible corrugated pipe.

2.) Perforated PVC pipe should be tight jointed and laid with perforations oriented downward. The pipe should be gently sloped to provide flow toward the tightline or discharge location.

3.) Do not connect other drainage lines into the footing drainage system.

4.) Backfill should meet structural fill specifications if it will support driveways, sidewalks, patios, or other structures. Refer to the geotechnical engineering report for structural fill recommendations.

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

TYPICAL FOOTING DRAIN DETAIL

PROPOSED RESIDENCE
3064 - 68TH AVENUE SE
MERCER ISLAND, WASHINGTON

SCALE NONE	**DATE** 8/26/2022	**MADE** KJ	**CHKD** WC	**JOB NO.** G-5713	**PLATE** 5

ATTACHMENT A

G-5713

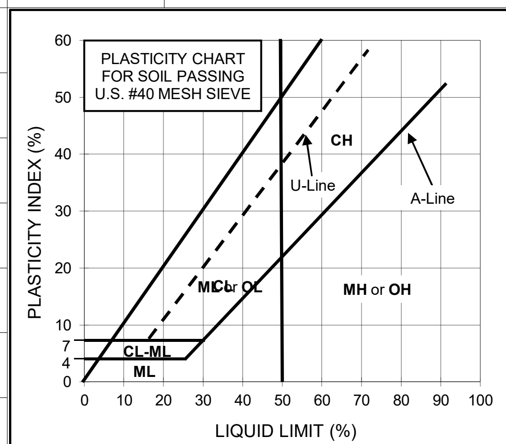
BORING LOGS

GEO Group Northwest, Inc.

SOIL CLASSIFICATION & PENETRATION TEST DATA EXPLANATION

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

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



SOIL PARTICLE SIZE

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

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

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

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

PLATE A1

BORING NO. B - 1

Logged By: KJ Date Drilled: 6/27/2022 Surface Elev. 147'
Drilled By: CN Drilling

Depth ft.	Elevation	USCS Code	Description	Sample Loc.	Sample No.	SPT Blow Counts	Water Content %	Other Tests/ Comments
		ML-CL	Grass lawn surface with approx. 4" of topsoils. Brown SILT to SANDY CLAYEY SILT, moist, loose,	I		2,4,5 (N=9)	28.0	high toughness
		ML-CL	Brown SANDY CLAYEY SILT, moist, loose to medium dense, fine grained, mottled with oxide stain below 3', becomes very fine and olive colored at bottom of sample.	I		1,4,5 (N=9)	32.1	high toughness
5		ML	Gray and brown SANDY SILT, mottled, very moist, medium dense, sheared texture.	I		5,7,12 (N=19)	37.8	med to low toughness
		SM	Gray SILTY SAND, very moist, medium dense, sand is very fine grained, very silty, sheared texture in bottom of sample.	I		8,16,13 (N=29)	27.5	
10		ML/SM	Olive SANDY SILT, moist, dense, sand is very fine grained, contains brown oxidized sheared zone, also dark gray portions.	I		10,17,21 (N=38)	27.1	med to low toughness
		ML	Gray SANDY SILT to SILTY SAND, moist, medium dense to dense, sand is very fine grained, no staining.	I		10,14,16 (N=30)	23.7	
15		ML	As above, dense.	I		12,14,21 (N=35)	23.9	
20		ML	Olive gray SANDY SILT, wet, medium dense, fine grained, no staining	I		4,8,14 (N=22)	28.3	
25								

LEGEND: I 2" O.D. SPT Sampler; II 2.5" O.D. California Sampler; ▽ Water Level noted during drilling; ▼ Water Level measured at later time, as noted

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

BORING LOG

PROPOSED RESIDENCE
3064 - 68TH AVENUE SE
MERCER ISLAND, WASHINGTON

JOB NO. G-5713 **DATE** 8/26/2022 **PLATE** A2

BORING NO. B - 1

Logged By: KJ
Drilled By: CN Drilling
Date Drilled: 6/27/2022
Surface Elev. 147'

Depth ft.	Elevation	USCS Code	Description	Sample Loc.	Sample No.	SPT Blow Counts	Water Content %	Other Tests/ Comments
		ML-SM	Olive gray SANDY SILT to SILTY SAND, very moist to wet, dense to very dense, sand is fine grained, no stain.			12,24,26 (N=50)	27.5	
5			Depth of boring: 26.5 feet. Drilling Method: Hollow-stem auger. Sampling Method: 2"-O.D. standard penetration test sampler driven with 140 lb. hammer and cathead. Groundwater seepage encountered at approx. 10, 19, and 24 feet during drilling.					
10								
15								
20								
25								

LEGEND: 2" O.D. SPT Sampler; 2.5" O.D. California Sampler; ▽ Water Level noted during drilling; ▼ Water Level measured at later time, as noted

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

BORING LOG

PROPOSED RESIDENCE
3064 - 68TH AVENUE SE
MERCER ISLAND, WASHINGTON

JOB NO. G-5713 **DATE** 8/26/2022 **PLATE** A3

BORING NO. B - 2

Logged By: KJ　　Date Drilled: 6/27/2022　　Surface Elev. 141'

Drilled By: CN Drilling

Depth ft.	Elevation	USCS Code	Description	Sample Loc.	Sample No.	SPT Blow Counts	Water Content %	Other Tests/ Comments
		ML	Overgrown landscaping and weeds at surface. Grayish brown clayey silt and fine sand below 4" of topsoils, moist, loose.	I		2,3,2 (N=5)	25.1	med to low toughness
		ML	Light olive brown SILT and SANDY SILT, moist, loose, thinly bedded, minor fine black organics and weak oxide stain.	I		1,2,3 (N=5)	24.8	
5		ML-CL	Brown to olive brown CLAYEY SILT and SANDY SILT, moist, loose, sand is fine grained with trace medium and coarse sand, weak mottling, olive fine silty sand lense in bottom of sample.	I		1,1,4 (N=5)	26.3	high toughness
		ML	Olive gray SILT and SANDY SILT, very moist to wet, very loose to loose, strongly mottled in upper part of sample, brown with less mottling below.	I		1,1,2 (N=3)	34.3	
10		ML-CL	Olive gray and brown CLAYEY SILT and SANDY SILT, moist, loose to medium dense, some wet fractures in upper part of sample, fractures in lower part are not wet, sheared texture fracture zones.	I		1,4,6 (N=10)	35.4	high toughness suspected seepage at 9 to 10 feet.
		ML	Gray SANDY SILT, moist, very dense, sand is very fine grained, faintly stratified, steep dipping fracture through lower part of sample, with green and rust color staining on surfaces.	I		10,21,41 (N=62)	30.6	
15		ML	Gray SANDY SILT, damp, dense, sand is very fine, some very sandy zones, no staining	I		13,20,25 (N=45)	20.9	
								suspected seepage at 18 to 19 feet.
20		ML	Gray to purplish gray SILT, moist, dense, no sand, no staining.	I		6,16,15 (N=31)	25.0	
25			Depth of boring: 21.5 feet. Drilling Method: Hollow-stem auger. Sampling Method: 2"-O.D. standard penetration test sampler driven with 140 lb. hammer and cathead. Groundwater seepage encountered at approx. 9 and 18 feet during drilling.					

LEGEND:
- 2" O.D. SPT Sampler
- 2.5" O.D. California Sampler
- ▽ Water Level noted during drilling
- ▼ Water Level measured at later time, as noted

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

BORING LOG

PROPOSED RESIDENCE
3064 - 68TH AVENUE SE
MERCER ISLAND, WASHINGTON

JOB NO. G-5713　**DATE** 8/26/2022　**PLATE** A4

BORING NO. B - 3

Logged By: KJ Date Drilled: 7/13/2022 Surface Elev. 134'
Drilled By: CN Drilling

Depth ft.	Elevation	USCS Code	Description	Sample Loc.	Sample No.	SPT Blow Counts	Water Content %	Other Tests/ Comments
		ML	Weeds with approx. 3" of topsoils at surface. Dark brown SILT to SANDY CLAYEY SILT, moist, loose to medium dense, sheared texture through much of sample.	I		2,4,6 (N=10)	18.9	
		ML-CL	Dark brown and dark grayish brown CLAYEY SILT and SANDY SILT, moist, loose, fine grained, sand is predominantly fine grained, mottled, very moist at bottom of sample, sheared texture through much of sample.	I		1,1,3 (N=4)	25.4	med toughness
5		ML	Light brown SILT, moist, loose, sheared texture, veined with rust color oxide staining, grades to dark green-gray unoxidized SANDY SILT in lower part of sample.	I		1,2,6 (N=8)	32.9	
		ML	Olive to olive brown SANDY SILT, moist, medium dense, sand is very fine grained, some very sandy portions,	I		5,8,13 (N=21)	26.4	
10		ML-SM	Olive to olive gray SANDY SILT to SILTY SAND, sand is very fine grained, contains brown oxidized sheared zone, also dark gray portions.	I		10,12,17 (N=29)	25.3	
		ML-SM	Olive to olive gray SANDY SILT to SILTY SAND, moist, dense, sand is very fine grained, no staining.	I		7,14,18 (N=32)	24.3	
15		ML-CL	Olive gray SANDY CLAYEY SILT, moist, medium dense, steeply inclined fracture surfaces in bottom half of sample approx. 6" apart, oxide stain on surfaces, some sheared soil with oxide staining at top of sample.	I		5,8,12 (N=20)	32.1	med to high toughness
20		ML-CL	Gray CLAYEY SILT, moist, medium dense, massive, no staining, some parting surfaces 60 degrees from horizontal in sample and some horizontal partings.	I		5,10,11 (N=21)	34.8	high toughness
25								

LEGEND:
- 2" O.D. SPT Sampler
- 2.5" O.D. California Sampler
- ▽ Water Level noted during drilling
- ▼ Water Level measured at later time, as noted

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

BORING LOG

PROPOSED RESIDENCE
3064 - 68TH AVENUE SE
MERCER ISLAND, WASHINGTON

JOB NO. G-5713 **DATE** 8/26/2022 **PLATE** A5

BORING NO. B - 3

Logged By: KJ
Drilled By: CN Drilling
Date Drilled: 7/13/2022
Surface Elev. 134'

Depth ft.	Elevation	USCS Code	Description	Sample Loc.	Sample No.	SPT Blow Counts	Water Content %	Other Tests/ Comments
		ML-CL	Gray CLAYEY SILT, moist, medium dense, laminated, no staining, no partings or fractures.			5,8,13 (N=21)	35.1	high toughness
5			Depth of boring: 26.5 feet. Drilling Method: Hollow-stem auger. Sampling Method: 2"-O.D. standard penetration test sampler driven with 140 lb. hammer and cathead. Groundwater not encountered.					
10								
15								
20								
25								

LEGEND:
- 2" O.D. SPT Sampler
- 2.5" O.D. California Sampler
- ▽ Water Level noted during drilling
- ▼ Water Level measured at later time, as noted

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

BORING LOG

PROPOSED RESIDENCE
3064 - 68TH AVENUE SE
MERCER ISLAND, WASHINGTON

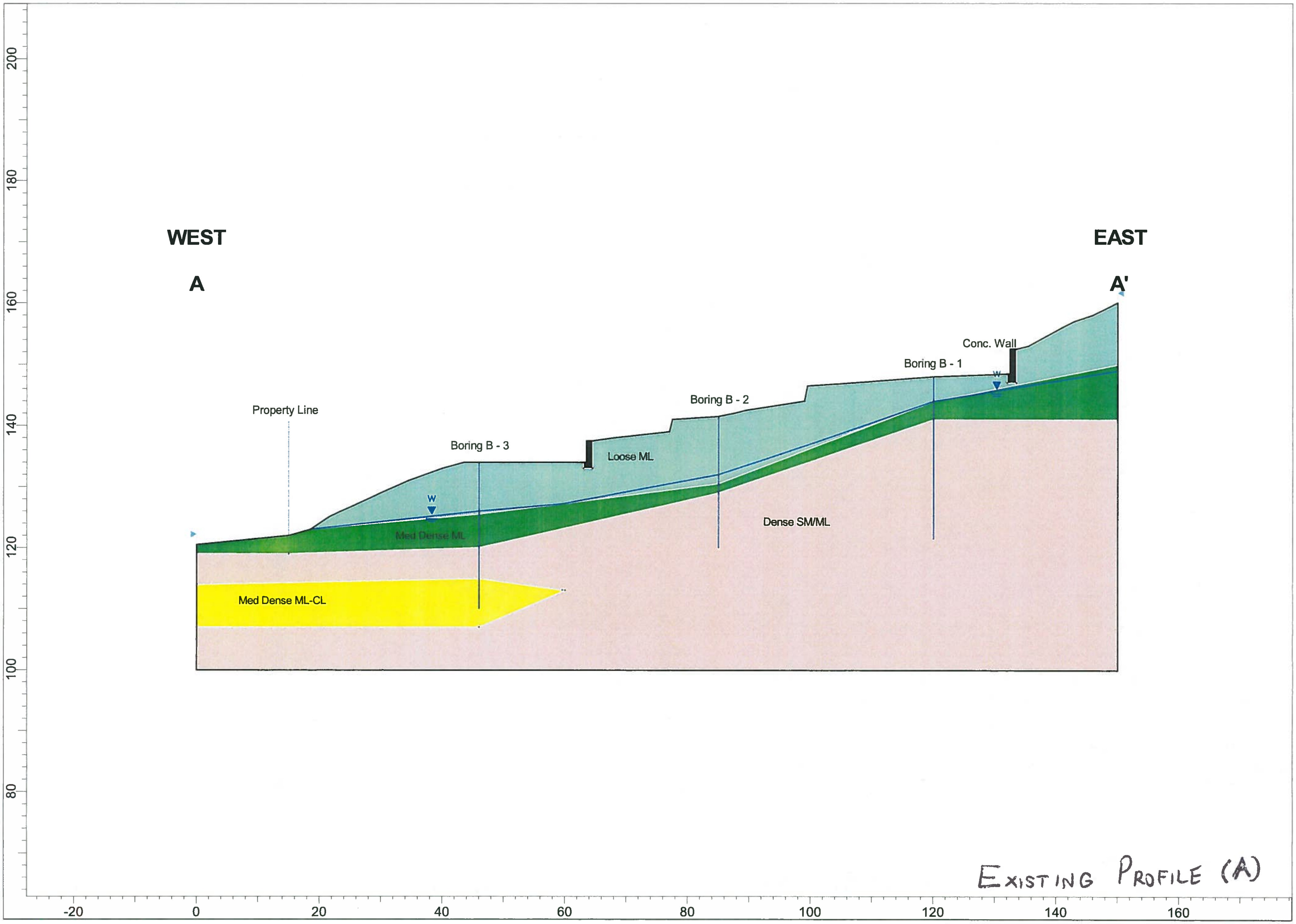
JOB NO. G-5713 **DATE** 8/26/2022 **PLATE** A6

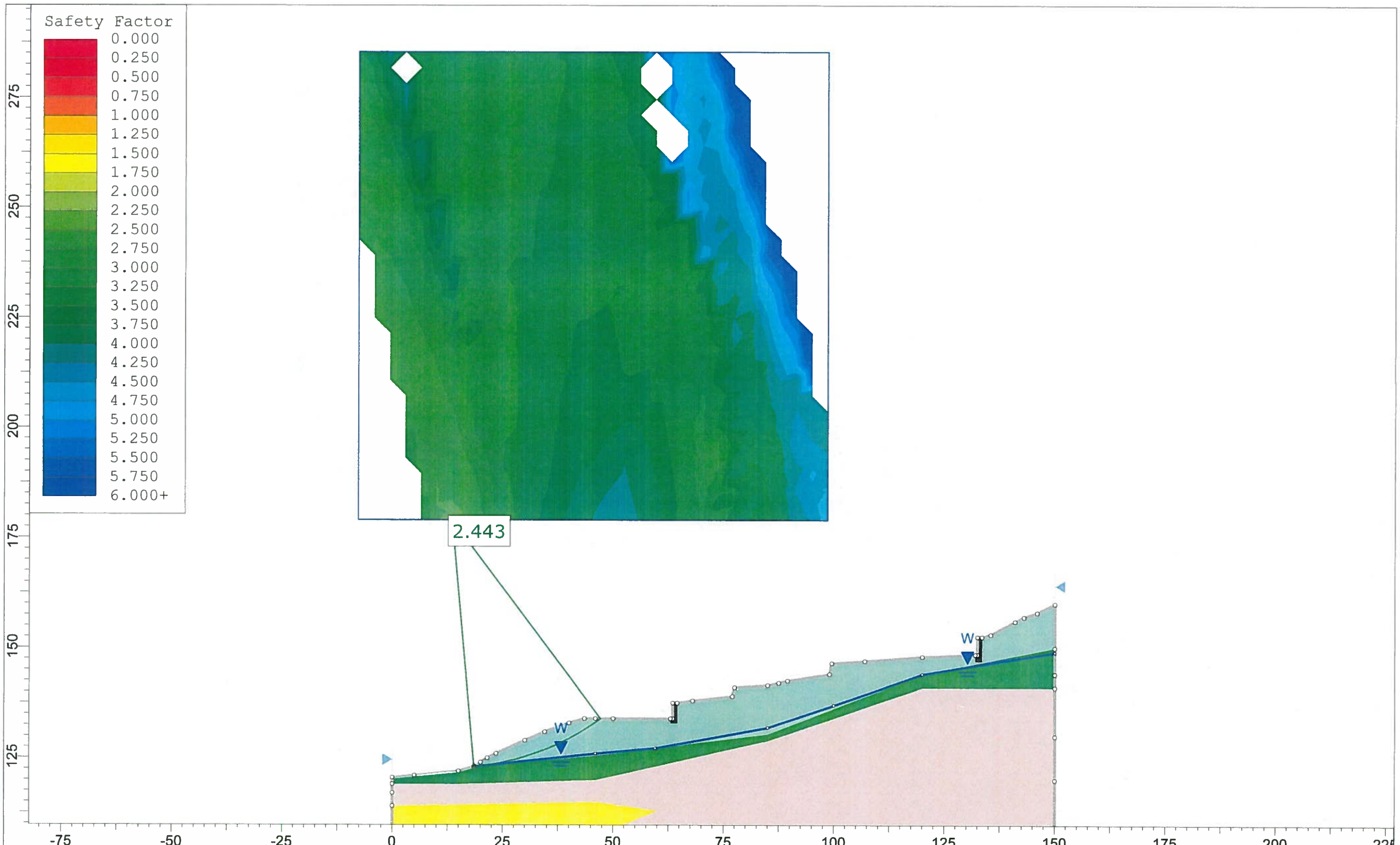
ATTACHMENT B

G-5713

SLOPE STABILITY ANALYSIS DATA

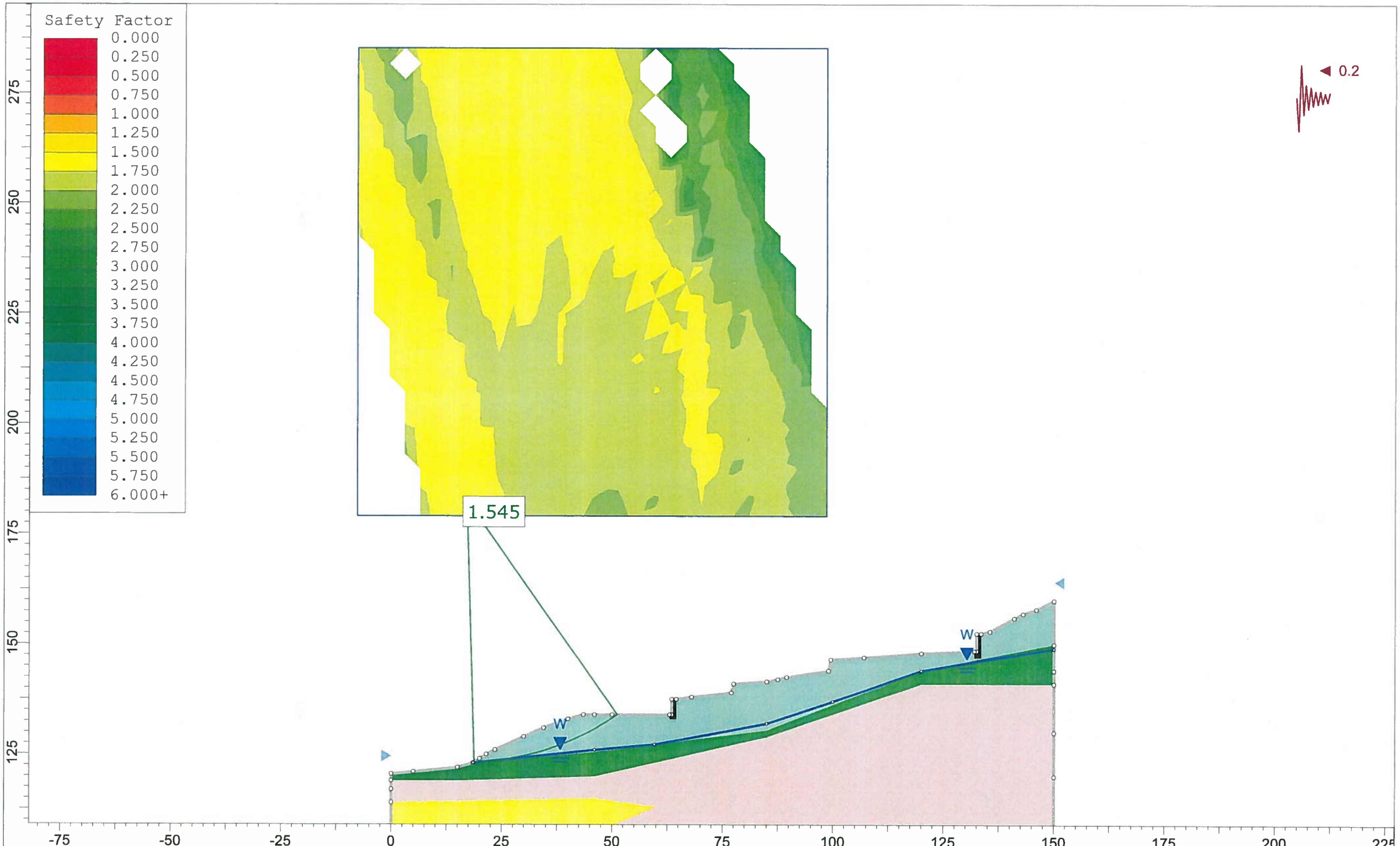
GEO Group Northwest, Inc.


WEST
A
EAST
A'
Property Line
Boring B - 3
Boring B - 2
Boring B - 1
Conc. Wall
Loose ML
Med Dense ML
Dense SM/ML
Med Dense ML-CL
W
W
200
180
160
140
120
100
80
-20
0
20
40
60
80
100
120
140
160
EXISTING PROFILE (A)



rocscience	Project	New Residence, 3064 - 68th Ave SE, Mercer Island, WA	
	Analysis Description	Existing Profile	
	Drawn By	KJ	Scale 1:360
	Company	GEO Group Northwest, Inc.	
	Date		File Name G-5713 A3 static.slim

SLIDEINTERPRET 7.038



rocscience

SLIDEINTERPRET 7.038

Project	New Residence, 3064 - 68th Ave SE, Mercer Island, WA		
Analysis Description	Existing Profile		
Drawn By	KJ	Scale	1:360
Company	GEO Group Northwest, Inc.		
Date		File Name	G-5713 A3 seis.slim

Slide Analysis Information

New Residence, 3064 - 68th Ave SE, Mercer Island, WA

Project Summary

File Name:	G-5713 A3 seis
Last saved with Slide version:	7.038
Project Title:	New Residence, 3064 - 68th Ave SE, Mercer Island, WA
Analysis:	Existing Profile
Author:	KJ
Company:	GEO Group Northwest, Inc.
	Comments
	Comm 1
	Comm 2
	Comm 3
	Comm 4
	Comm 5

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	inches/hour
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	25
Maximum Support Properties:	25

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	75
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]: 62.4
Use negative pore pressure cutoff: Yes
Maximum negative pore pressure [psf]: 0
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth [ft]: 3
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Loading

Seismic Load Coefficient (Horizontal): 0.2

Material Properties

Property	Loose ML	Med Dense ML	Med Dense ML-CL	Dense SM ML unsat	Concrete
Color					
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Infinite strength
Unit Weight [lbs/ft3]	105	112.5	110	125	150
Cohesion [psf]	100	100	400	100	
Friction Angle [deg]	28	33	32	38	
Water Surface	Water Table	None	None	None	None
Hu Value	1				
Ru Value		0	0	0	0

List Of Coordinates

Water Table

X	Y
18.5773	123.052
46	126
59.5944	127.243
85	132
99.9629	137
120	144
150	149

External Boundary

X	Y
150	100
150	120
150	130
150	141
150	144
150	150
150	160
146	158
143	157
141	156
135.5	153
133.5	152.5
132.5	152.5
132.5	148.5
132	148.48
120	148
107	147
99.5	146.5
99	144
89.5	142.5
87.5	142
85	141.5
77.5	141
77	139
68	138
64.5	137.5
63.5	137.5
63.5	134
63	134
50	134
46	134
43.5	134
40	133
34.5	131
30	129
23.5	126
21.5	125
20	124
18.5773	123.052
18.5	123
15	122
5	121
0	120.5
0	119
0	117
0	114
0	107
0	105
0	100

Material Boundary

X	Y
18.5773	123.052
46	125.5
85	130.5
120	144
150	150

Material Boundary

X	Y
0	119
15	119
46	120
85	129
120	141
150	141

Material Boundary

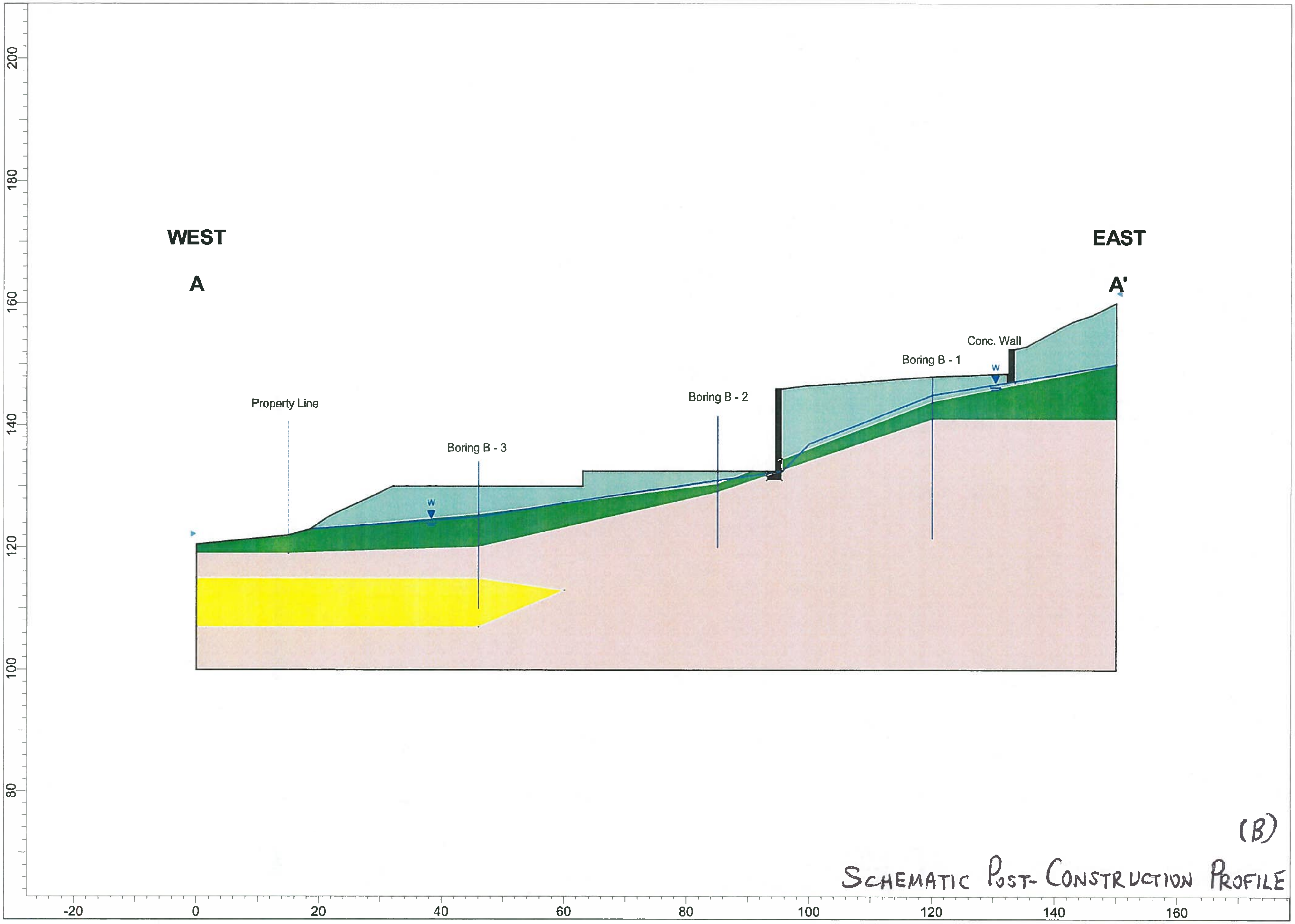
X	Y
132	148.48
132	147
133.5	147
133.5	152.5

Material Boundary

X	Y
63	134
63	133
64.5	133
64.5	137.5

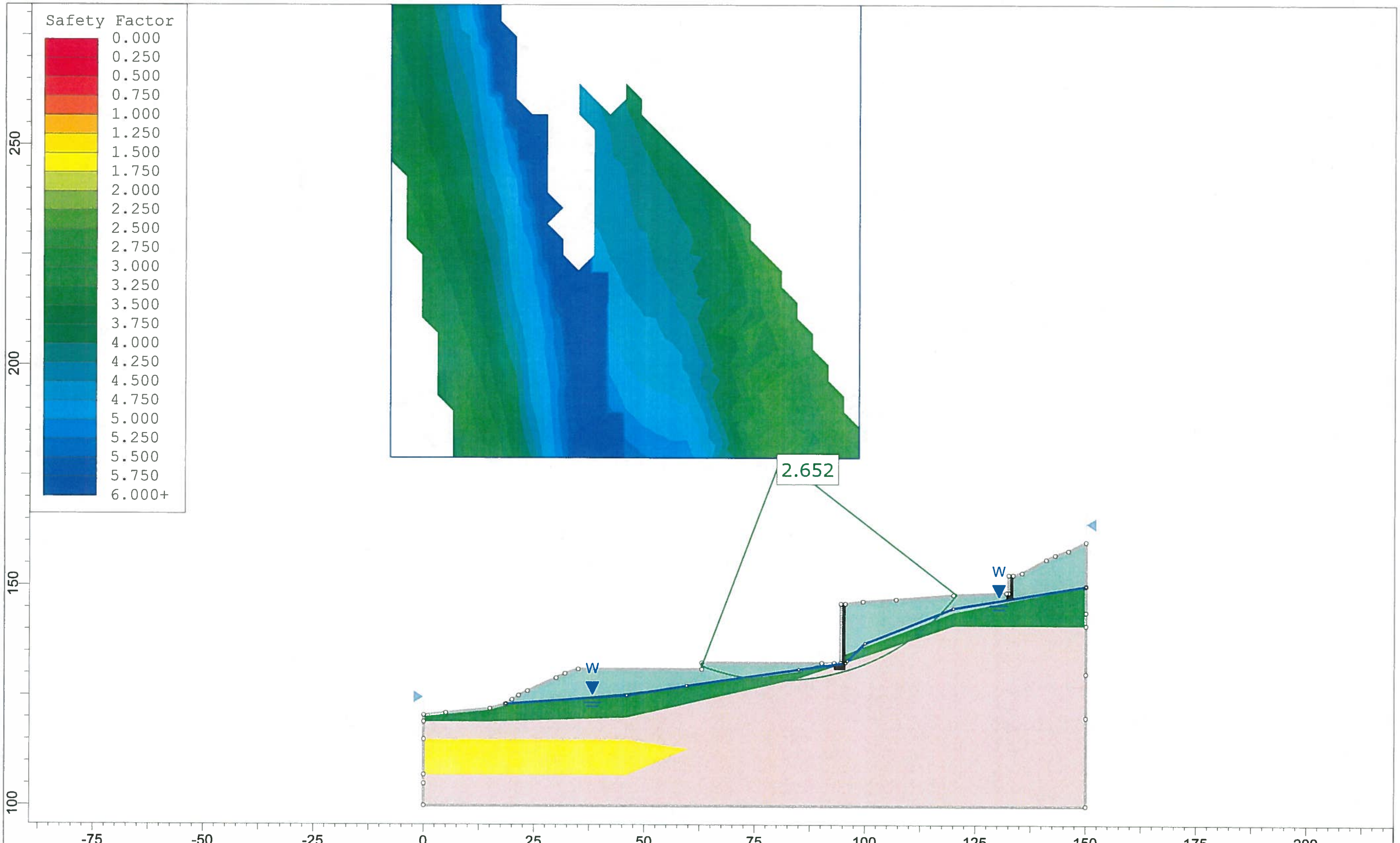
Material Boundary

X	Y
0	107
46	107
60	113
59.5596	113.063
46	115
0	114



(B)

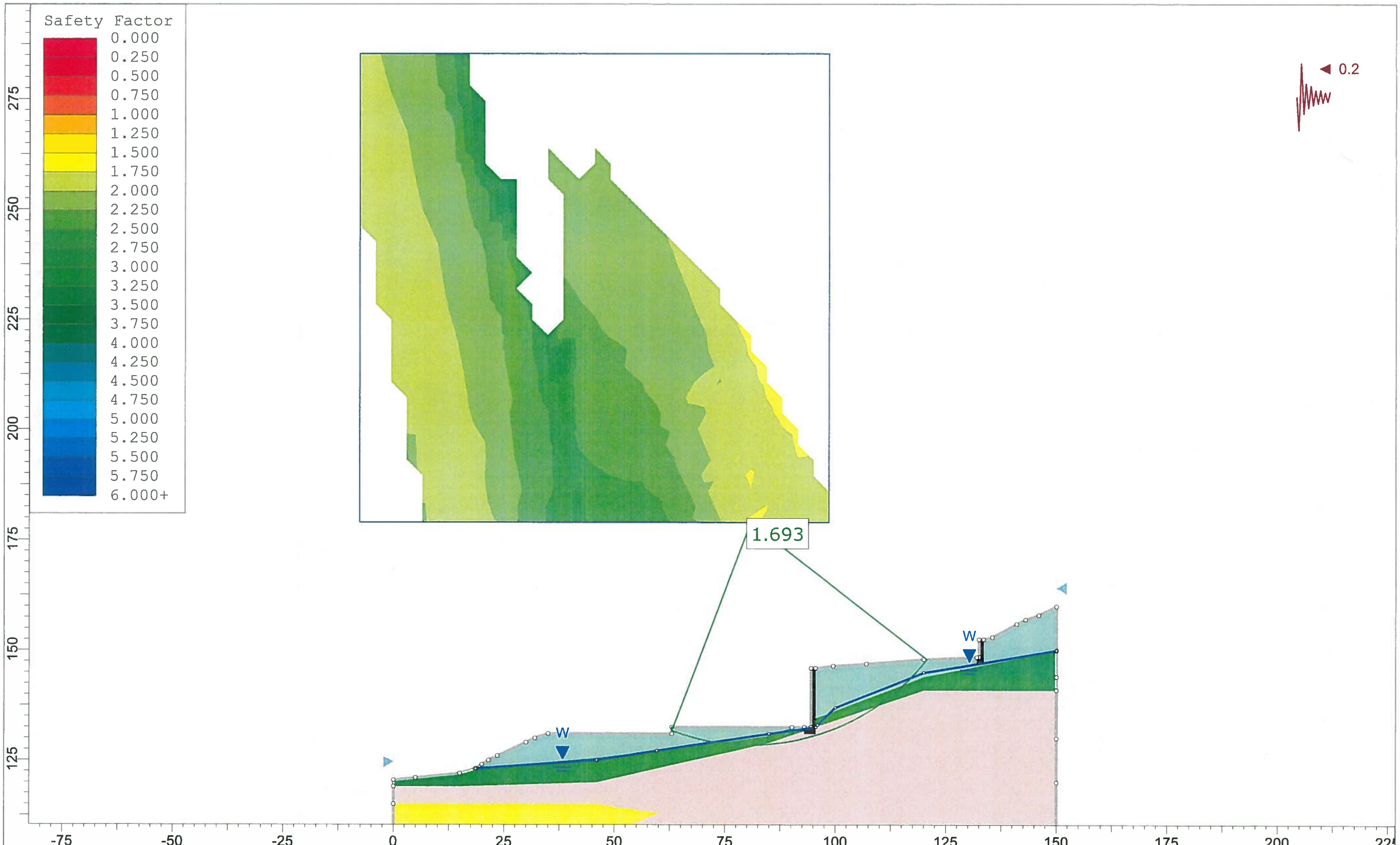
SCHEMATIC POST-CONSTRUCTION PROFILE



rocscience

SLIDEINTERPRET 7.038

Project	New Residence, 3064 - 68th Ave SE, Mercer Island, WA
Analysis Description	Schematic Proposed Profile
Drawn By	KJ
Scale	1:360
Company	GEO Group Northwest, Inc.
Date	
File Name	G-5713 B5 1325 static.slim



rocscience	Project	New Residence, 3064 - 68th Ave SE, Mercer Island, WA	
	Analysis Description	Schematic Proposed Profile	
	Drawn By: KJ	Scale: 1:360	Company: GEO Group Northwest, Inc.
SLIDEINTERPRET 7.038	Date		File Name: G-5713 B5 1325 seis.slim

Slide Analysis Information

New Residence, 3064 - 68th Ave SE, Mercer Island, WA

Project Summary

File Name:	G-5713 B5 1325 seis
Last saved with Slide version:	7.038
Project Title:	New Residence, 3064 - 68th Ave SE, Mercer Island, WA
Analysis:	Schematic Proposed Profile
Author:	KJ
Company:	GEO Group Northwest, Inc.
	Comments
	Comm 1
	Comm 2
	Comm 3
	Comm 4
	Comm 5

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	inches/hour
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	25
Maximum Support Properties:	25

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	75
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]: 62.4
Use negative pore pressure cutoff: Yes
Maximum negative pore pressure [psf]: 0
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth [ft]: 3
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Loading

Seismic Load Coefficient (Horizontal): 0.2

Material Properties

Property	Loose ML	Med Dense ML	Med Dense ML-CL	Dense SM ML unsat	Concrete
Color					
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Infinite strength
Unit Weight [lbs/ft3]	105	112.5	110	125	150
Cohesion [psf]	100	100	400	100	
Friction Angle [deg]	28	33	32	38	
Water Surface	Water Table	None	None	None	None
Hu Value	1				
Ru Value		0	0	0	0

List Of Coordinates

Water Table

X	Y
18.5773	123.052
46	125
59.5944	127.243
85	131
95.6	132.5
96	133
99.9629	137
120	145
150	150

External Boundary

X	Y
150	100
150	120
150	130
150	141
150	144
150	150
150	160
146	158
143	157
141	156
135.5	153
133.5	152.5
132.5	152.5
132.5	148.5
132	148.48
120	148
107	147
99.5	146.5
95.5	146
94.5	146
94.5	132.5
93	132.5
90.1852	132.5
63	132.5
63	131
35	131
32	130
30	129
23.5	126
21.5	125
20	124
18.5773	123.052
18.5	123
15	122
5	121
0	120.5
0	119
0	115
0	107
0	105
0	100

Material Boundary

X	Y
18.5773	123.052
46	125.5
85	130.5
90.1852	132.5

Material Boundary

X	Y
0	119
15	119
46	120
85	129
93	131.743
94	132.086
95.5	132.6
120	141
150	141

Material Boundary

X	Y
132	148.48
132	147
133.5	147
133.5	152.5

Material Boundary

X	Y
0	107
46	107
60	113
46	115
0	115

Material Boundary

X	Y
93	132.5
93	132.086
93	131.743
93	131
95.5	131
95.5	132.6
95.5	134.55
95.5	146

Material Boundary

X	Y
94.6269	134.213
95.5	134.55
120	144
150	150