

March 13, 2025

JN 24433

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Subject: **Transmittal Letter – Geotechnical Engineering Study**
Proposed Residence Remodel and Additions
Parikh Property
2816 – 68th Avenue Southeast
Mercer Island, Washington

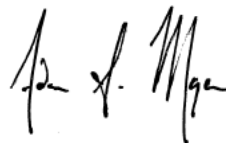
Greetings:

Attached to this transmittal letter is our geotechnical engineering report for the proposed remodel and additions to the existing residence in Mercer Island, Washington. The scope of our services consisted of exploring site surface and subsurface conditions, and then developing this report to provide recommendations for general earthwork and design considerations for foundations, retaining walls, subsurface drainage, and temporary excavations. This work was authorized by your acceptance of our proposal, P-11782, dated December 9, 2024.

The attached report contains a discussion of the study and our recommendations. Please contact us if there are any questions regarding this report, or for further assistance during the design and construction phases of this project.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.



Adam S. Moyer
Geotechnical Engineer

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ASM/MRM:kg

GEOTECHNICAL ENGINEERING STUDY
Proposed Residence Remodel and Additions
Parikh Property
2816 – 68th Avenue Southeast
Mercer Island, Washington

This report presents the findings and recommendations of our geotechnical engineering study for the site of the proposed remodel and additions to the existing Parikh residence located in Mercer Island.

Development of the property is in the planning stage, and detailed plans were not available at the time of this study. We were provided with preliminary plans of the proposed project and a topographic survey of the subject property. Sturman Architects developed the preliminary plans, dated November 22, 2024, and the topographic survey was developed by Terrane and dated September 19, 2024. Based on these plans, and our discussions with Sturman Architects the interior of the existing home will be substantially remodeled, including moving interior walls and likely altering structural loads. The plans also indicate that a new second-story will be added to approximately the northern one-third of the building footprint; an uncovered deck will cantilever off the western side of the proposed second-story addition.

The footprint of the main floor of the residence will also be expanded to enclose the existing covered deck above the basement garage off the southern end of the building. The western half of the daylight basement garage will also be expanded several feet to the south. A new deck will be constructed off the western side of the northern two-thirds of the house's main floor; this proposed new deck will be supported on foundations near the top of the existing rockery located to the west of the residence. An exterior spiral staircase will connect the two new upper and lower western decks to the yard below.

Finally, we understand that the exterior hardscaping around the residence will be updated and improved. The exterior concrete stairs and rockery off the southeast corner of the residence, which connect the driveway and the upper eastern side yard will be removed and replaced with new concrete retaining walls and stairs. The existing deck off the eastern side of the house will also be expanded to the south.

If the scope of the project changes from what we have described above, we should be provided with revised plans in order to determine if modifications to the recommendations and conclusions of this report are warranted.

SITE CONDITIONS

SURFACE

The Vicinity Map, Plate 1, illustrates the general location of the site in the northwestern portion of Mercer Island. The rectangular-shaped subject site has 150 feet of frontage along the eastern side of 68th Avenue Southeast, and extends to a depth of 100 feet to the east. The property and surrounding area generally slope downwards to the west. A one-story single-family residence underlain by a west-facing daylight basement is currently located in the northeast quadrant of the property. A one-story attached garage extends southward from the residence, with a deck above it extending off the main floor. The garage exits to a level concrete driveway/parking area which

covers the southeast corner of the property. From this parking area, the driveway descends diagonally to the northwest, dropping approximately 24 feet in elevation, to connect to 68th Avenue Southeast near the property's northwest corner. The eastern perimeter of the driveway is bordered by a rockery that rises 6 to 14 feet to the small yard area west of the residence. The rockery increases in height from south to north along the driveway; in addition, the rockery transitions to two tiered rockeries along approximately the northern half of the driveway's eastern perimeter.

The western perimeter of the driveway defines the top of a steep slope that descends to the west down to 68th Avenue Southeast. This slope has an overall height ranging from 14 to 48 feet from north to south across the property, with an inclination ranging from approximately 47 to 57 percent. However, the upper portion of the slope (on the property) is more steeply inclined across the above-mentioned rockeries and the fill slope that was constructed for the western, downslope, edge of the driveway.

The ground surface rises around the footprint of the residence to a level side yard alongside the eastern perimeter of the home. The northern half of this side yard is covered by a wooden deck. A 6- to 14-foot-tall rockery straddles the subject site's eastern property line. A set of concrete stairs and a rockery off the southeast corner of the house separate the upper eastern yard from the driveway to the south. Upslope of the rockery along the eastern property line, the ground surface continues to rise steeply to the east on the neighboring property.

The City of Mercer Island's GIS Portal maps the project area on the site within several Geologically Hazardous Areas. The subject site and general vicinity are mapped as a Seismic Hazard Area, an Erosion Hazard Area, and a Potential Landslide Hazard Area. Finally, most of the property is mapped as a Steep Slope Hazard Area. Based on the provided topographic survey of the property, the ground surface west and downslope of the driveway declines 14 to 48 down to 68th Avenue Southeast at an inclination over 40 percent. This means that the western portion of the property would be considered a Steep Slope Hazard Area under the Mercer Island Municipal Code. This western-facing steep slope continues to the south onto the southern adjacent parcel, on which the steep slope descends to the south-southwest. In addition, from the top of the rockery along the eastern property line, the ground surface rises at least 10 feet to the east at an inclination greater than 40 percent. Therefore, a Steep Slope Hazard Area is also located on the eastern adjacent property; a small section of this Steep Slope Hazard Area extends onto the northern end of the subject site's eastern perimeter, where the aforementioned rockery turns west off the property line, and onto the subject parcel.

We saw no indications of recent instability on, or near, the site. The *Landslide Hazard Assessment of Mercer Island* indicates that documented landslides have occurred several lots to the south of the site. According to documents found on Mercer Island's GIS, 2-inch-diameter pipe piles were installed in 2004 to underpin the entire western perimeter foundation, as well as the western portion of the north foundation. These piles were apparently installed to stop settlement of these areas. No pipe piles are indicated to have been installed inside the house itself. There are no records of the actual installed lengths of the piles. However, a testing lab (Cascade Testing) did inspect the concrete used to connect the piles to the existing foundations, providing verification that underpinning piles were installed.

As discussed above, the subject site is bordered by 68th Avenue Southeast to the west. Parcels containing single-family homes with large building setbacks border the subject site to the north and east. An undeveloped parcel borders the subject site's southern perimeter.

SUBSURFACE

The subsurface conditions were explored by drilling four test borings at the approximate locations shown on the Site Exploration Plan, Plate 2. Our exploration program was based on the proposed construction, anticipated subsurface conditions and those encountered during exploration, and the scope of work outlined in our proposal.

The test borings were drilled on January 16, 2025 using both a track-mounted, hollow-stem auger drill and a portable Acker drill. The Acker drill system utilizes a small, gasoline-powered engine to advance a hollow-stem auger to the sampling depth. Samples were taken at approximate 2.5- to 5-foot intervals with a standard penetration sampler. This split-spoon sampler, which has a 2-inch outside diameter, is driven into the soil with a 140-pound hammer falling 30 inches. The number of blows required to advance the sampler a given distance is an indication of the soil density or consistency. A geotechnical engineer from our staff observed the drilling process, logged the test borings, and obtained representative samples of the soil encountered. The Test Boring Logs are attached as Plates 3 through 6.

Soil Conditions

The test borings conducted around the existing residence encountered 5.5 to 8 feet of loose sand fill soils beneath the ground surface. Native, interbedded, loose to dense sand and stiff to very stiff silt was encountered beneath the fill soils. The native sands and silts became medium-dense to dense at depths ranging from 5.5 to 12 feet below grade, and very dense/very hard below 7.5 to 15 feet. The very dense underlying silt and sand soils extended to the maximum-explored depth of 25.4 feet.

Test Boring 1 was conducted in the driveway, off the southwest corner of the residence's daylight basement. The test boring found 5.5 feet of loose fill soils overlying the native medium-dense to dense sand and silt soils.

Test Boring 2 was conducted in the upper eastern yard near the eastern perimeter of the residence's first floor. Approximately 7.5 feet of loose fill soils (backfill of the adjacent basement foundation) were revealed beneath the ground surface. Very dense native sand was revealed directly beneath the fill soils, at the elevation of the existing basement.

Test Borings 3 and 4 were completed between the downslope western perimeter of the house and the top of the existing rockery which descends to the driveway to the west. Loose fill soils were revealed to depths of 5.5 to 8 feet beneath the western yard grade. Loose to medium-dense/stiff native sand and silt was revealed beneath the fill soils. The underlying sand and silts became medium-dense to dense at depths of 8.5 to 12 feet from south to north beneath the western yard. Very dense/very hard silt was revealed below 10 to 15 feet from south to north.

No obstructions were revealed by our explorations. However, debris, buried utilities, and old foundation and slab elements are commonly encountered on sites that have had previous development.

Groundwater Conditions

No groundwater seepage was observed in our subsurface explorations. The test borings were conducted following several months of wet weather. The borings were left open for

only a short time period. Therefore, the seepage levels on the logs represent the location of transient water seepage and may not indicate the static groundwater level.

It should be noted that groundwater levels vary seasonally with rainfall and other factors. We anticipate that groundwater could be found in more permeable sand layers and within the looser near-surface soils, perched on top of the relatively impermeable underlying dense silt.

The stratification lines on the logs represent the approximate boundaries between soil types at the exploration locations. The actual transition between soil types may be gradual, and subsurface conditions can vary between exploration locations. The logs provide specific subsurface information only at the locations tested. If a transition in soil type occurred between samples in the borings, the depth of the transition was interpreted. The relative densities and moisture descriptions indicated on the test boring logs are interpretive descriptions based on the conditions observed during drilling.

CRITICAL AREA STUDY (MICC 19.07)

Seismic Hazard and Potential Landslide Hazard Areas: The subject site is located within both a mapped Seismic Hazard Area and Potential Landslide Hazard area. Both geologic hazard areas cover much of the general vicinity. As previously discussed, the core of the subject site consists of dense to very dense/very hard, sand and silt soils that have a low potential for deep-seated landslides. The mapping of the Potential Landslide Hazard Area is due to the ground surface being moderately sloped and inference by geologists that the site lies near the scarp on an ancient landslide based on LiDAR imaging. An ancient landslide as mapped would most likely have occurred following the recession of the last glaciers, over 13,000 years ago. No recent landslide movement has been documented in this area. The proposed new residence additions will be supported on foundations bearing directly on the dense to very dense native soils, or on small-diameter pipe piles embedded into these dense to very dense soils, which are not liquefiable due to their dense nature and the absence of near-surface groundwater. This mitigates the Seismic Hazard. Furthermore, the existing rockery located downslope of the proposed residence addition will be replaced by an engineered soldier pile retaining wall to provide lateral stability for the tall filled rockery located to the west of the new second-story addition.

Steep Slope Hazard Areas: Based on the provided topographic map of the subject site, the western perimeter of the property located downslope of the driveway has an inclination of at least 40 percent over a horizontal distance of 30 feet (which the City of Mercer Island code defines as a Steep Slope). This steep slope area was likely at least partially created by placing fill (and therefore oversteepening the existing slope) to construct the driveway when the lot was originally developed. This was a common practice at the time. A Steep Slope is a qualification as a Landslide Hazard Area under the Mercer Island Code. As previously discussed, the slope on the western side of the property has an inclination ranging from 40 to 100 percent, rising from 68th Avenue Southeast up to the western perimeter of the driveway. In addition, a Steep Slope Hazard Area is located upslope and east of the rockery that follows the subject site's eastern property line. This Steep Slope Hazard Area is predominantly located on the eastern adjacent property, and has an inclination of 45 to 73 percent.

Both the existing development, and the proposed new residence additions will be located within the prescriptive minimum 25-foot buffers that extend from Steep Slopes to the west and east. The proposed residence additions will be located within 15 feet of the Steep Slope to the east. The proposed additions will also be within approximately 12 to 25 feet from the top of the Steep Slope along the western perimeter of the driveway.

As further discussed in this report, the proposed new residence additions will be supported on foundations bearing directly on the dense underlying sand and silt, or on small-diameter pipe piles embedded into these competent dense soils, which are not susceptible to deep-seated movement. For the taller portion of this rockery, which is located downslope of the planned second-story addition, we recommend rebuilding the rockery as an engineered soldier pile retaining wall. Considering this, it is our opinion that no additional buffers or setbacks are required from the steep slope, provided the recommendations presented in this report are followed. The recommendations presented in the report are intended to prevent adverse impacts to the stability of the slopes on the site and the neighboring properties, and to protect the planned development from damage in the event of potential shallow soil movement on the steep slope.

Erosion Hazard Areas: The site also meets the City of Mercer Island's criteria for an Erosion Hazard Area. This potential hazard can be mitigated by implementing proper temporary erosion control measures during the site development.

The temporary erosion control measures needed during the site development will depend heavily on the weather conditions that are encountered during the site work. One of the most important considerations, particularly during wet weather, is to immediately cover any bare soil areas to prevent accumulated water or runoff from the work area from becoming silty in the first place. A wire-backed silt fence bedded in compost, not native soil or sand, should be erected as close as possible to the planned work area, and the existing vegetation between the silt fence and the top of the steep slope be left in place. Rocked construction access and staging areas should be established wherever trucks will have to drive off of pavement, in order reduce the amount of soil or mud carried off the property by trucks and equipment. Covering the base of the excavation with a layer of clean gravel or rock is also prudent to reduce the amount of mud and silty water generated. Cut slopes and soil stockpiles should be covered with plastic during wet weather. Soil stockpiles should be minimized. Following rough grading, it may be necessary to mulch or hydroseed bare areas that will not be immediately covered with landscaping or an impervious surface.

Buffers and Mitigation: Under MICC 19.07.160(C), a prescriptive buffer of 25 feet is required from all sides of a landslide hazard area for potential shallow-seated slope failures. As noted above, the entire subject site lies within a mapped Potential Landslide Hazard Area and the prescriptive buffer would encompass the entire residence footprint and the planned development area. The recommendations presented in this report are intended to protect the planned additions, portions of which will be located within prescriptive buffer from the adjacent Steep Slope Hazard Areas to the east and west of the residence.

No buffer is required by the MICC for an Erosion Hazard Area.

Recommended Buffer: In order to prevent adverse impacts to the stability or erosion potential on, and near, the adjacent steep slopes, we recommend that no filling or substantial disturbance (such as clearing, utility installation, or construction staging) occur on the steep slopes to the east and west of the existing residence and proposed additions without the review of the project geotechnical engineer.

We recognize that the planned development will occur within the prescriptive critical area buffers. The recommendations presented in this geotechnical report are intended to allow the project to be constructed in the proposed configuration without adverse impacts to critical areas on the site or the neighboring properties. The geotechnical recommendations associated with foundations and erosion control will mitigate any potential hazards to critical areas on the site.

Statement of Risk: In order to satisfy the City of Mercer Island's requirements, a statement of risk is needed. As such, we make the following statement:

Provided the recommendations in this report are followed, it is our professional opinion that the recommendations presented in this report for the planned alterations will render the development as safe as if it were not located in a geologically hazardous area, and will not adversely impact critical areas on adjacent properties.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

THIS SECTION CONTAINS A SUMMARY OF OUR STUDY AND FINDINGS FOR THE PURPOSES OF A GENERAL OVERVIEW ONLY. MORE SPECIFIC RECOMMENDATIONS AND CONCLUSIONS ARE CONTAINED IN THE REMAINDER OF THIS REPORT. ANY PARTY RELYING ON THIS REPORT SHOULD READ THE ENTIRE DOCUMENT.

The test borings conducted for this study encountered 5.5 to 8 feet of loose sand fill soils beneath the ground surface, overlying native interbedded sands and silts. The underlying native soils were initially loose to medium-dense, but became medium-dense to dense 5.5 to 12 feet below grade, and very dense/very hard below depths of 7.5 to 15 feet. Based on the test borings, it appears approximately the upslope eastern half of the residence's basement is supported on footings bearing on the dense native soils. However, test borings indicate the competent bearing soils drop in elevation to the west and northwest beneath the building. It therefore appears the downslope western portion of the existing house is underlain by loose fill soils placed over the original ground surface for the construction of the home. Permit records and a geotechnical engineering letter from 2004 obtained from the City of Mercer Island's GIS indicate that the western perimeter foundation and the western portion of the north foundation were underpinned with 2-inch-diameter pipe piles to stop further settlement.

While detailed plans have not yet been developed for the project, we anticipate that the proposed second story addition and interior remodel will require new foundations, and will also add new building loads to some of the existing foundations. Based on our subsurface explorations, new or existing footings on the upslope eastern half of the residence footprint may be supported on conventional footings bearing on the competent underlying medium-dense to dense native sands and silts. However, we recommend any new foundations or existing foundations supporting new loads from the proposed addition on the downslope western half of the residence be supported on small-diameter pipe piles driven into the dense underlying soils. Some minor overexcavation may be needed to reach the underlying competent bearing soils beneath the new eastern conventional footings. We also recommend that any existing footings that will experience new structural loads from the additions be exposed, so that the project geotechnical engineer can verify that the existing footings bear on competent native soils.

It has been standard practice in the Pacific Northwest that the 2-inch-diameter underpinning piles were installed to a typical refusal rate of one inch per minute when driven with a 90-pound jackhammer. These piles can be assumed to support a 2-ton allowable capacity.

The provided preliminary plans also indicate that a new deck will be constructed west of the northern two-thirds of the existing residence's western perimeter off the main floor. A new upper deck is also proposed, which will cantilever off the western perimeter of the proposed second-story

addition. An exterior spiral staircase will connect both new decks to the ground surface. Given the loose soils encountered beneath the ground surface west of the residence, we recommend the proposed new decks and the exterior spiral staircase be supported on driven pipe piles as well. The **Pipe Piles** section of this report should be reviewed for additional recommendations.

As discussed previously, the upper half of rockery located along the upslope eastern perimeter of the driveway appears to retain loose fill soils which were placed during the property's original development. Approximately the lower half of the rockery appears to retain a cut below the original site grade, and retains loose to medium-dense to dense native sand and silt. To provide proper permanent lateral support of the proposed second-story addition, we recommend the existing rockery be replaced with a new permanent engineered soldier pile retaining wall. This new retaining wall should be located downslope of the proposed new second-story addition. The top of the new soldier piles could match the elevation of the top of the existing rockeries, or could be backfilled with a 2:1 (Horizontal:Vertical) slope up to the existing western yard grade to reduce the wall height. The **Permanent Soldier Pile Retaining Wall** section of this report presents more detailed recommendations.

Based on the provided preliminary plans, the existing deck located east of the northern half of the residence will be expanded to the south between the residence to the west and the rockery to the east. Loose sand fill soils (backfill of the adjacent basement foundation) were encountered to a depth of 7.5 feet in our test boring alongside the residence in the area of the proposed new eastern deck. The eastern perimeter of the deck, near the toe of the eastern rockery, may be supported on conventional footings bearing on the medium-dense to dense native soils. However, due to the loose basement backfill, we recommend the remainder of the new deck be either 1) supported on driven pipe piles, or 2) the deck be structurally connected to the residence's eastern foundation wall, and designed to span between the residence and the eastern perimeter deck footings.

An existing rockery and concrete staircase currently span between the southeast corner of the residence and the rockery that follows the eastern property line. The rockery and staircase separate the lower driveway (at the basement elevation) and the upper eastern yard (at the main floor elevation). The project will also include replacing the existing rockery/stairs with new exterior concrete retaining walls and stairs. The new lower retaining walls near the elevation of the existing driveway may be supported on conventional footings bearing on the medium-dense to dense native soils. However, we recommend the remainder of the stairs and retaining walls stepping up to north be supported on pipe piles, since we anticipate loose fill soils will be encountered as the grade steps up to the eastern elevated yard grade. It will be important to determine the elevation of the base of the existing rockery which follows the eastern property line alongside the proposed new retaining walls. The planned excavations for the new retaining walls should not extend below the toe of the adjacent rockery to the east.

Onsite infiltration of collected stormwater is being evaluated for most new developments. The silt soils encountered beneath the site are essentially impervious due to their high fines content and density. Any water that percolates through the loose upper soils will become perched above the relatively impervious underlying dense soils and migrate downslope toward the steep slope and on the western end of the property. Water perched in loose near-surface soils is a well-documented factor in slope instability in the Puget Sound area. Therefore, it is our opinion that onsite dispersion or concentrated infiltration of collected stormwater is not appropriate for the subject site. All collected stormwater should be tightlined to an approved off-site stormwater discharge system.

The erosion control measures needed during the site development will depend heavily on the weather conditions that are encountered. We anticipate that a silt fence will be needed around the

downslope sides of any cleared areas. Existing pavements, ground cover, and landscaping should be left in place wherever possible to minimize the amount of exposed soil. Rocked staging areas and construction access roads should be provided to reduce the amount of soil or mud carried off the property by trucks and equipment. Wherever possible, the access roads should follow the alignment of planned pavements. Trucks should not be allowed to drive off of the rock-covered areas. Cut slopes and soil stockpiles should be covered with plastic during wet weather. Following clearing or rough grading, it may be necessary to mulch or hydroseed bare areas that will not be immediately covered with landscaping or an impervious surface. On most construction projects, it is necessary to periodically maintain or modify temporary erosion control measures to address specific site and weather conditions.

The drainage and/or waterproofing recommendations presented in this report are intended only to prevent active seepage from flowing through concrete walls or slabs. Even in the absence of active seepage into and beneath structures, water vapor can migrate through walls, slabs, and floors from the surrounding soil, and can even be transmitted from slabs and foundation walls due to the concrete curing process. Water vapor also results from occupant uses, such as cooking, cleaning, and bathing. Excessive water vapor trapped within structures can result in a variety of undesirable conditions, including, but not limited to, moisture problems with flooring systems, excessively moist air within occupied areas, and the growth of molds, fungi, and other biological organisms that may be harmful to the health of the occupants. The designer or architect must consider the potential vapor sources and likely occupant uses, and provide sufficient ventilation, either passive or mechanical, to prevent a build up of excessive water vapor within the planned structure.

We recommend including this report, in its entirety, in the project contract documents. This report should also be provided to any future property owners so they will be aware of our findings and recommendations.

SEISMIC CONSIDERATIONS

In accordance with the International Building Code (IBC), the site class within 100 feet of the ground surface is best represented by Site Class Type D (Stiff Soil). As noted in the ASCE 7 Hazard Tool website, the mapped spectral acceleration value for a 0.2 second (S_s) and 1.0 second period (S_1) equals 1.40g and 0.49g, respectively.

The IBC and ASCE 7 require that the potential for liquefaction (soil strength loss) during an earthquake be evaluated for the peak ground acceleration of the Maximum Considered Earthquake (MCE), which has a probability of occurring once in 2,475 years (2 percent probability of occurring in a 50-year period). The soils beneath the site are not susceptible to seismic liquefaction under the ground motions of the MCE because of their dense nature and the absence of near-surface groundwater.

CONVENTIONAL FOUNDATIONS

As discussed in the **General** section, any new foundations within the eastern, upslope half of the residence, as well as the exterior retaining walls and stairs off the southeast corner of the residence may be supported on conventional continuous and spread footings bearing on undisturbed, medium-dense to dense native sand or silt. Furthermore, any existing footings on the eastern half of the residence which will experience added structural loads from the remodel and addition should be

exposed during the demolition process so that the project geotechnical engineer can verify that they bear on dense soils suitable to support the proposed new building loads.

We recommend that continuous and individual spread footings have minimum widths of 16 and 24 inches, respectively. Exterior footings should also be bottomed at least 18 inches below the lowest adjacent finish ground surface for protection against frost and erosion. The local building codes should be reviewed to determine if different footing widths or embedment depths are required. Footing subgrades must be cleaned of loose or disturbed soil prior to pouring concrete. Depending upon site and equipment constraints, this may require removing the disturbed soil by hand.

An allowable bearing pressure of 3,000 pounds per square foot (psf) is appropriate for footings supported on undisturbed, medium-dense to dense native sand or silt. A one-third increase in this design bearing pressure may be used when considering short-term wind or seismic loads. For the above design criteria, it is anticipated that the total post-construction settlement of footings founded on competent native soil will be about one inch, with differential settlements on the order of one-half inch in a distance of 50 feet along a continuous footing with a uniform load.

Lateral loads due to wind or seismic forces may be resisted by friction between the foundation and the bearing soil, or by passive earth pressure acting on the vertical, embedded portions of the foundation. For the latter condition, the foundation must be either poured directly against relatively level, undisturbed soil or be surrounded by level, well-compacted fill. We recommend using the following ultimate values for the foundation's resistance to lateral loading:

PARAMETER	ULTIMATE VALUE
Coefficient of Friction	0.40
Passive Earth Pressure	300 pcf

Where: pcf is Pounds per Cubic Foot, and Passive Earth Pressure is computed using the Equivalent Fluid Density.

If the ground in front of a foundation is loose or sloping, the passive earth pressure given above will not be appropriate. The above ultimate values for passive earth pressure and coefficient of friction do not include a safety factor.

PIPE PILES

As discussed in the **General** section, any new foundations or existing foundations which will experience new structural loads on the downslope western half of the residence should be supported on small-diameter pipe piles driven in the dense underlying soils.

A 2-inch-diameter pipe pile driven with a minimum 90-pound jackhammer or a 140-pound Rhino hammer to a final penetration rate of 1-inch or less for one minute of continuous driving may be assigned an allowable compressive load of 3 tons. Extra-strong steel pipe should be used. The site soils are not highly organic, and are not located near salt water. As a result, they do not have an elevated corrosion potential. Considering this, it is our opinion that standard "black" pipe can be used, and corrosion protection, such as galvanizing, is not necessary for the pipe piles. Subsequent pipe sections should be connected together using threaded or slip couplers, or by welding. If slip couplers are used, they must fit snugly into the ends of the pipes. This can require that shims or beads of welding flux be applied to the couplers.

Pile caps and grade beams should be used to transmit loads to the piles. A minimum of two piles should be used in isolated pile caps, in order to prevent eccentric loading on individual piles.

Lateral loads may be resisted by passive earth pressure acting on the vertical, embedded portions of the foundation. For this condition, the foundation must be either poured directly against relatively level, undisturbed soil or surrounded by level structural fill. We recommend using a passive earth pressure of 300 pounds per cubic foot (pcf) for this resistance. This is an ultimate value; it does not include a safety factor. If the ground in front of a foundation is loose or sloping, the passive earth pressure given above will not be appropriate. Due to their small diameter, the lateral capacity of vertical pipe piles is negligible. However, if lateral resistance in addition to the passive soil pressure is required, we recommend driving battered piles in the same direction as the applied lateral load. The lateral capacity of a battered pile is equal to one-half of the lateral component of the allowable compressive load, with a maximum allowable lateral capacity of 500 pounds. The allowable vertical capacity of battered piles does not need to be reduced if the piles are battered steeper than 1:5 (Horizontal:Vertical).

FOUNDATION AND RETAINING WALLS

Retaining walls backfilled on only one side should be designed to resist the lateral earth pressures imposed by the soil they retain. The following recommended parameters are for walls that restrain level backfill:

PARAMETER	VALUE
Lateral Earth Pressure *	35 pcf
Passive Earth Pressure	300 pcf
Coefficient of Friction	0.40
Soil Unit Weight	125 pcf

Where: pcf is Pounds per Cubic Foot, and Lateral and Passive Earth Pressures are computed using the Equivalent Fluid Pressures.

* For a restrained wall that cannot deflect at least 0.002 times its height, a uniform lateral pressure equal to 10 psf times the height of the wall should be added to the above lateral equivalent fluid pressure. This applies only to walls with level backfill.

The design values given above do not include the effects of any hydrostatic pressures behind the walls and assume that no surcharges, such as those caused by slopes, vehicles, or adjacent foundations will be exerted on the walls. If these conditions exist, those pressures should be added to the above lateral soil pressures. Where sloping backfill is desired behind the walls, we will need to be given the wall dimensions and the slope of the backfill in order to provide the appropriate design earth pressures. The surcharge due to traffic loads behind a wall can typically be accounted for by adding a uniform pressure equal to 2 feet multiplied by the above lateral fluid density. Heavy construction equipment should not be operated behind retaining and foundation walls within a distance equal to the height of a wall, unless the walls are designed for the additional lateral pressures resulting from the equipment.

The values given above are to be used to design only permanent foundation and retaining walls that are to be backfilled, such as conventional walls constructed of reinforced concrete or masonry.

It is not appropriate to use the above earth pressures and soil unit weight to back-calculate soil strength parameters for design of other types of retaining walls, such as soldier pile, reinforced earth, modular or soil nail walls. We can assist with the design of these types of walls, if desired.

The passive pressure given is appropriate only for a shear key poured directly against undisturbed native soil, or for the depth of level, well-compacted fill placed in front of a retaining or foundation wall. The values for friction and passive resistance are ultimate values and do not include a safety factor. Restrained wall soil parameters should be utilized for the wall and reinforcing design for a distance of 1.5 times the wall's height from corners or bends in the walls, or from other points of restraint. This is intended to reduce the amount of cracking that can occur where a wall is restrained by a corner.

Wall Pressures Due to Seismic Forces

Per IBC Section 1803.5.12, a seismic surcharge load need only be considered in the design of backfilled walls retaining over 6 feet of soil. A seismic surcharge load would be imposed by adding a uniform lateral pressure to the above-recommended lateral pressure. The recommended seismic surcharge pressure for this project is $9H$ pounds per square foot (psf), where H is the design retention height of the wall. Using this increased pressure, the safety factor against sliding and overturning can be reduced to 1.2 for the seismic analysis.

Retaining Wall Backfill and Waterproofing

Backfill placed behind retaining or foundation walls should be coarse, free-draining structural fill containing no organics. This backfill should contain no more than 5 percent silt or clay particles and have no gravel greater than 4 inches in diameter. The percentage of particles passing the No. 4 sieve should be between 25 and 70 percent. The later section entitled ***Drainage Considerations*** should also be reviewed for recommendations related to subsurface drainage behind foundation and retaining walls.

The purpose of these backfill requirements is to ensure that the design criteria for a retaining wall are not exceeded because of a build-up of hydrostatic pressure behind the wall. Also, subsurface drainage systems are not intended to handle large volumes of water from surface runoff. The top 12 to 18 inches of the backfill should consist of a compacted, relatively impermeable soil or topsoil, or the surface should be paved. The ground surface must also slope away from backfilled walls at one to 2 percent to reduce the potential for surface water to percolate into the backfill.

Water percolating through pervious surfaces (pavers, gravel, permeable pavement, etc.) must also be prevented from flowing toward walls or into the backfill zone. Foundation drainage and waterproofing systems are not intended to handle large volumes of infiltrated water. The compacted subgrade below pervious surfaces and any associated drainage layer should therefore be sloped away. Alternatively, a membrane and subsurface collection system could be provided below a pervious surface.

Wall backfill should be placed in lifts and be properly compacted, in order for the above-recommended design earth pressures to be appropriate. The recommended wall design criteria assume that the backfill will be well-compacted in lifts no thicker than 12 inches. The compaction of backfill near the walls should be accomplished with hand-operated equipment to prevent the walls from being overloaded by the higher soil forces that occur during compaction.

The above recommendations are not intended to waterproof below-grade walls, or to prevent the formation of mold, mildew or fungi in interior spaces. Over time, the performance of subsurface drainage systems can degrade, subsurface groundwater flow patterns can change, and utilities can break or develop leaks. Therefore, waterproofing should be provided where future seepage through the walls is not acceptable. This typically includes limiting cold-joints and wall penetrations, and using bentonite panels or membranes on the outside of the walls. There are a variety of different waterproofing materials and systems, which should be installed by an experienced contractor familiar with the anticipated construction and subsurface conditions. Applying a thin coat of asphalt emulsion to the outside face of a wall is not considered waterproofing, and will only help to reduce moisture generated from water vapor or capillary action from seeping through the concrete. As with any project, adequate ventilation of basement and crawl space areas is important to prevent a buildup of water vapor that is commonly transmitted through concrete walls from the surrounding soil, even when seepage is not present. This is appropriate even when waterproofing is applied to the outside of foundation and retaining walls. We recommend that you contact an experienced envelope consultant if detailed recommendations or specifications related to waterproofing design, or minimizing the potential for infestations of mold and mildew are desired.

The **General**, **Floor Slabs**, and **Drainage Considerations** sections should be reviewed for additional recommendations related to the control of groundwater and excess water vapor for the anticipated construction.

EXCAVATIONS AND SLOPES

Temporary excavation slopes should not exceed the limits specified in local, state, and national government safety regulations. Also, temporary cuts should be planned to provide a minimum of 2 to 3 feet of space for construction of foundations, walls, and drainage. Temporary cuts to a maximum overall depth of about 4 feet may be attempted vertically in unsaturated soil, if there are no indications of slope instability. However, vertical cuts should not be made near property boundaries, or existing utilities and structures. Unless approved by the geotechnical engineer of record, it is important that vertical cuts not be made at the base of sloped cuts. Based upon Washington Administrative Code (WAC) 296, Part N, the soil at the subject site would generally be classified as Type B. Therefore, temporary cut slopes greater than 4 feet in height should not be excavated at an inclination steeper than 1:1 (Horizontal:Vertical), extending continuously between the top and the bottom of a cut.

The above-recommended temporary slope inclination is based on the conditions exposed in our explorations, and on what has been successful at other sites with similar soil conditions. It is possible that variations in soil and groundwater conditions will require modifications to the inclination at which temporary slopes can stand. Temporary cuts are those that will remain unsupported for a relatively short duration to allow for the construction of foundations, retaining walls, or utilities. Temporary cut slopes should be protected with plastic sheeting during wet weather. It is also important that surface runoff be directed away from the top of temporary slope cuts. Cut slopes should also be backfilled or retained as soon as possible to reduce the potential for instability. Please note that sand or loose soil can cave suddenly and without warning. Excavation, foundation, and utility contractors should be made especially aware of this potential danger. These recommendations may need to be modified if the area near the potential cuts has been disturbed in the past by utility installation, or if settlement-sensitive utilities are located nearby.

All permanent cuts into native soil should be inclined no steeper than 2:1 (H:V). To reduce the potential for shallow sloughing, fill must be compacted to the face of these slopes. This can be accomplished by overbuilding the compacted fill and then trimming it back to its final inclination. Adequate compaction of the slope face is important for long-term stability and is necessary to prevent excessive settlement of patios, slabs, foundations, or other improvements that may be placed near the edge of the slope.

Water should not be allowed to flow uncontrolled over the top of any temporary or permanent slope. All permanently exposed slopes should be seeded with an appropriate species of vegetation to reduce erosion and improve the stability of the surficial layer of soil.

Any disturbance to the existing slope outside of the building limits may reduce the stability of the slope. Damage to the existing vegetation and ground should be minimized, and any disturbed areas should be revegetated as soon as possible. Soil from the excavation should not be placed on the slope, and this may require the off-site disposal of any surplus soil.

CANTILEVERED SOLDIER PILE RETAINING WALL

The new permanent soldier pile wall would be constructed in conjunction with sequenced removal of the rockery by setting steel H-beams in a drilled hole and grouting the space between the beam and the soil with concrete for the entire height of the drilled hole. The shoring contractor should be prepared to case the holes or use the slurry method if caving soil is encountered. Excessive ground loss in the drilled holes must be avoided to reduce the potential for settlement on adjacent properties. If water is present in a hole at the time the soldier pile is poured, concrete must be tremied to the bottom of the hole.

As excavation proceeds downward, the space between the piles should be lagged with timber, and any voids behind the timbers should be filled with pea gravel, or a slurry comprised of sand and fly ash. Treated lagging is usually required for permanent walls, while untreated lagging can often be utilized for temporary shoring walls. Temporary vertical cuts will be necessary between the soldier piles for the lagging placement. The prompt and careful installation of lagging is important, particularly in loose or caving soil, to maintain the integrity of the excavation and provide safer working conditions. Additionally, care must be taken by the excavator to remove no more soil between the soldier piles than is necessary to install the lagging. Caving or overexcavation during lagging placement could result in loss of ground on neighboring properties. Timber lagging should be designed for an applied lateral pressure of 30 percent of the design wall pressure, if the pile spacing is less than three pile diameters. For larger pile spacings, the lagging should be designed for 50 percent of the design load.

Soldier Pile Wall Design

Permanent soldier pile retaining walls that are cantilevered and that have a level backslope should be designed for an active soil pressure equal to that pressure exerted by an equivalent fluid with a unit weight of 40 pounds per cubic foot (pcf). For a 2:1 (H:V) backslope, an active unit weight of 60 pcf should be used. The active pressure should act on the pile spacing above the level of the existing driveway, and on the pile diameter below that point. A safety factor of 1.5 should be used for the design of permanent soldier pile walls. A uniform seismic surcharge load of $9H$ pounds per square foot (psf), where H is the design retention height of the wall, should be added to the above active pressure. Using this

increased pressure, the safety factor against sliding and overturning can be reduced to 1.2 for the seismic analysis.

Slopes above the retaining walls will exert additional surcharge pressures. Traffic surcharges can typically be accounted for by increasing the effective height of the shoring wall by 2 feet.

It is important that the shoring design provides sufficient working room to drill and install the soldier piles, without needing to make unsafe, excessively steep temporary cuts. Cut slopes should be planned to intersect the backside of the drilled holes, not the back of the lagging.

Lateral movement of the soldier piles below the excavation level will be resisted by an ultimate passive soil pressure equal to that pressure exerted by a fluid with a density of 400 pcf. A reduction factor is included in this passive pressure to account for strain compatibility in regards to pile deflection. For permanent walls, we recommend a minimum factor of safety of 1.5 be applied to overturning and sliding calculations when using this ultimate value (temporary installations may use a factor of safety of 1.2). This soil pressure is valid only for a level excavation in front of the soldier pile; due to the glacially consolidated nature of the site soils, this passive pressure can act on three times the grouted pile diameter, or the pile spacing, whichever is smaller. Cut slopes made in front of shoring walls significantly decrease the passive resistance. The minimum pile embedment for cantilever soldier piles should be equal to the height of the "stick-up." A typical Cantilevered Soldier Pile Retaining Wall detail is attached to this report as Plate 7.

DRAINAGE CONSIDERATIONS

Footing drains should be used where: (1) crawl spaces or basements will be below a structure; (2) a slab is below the outside grade; or, (3) the outside grade does not slope downward from a building. Drains should also be placed at the base of all earth-retaining walls. These drains should be surrounded by at least 6 inches of 1-inch-minus, washed rock that is encircled with non-woven, geotextile filter fabric (Mirafi 140N, Supac 4NP, or similar material). At its highest point, a perforated pipe invert should be at least 6 inches below the bottom of a slab floor or the level of a crawl space. The discharge pipe for subsurface drains should be sloped for flow to the outlet point. Roof and surface water drains must not discharge into the foundation drain system. A typical footing drain detail is attached to this report as Plate 8. For the best long-term performance, perforated PVC pipe is recommended for all subsurface drains. Clean-outs should be provided for potential future flushing or cleaning of footing drains.

No groundwater was observed during our field work. If seepage is encountered in an excavation, it should be drained from the site by directing it through drainage ditches, perforated pipe, or French drains, or by pumping it from sumps interconnected by shallow connector trenches at the bottom of the excavation.

The excavation and site should be graded so that surface water is directed off the site and away from the tops of slopes. Water should not be allowed to stand in any area where foundations, slabs, or pavements are to be constructed. Final site grading in areas adjacent to a building should slope away at least one to 2 percent, except where the area is paved. Surface drains should be provided where necessary to prevent ponding of water behind foundation or retaining walls. A discussion of grading and drainage related to pervious surfaces near walls and structures is contained in the **Foundation and Retaining Walls** section.

GENERAL EARTHWORK AND STRUCTURAL FILL

All building and pavement areas should be stripped of surface vegetation, topsoil, organic soil, and other deleterious material. The stripped or removed materials should not be mixed with any materials to be used as structural fill, but they could be used in non-structural areas, such as landscape beds.

Structural fill is defined as any fill, including utility backfill, placed under, or close to, a building, or in other areas where the underlying soil needs to support loads. All structural fill should be placed in horizontal lifts with a moisture content at, or near, the optimum moisture content. The optimum moisture content is that moisture content that results in the greatest compacted dry density. The moisture content of fill is very important and must be closely controlled during the filling and compaction process.

The allowable thickness of the fill lift will depend on the material type selected, the compaction equipment used, and the number of passes made to compact the lift. The loose lift thickness should not exceed 12 inches, but should be thinner if small, hand-operated compactors are used. We recommend testing structural fill as it is placed. If the fill is not sufficiently compacted, it should be recompacted before another lift is placed. This eliminates the need to remove the fill to achieve the required compaction. The following table presents recommended levels of relative compaction for compacted fill:

LOCATION OF FILL PLACEMENT	MINIMUM RELATIVE COMPACTION
Beneath slabs or walkways	95%
Filled slopes and behind retaining walls	90%
Beneath pavements	95% for upper 12 inches of subgrade; 90% below that level

Where: Minimum Relative Compaction is the ratio, expressed in percentages, of the compacted dry density to the maximum dry density, as determined in accordance with ASTM Test Designation D 1557-91 (Modified Proctor).

LIMITATIONS

The conclusions and recommendations contained in this report are based on site conditions as they existed at the time of our exploration and assume that the soil and groundwater conditions encountered in the test borings are representative of subsurface conditions on the site. If the subsurface conditions encountered during construction are significantly different from those observed in our explorations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. Unanticipated conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking samples in test borings. Subsurface conditions can also vary between exploration locations. Such unexpected conditions frequently require making additional expenditures to attain a properly constructed project. It is recommended that the owner consider providing a contingency fund to accommodate such potential extra costs and risks. This is a standard recommendation for all projects.

This report has been prepared for the exclusive use of Sanjiv Parikh and his representatives, for specific application to this project and site. Our conclusions and recommendations are professional opinions derived in accordance with our understanding of current local standards of practice, and within the scope of our services. No warranty is expressed or implied. The scope of our services does not include services related to construction safety precautions, and 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. Our services also do not include assessing or minimizing the potential for biological hazards, such as mold, bacteria, mildew and fungi in either the existing or proposed site development.

ADDITIONAL SERVICES

In addition to reviewing the final plans, Geotech Consultants, Inc. should be retained to provide geotechnical consultation, testing, and observation services during construction. This is to confirm that subsurface conditions are consistent with those indicated by our exploration, to evaluate whether earthwork and foundation construction activities comply with the general intent of the recommendations presented in this report, and to provide suggestions for design changes in the event subsurface conditions differ from those anticipated prior to the start of construction. However, our work would not include the supervision or direction of the actual work of the contractor and its employees or agents. Also, job and site safety, and dimensional measurements, will be the responsibility of the contractor.

During the construction phase, we will provide geotechnical observation and testing services when requested by you or your representatives. Please be aware that we can only document site work we actually observe. It is still the responsibility of your contractor or on-site construction team to verify that our recommendations are being followed, whether we are present at the site or not.

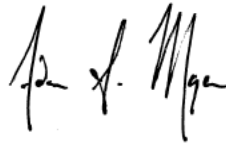
The following plates are attached to complete this report:

Plate 1	Vicinity Map
Plate 2	Site Exploration Plan
Plates 3 - 6	Test Boring Logs
Plate 7	Cantilevered Soldier Pile Retaining Wall Detail
Plate 8	Typical Footing Drain Detail

We appreciate the opportunity to be of service on this project. Please contact us if you have any questions, or if we can be of further assistance.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.



Adam S. Moyer
Geotechnical Engineer



3/13/2025

Marc R. McGinnis, P.E.
Principal

ASM/MRM:kg

NORTH



(Source: King County iMap)



GEOTECH
CONSULTANTS, INC.

VICINITY MAP

2816 - 68th Avenue Southeast
Mercer Island, Washington

Job 24433	Date: Mar. 2025		Plate: 1
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BORING 1

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
5						Brown SAND with silt, gravel, and trace organics, fine to medium-grained, dry, medium-dense (FILL)
14			1		FILL	- with glacial till inclusions
43			2		SP	Light-brown SAND with silt and gravel, fine to medium-grained, dry, medium-dense to dense
25			3		ML	Gray-brown with rust mottling, sandy SILT, slightly plastic, moist, very stiff
10					SP	Brown SAND with silt, fine-grained, moist, medium-dense
43			4			Gray-brown SILT with sand seams, slightly plastic, moist, very stiff L becomes sandy, non-plastic, dense L becomes moist to very moist
15			50/5"	5	ML	- becomes gray, plastic, very hard, reduced sand content - with occasional thin sand seams
20			50/5"	6		- becomes gray-brown
					SP	Gray-brown SAND with trace silt, fine-grained, moist, very dense
25			50/5"	7		- becomes gray, moist to very moist

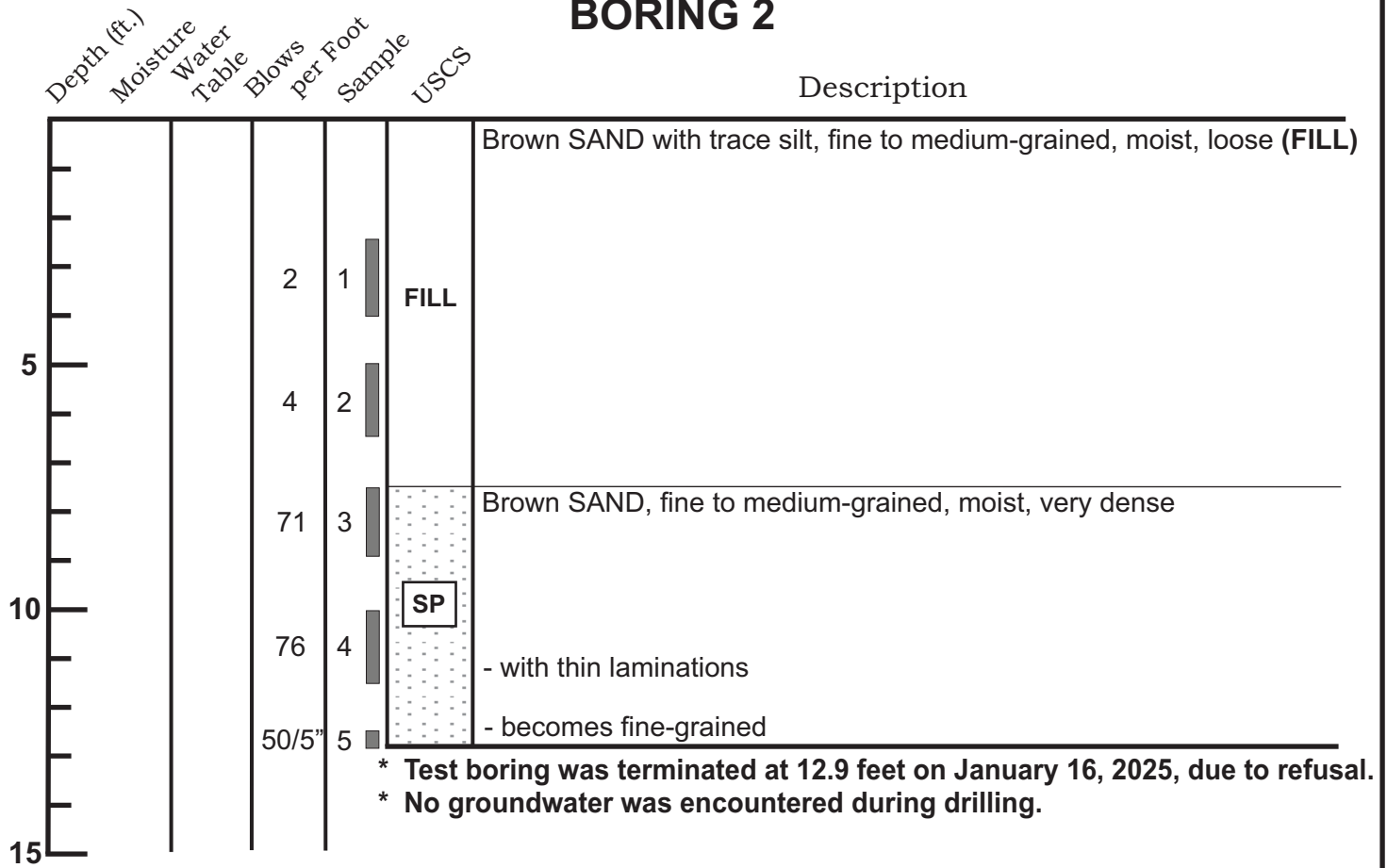
* Test boring was terminated at 25.4 feet on January 16, 2025, due to refusal.
 * No groundwater was encountered during drilling.



TEST BORING LOG
 2816 - 68th Avenue Southeast
 Mercer Island, Washington

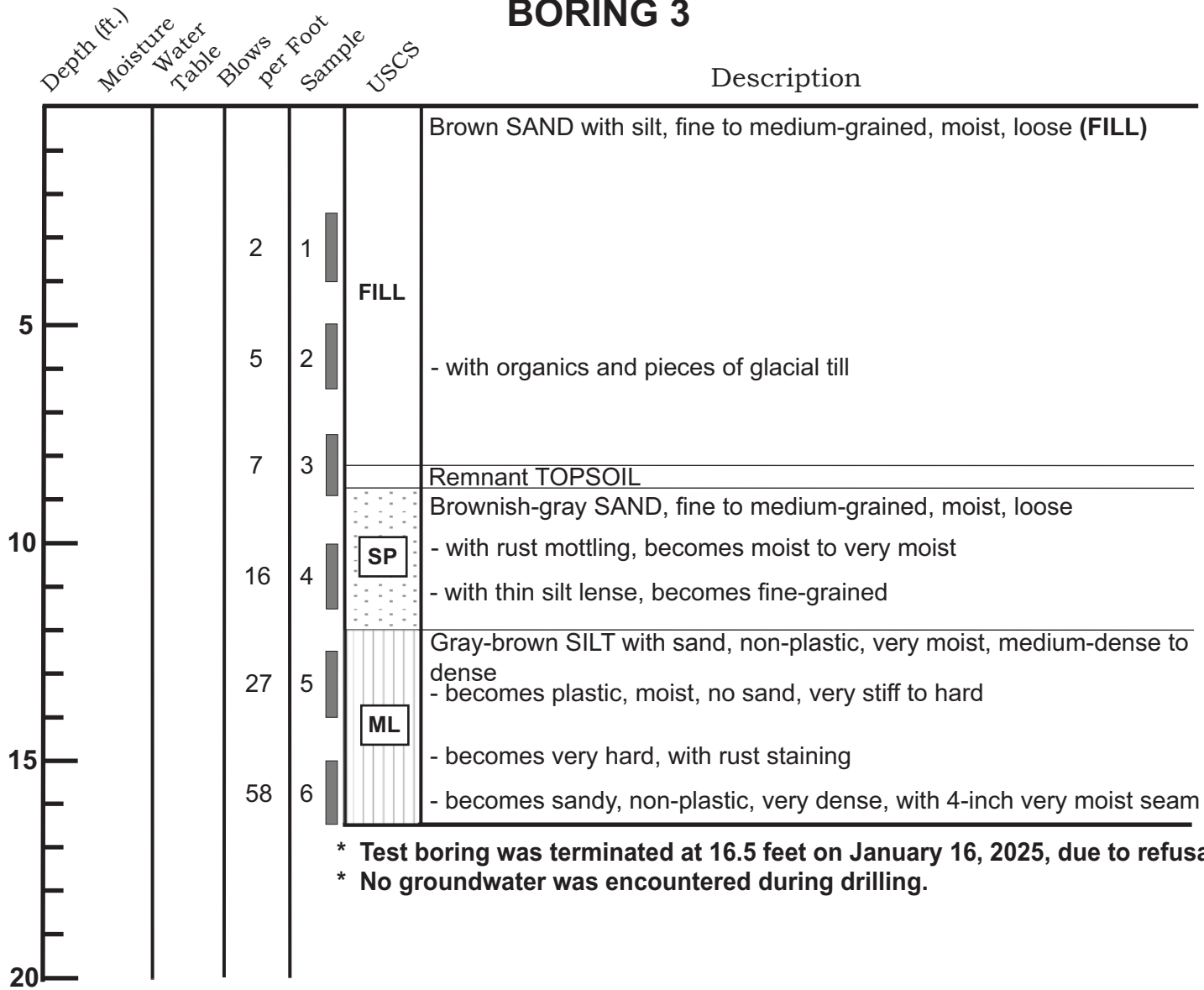
Job 24433	Date: Mar. 2025	Logged by: ASM	Plate: 3
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BORING 2



TEST BORING LOG			
2816 - 68th Avenue Southeast Mercer Island, Washington			
Job 24433	Date: Mar. 2025	Logged by: ASM	Plate: 4

BORING 3



* Test boring was terminated at 16.5 feet on January 16, 2025, due to refusal.
 * No groundwater was encountered during drilling.



TEST BORING LOG
 2816 - 68th Avenue Southeast
 Mercer Island, Washington

Job 24433	Date: Mar. 2025	Logged by: ASM	Plate: 5
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BORING 4

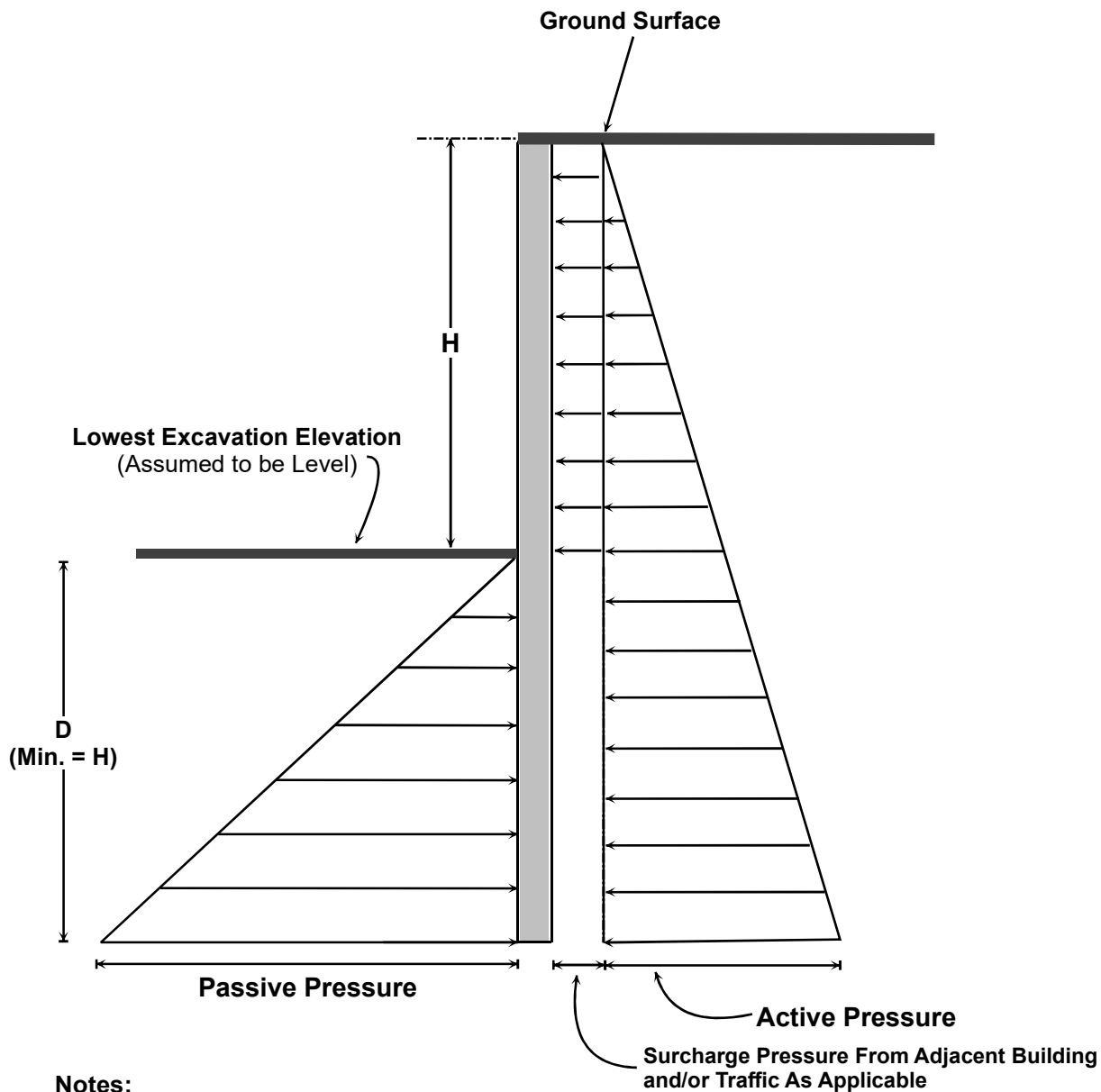
Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
						Brown SAND with silt and gravel, fine to medium-grained, moist, loose (FILL)
4			1		FILL	- with organics
5			2			Remnant TOPSOIL
					SP	Brown SAND with trace silt, fine to medium-grained, moist, loose
29			3		ML	Gray-brown with rust mottling, sandy SILT, plastic, moist, stiff
					SP	Gray-brown with rust mottling SAND with silt, fine-grained, moist, medium-dense to dense
85/11"			4		ML	Gray SILT, plastic, moist, very hard - with 6-inch moist to very moist, sandy lense

- * Test boring was terminated at 11.5 feet on January 16, 2025, due to refusal.
- * No groundwater was encountered during drilling.



TEST BORING LOG
2816 - 68th Avenue Southeast
Mercer Island, Washington

Job 24433	Date: Mar. 2025	Logged by: ASM	Plate: 6
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Notes:

- (1) The report should be referenced for specifics regarding design and installation.
- (2) Active pressures act over the pile spacing above the bottom of the excavation, and on the pile diameter below the bottom of excavation.
- (3) Passive pressures act over three times the grouted soldier pile diameter or the pile spacing, whichever is smaller.
- (4) It is assumed that no hydrostatic pressures act on the back of the shoring walls.
- (5) Cut slopes or adjacent structures positioned above or behind shoring will exert additional pressures on the shoring wall.

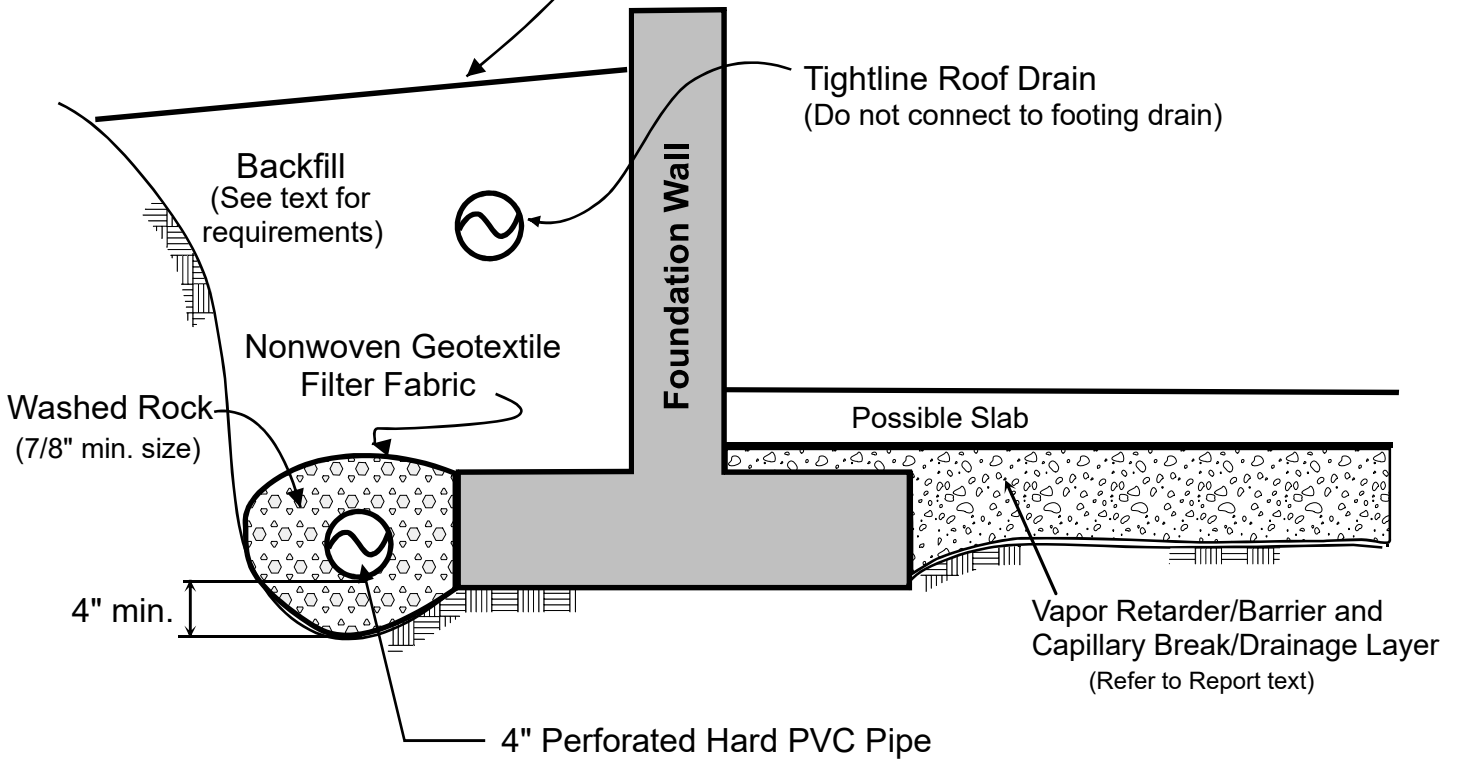


CANTILEVERED SOLDIER PILE RETAINING WALL

2816 - 68th Avenue Southeast
Mercer Island, Washington

Job 24433	Date: Mar. 2025	Plate:	7
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Slope backfill away from foundation. Provide surface drains where necessary.



(Invert at least 6 inches below slab or crawl space. Footing drain pipes can be laid flat with no slope, however, the non-perforated discharge pipes that connect to the footing drains should be sloped for flow to the outlet point. Place holes downward.)

NOTES:

- (1) In crawl spaces, provide an outlet drain to prevent buildup of water that bypasses the perimeter footing drains.
- (2) Refer to report text for additional drainage, waterproofing, and slab considerations.



FOOTING DRAIN DETAIL
 2816 - 68th Avenue Southeast
 Mercer Island, Washington

Job 24433	Date: Mar. 2025	Plate: 8
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