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JN 23365

Steve and Joanne Adams
8035 Southeast 45th Street
Mercer Island, Washington 98040

Sent to: McFadden Design
Attention: Michael McFadden
via email: michael@mcfaddendesign.com

Subject: **Transmittal Letter – Geotechnical Engineering Study**
Proposed Residence Addition Project
8035 Southeast 45th Street
Mercer Island, Washington

Greetings:

Attached to this transmittal letter is our geotechnical engineering report for the residence addition project to be constructed on 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-11490, dated October 3, 2023.

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.

D. Robert Ward, P.E.
Principal

DRW:kg

GEOTECHNICAL ENGINEERING STUDY
Residence Addition Project
8035 Southeast 45th Street
Mercer Island, Washington

This report presents the findings and recommendations of our geotechnical engineering study for the site of the proposed residence project to be located at 8035 Southeast 45th Street on Mercer Island.

Based on information in a site plan that was given to us by McFadden Design LLC, we understand that a bedroom addition is proposed onto the lower, southwestern side of the existing residence, while a kitchen addition is proposed onto the west-central portion of the residence. Also, an addition is proposed onto the northern side of the existing detached garage. We believe the lower floor of the bedroom addition will be at the residence's basement level of approximately elevation 187 feet, while the other two additions will be at the main level grade of approximately elevation 195 to 196 feet. Excavations for these additions will likely be relatively minor.

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 on Mercer Island. The irregularly-shaped subject site has 115.4 feet of frontage along the southern side of Southeast 45th Street and extends a depth of 201 feet to the south along the site's eastern property line. The western property line is roughly a large arc, such that the center of the property has a width of approximately 141 feet, while the southern property line has a length of only 62.5 feet.

A one-story, H-shaped residence is located in the center of the property. The residence has western and eastern wings (each long in the north-south direction), which are connected by a narrow hallway. The residence generally has a finished floor elevation of approximately 195.5 feet, which matches the relatively level ground surface that surrounds much of the residence. However, the southern end of the western wing overlies a basement that daylights to the west at an elevation of 187.2 feet. The northern end of the eastern wing contains a three-car garage. An asphalt motorcourt extends north from the garage, and a driveway extends from the motorcourt to Southeast 45th Street to the northeast. Brick walkways wrap around the residence and between the two wings of the residence. A grass lawn covers the southeast corner of the property and a brick patio which extends approximately 25 feet west off of the western side of the residence's western wing at the main floor elevation. A staircase descends from the western end of the patio and turns to the south to a lower stone paver walkway and brick patio off the daylight basement in the southwest corner of the residence.

As discussed above, the majority of the subject site is generally flat surrounding the residence with a grade near elevation 195 to 195.5 feet. However, the grade rises steeply to the east along the eastern property line, and slopes steeply downwards to the north and west along the northern and western perimeters of the site. Along the eastern property line, the ground surfaces rises approximately 9 to 11.5 feet, up to the eastern adjacent properties over a series of short tiered wood walls, modular block walls, and rockeries. Along the northern and western perimeters of the property, the ground surface slopes steeply downward to the north and west over an ivy-covered slope. The majority of the northern steep slope is located within the northern adjacent Southeast 45th Street right-of-way; the 8 to 12-foot-tall northern slope has inclination of approximately 55 to 75 percent and terminates at the Southeast 45th Street pavement to the north. The slope on the western perimeter of the slope descends from the level western yard and patio, down to the western property line and a driveway on the western adjacent property; the western slope has an inclination of approximately 65 to 110 percent over a height of 10 to 12 feet. In the southwest corner of the property (west of the daylight basement), the grade drops only 2 to 4 feet over a short rockery to the driveway on the southwestern adjacent property.

Based on Building Intake Comments prepared by the City of Mercer Island, the entire property is noted as being in a Potential Slide Area and an Erosion Hazard Area.

As discussed above, the subject site is bordered by Southeast 45th Street to the north. Parcels containing single-family residences surround the remainder of the subject site. The neighboring residences generally have large setbacks from the shared property lines. However, a shared driveway for the western and southwestern adjacent properties follows the full length of the subject site's western property line. Also, a neighboring tennis court has little to no offset from the northern half of the subject site's eastern property line.

SUBSURFACE

The subsurface conditions were explored by drilling three test borings at the approximate locations shown on the Site Exploration Plan, Plate 2. We also excavated a test hole using hand equipment. 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 November 9, 2023 using both a small track-mounted, hollow-stem auger drill and a portable Acker drill (this 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 5.

Soil Conditions

Native soils were revealed at a shallow depth in the test boring drilled in the upper, northeastern portion of the of the site just north of the garage (B-2). The uppermost soils consist of medium-dense silty sand that is underlain by very dense silty sand/sandy silt. The two test borings drilled on the western side of the residence encountered approximately 4 feet of loose, unengineered fill soil overlying native soils. In the southwestern test boring (B-1), approximately 4 feet of native, loose, sandy silt that appears to be colluvium (old landslide soil) was revealed below the fill. At approximately 8.5 feet, non-colluvial, medium-dense silty sand/sandy silt was revealed that became denser with depth (maximum explored depth of B-1 was approximately 16 feet). In the west-central test boring (B-3), the fill soil was underlain by native, loose to medium-dense silty sand/sandy silt soil that became medium-dense at approximately 7 feet. At approximately 11 feet, this soil was underlain by dense sand that continued down to about 17 feet and was underlain by very stiff to hard silt. At a depth of about 28 feet, the silt was underlain by dense to very dense sand; this sand was revealed to the maximum explored depth of 31 feet.

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

Groundwater seepage was observed at a depth of approximately 30.5 feet in Test Boring 3. Groundwater levels encountered during drilling can be deceptive, because seepage into the boring can be blocked or slowed by the auger itself. We do not believe groundwater will be a geotechnical engineering issue for this project.

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. Where a transition in soil type occurred between samples in the test 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 excavation drilling.

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 USGS website, the mapped spectral acceleration value for a 0.2 second (S_s) and 1.0 second period (S_1) equals 1.43g and 0.50g, 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 MCE peak ground acceleration adjusted for site class effects (F_{PGA}) equals 0.68g. The soils beneath the site are not susceptible to seismic liquefaction under the ground motions of the MCE because of their dense/stiff nature and/or the absence of near-surface groundwater.

Sections 1803.5 of the IBC and 11.8 of ASCE 7 require that other seismic-related geotechnical design parameters (seismic surcharge for retaining wall design and slope stability) include the potential effects of the Design Earthquake. The peak ground acceleration for the Design Earthquake is defined in Section 11.2 of ASCE 7 as two-thirds (2/3) of the MCE peak ground acceleration, or 0.45g.

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.

In the area of the proposed garage addition, medium-dense soil was revealed in the test boring at a relatively shallow depth. Therefore, the foundation of the addition can consist of conventional footing provided they bear on the medium-dense soil. Information regarding footings is given in a subsequent section of this study.

Approximately 7 to 10 feet of relatively loose/soft soils were revealed in the test borings drilled on the western/southwestern portions of the site, respectively; these were located approximately where the kitchen and bedroom additions are proposed. Competent soil was revealed below these depths. A footing foundation could potentially be used for these additions, but the depth of excavation would be unreasonable for such a small project in our opinion. Therefore, we recommend that driven pipe piles be used for this project; these will extend through the incompetent upper soils and into the competent soils. Information regarding pipe piles is given in a subsequent section of this study.

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.

Geotech Consultants, Inc. should be allowed to review the final development plans to verify that the recommendations presented in this report are adequately addressed in the design. Such a plan review would be additional work beyond the current scope of work for this study, and it may include revisions to our recommendations to accommodate site, development, and geotechnical constraints that become more evident during the review process.

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.

CRITICAL AREAS STUDY (MICC 19.07)

Potential Landslide Hazard Area: As noted earlier, the entire property is mapped as Potential Landslide Hazard Area. However, the area of the proposed garage addition is flat, and the new foundations will bear on competent soil. Therefore, this area does not have any potential for the occurrence of a landslide. At the southwestern addition area, the ground is flat directly at the addition location and then only slopes moderately downward over a vertical height of 4 feet to an adjacent driveway. Because the area of the southwestern addition is flat and/or has only a small, moderate slope nearby, and because of the foundations that bear into competent soil, this area does not have a landslide potential. Lastly, the area of the proposed west-central kitchen addition is flat; this flat area extends out for about 22 to 24 feet west of the addition location. Below and west of this flat area is an approximate 10-foot-tall slope that ends at the adjacent driveway. Because there is a significant amount of flat area west of the addition and the steep slope below the flat slope is only about 10 feet tall, and because the foundation will bear into competent soil, it is our opinion that this area does not have a landslide potential. In summary, we believe that all of the addition areas are not landslide hazards, the project is very suitable from a geotechnical engineering standpoint. No adverse conditions will be made on the site or on adjacent sites if the recommendations in this report are followed.

Erosion Hazard: The site also meets the City of Mercer Island's criteria for an Erosion Hazard Area. However, the work areas for the proposed work are located where only flat to gently sloped areas and excavations for the project will not be substantial. Thus, typical erosion control measures will be very suitable to suitably control the potential of erosion. 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 should be erected as close as possible to the western and southern sides of the planned work area, and the existing vegetation (mostly yard grass) east of the silt fence. Straw wattles may also be used in tandem with the silt fence as needed. Also, any 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.

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:

> *It is our professional opinion that the recommendations presented in this report for the proposed additions project will render the development as safe as if it were not located in a geologically hazardous area and will not adversely impact adjacent properties.*

FOOTING FOUNDATIONS FOR GARAGE ADDITION

The proposed garage addition can be supported on conventional continuous and spread footings bearing on undisturbed, native, medium-dense soil. 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 2,000 pounds per square foot (psf) is appropriate for footings supported on medium-dense native soil. 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 3/4-inch, with differential settlements on the order of 1/2-inch in a distance of 25 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

Three- or 4-inch-diameter pipe piles driven with a 850- or 1,100- or 2,000-pound hydraulic jackhammer to the following final penetration rates may be assigned the following compressive capacities.

INSIDE PILE DIAMETER	FINAL DRIVING RATE (850-pound hammer)	FINAL DRIVING RATE (1,100-pound hammer)	FINAL DRIVING RATE (2,000-pound hammer)	ALLOWABLE COMPRESSIVE CAPACITY
3 inches	10 sec/inch	6 sec/inch	2 sec/inch	6 tons
4 inches	16 sec/inch	10 sec/inch	4 sec/inch	10 tons

Note: The refusal criteria indicated in the above table are valid only for pipe piles that are installed using a hydraulic impact hammer carried on leads that allow the hammer to sit on the top of the pile during driving. If the piles are installed by alternative methods, such as a vibratory hammer or a hammer that is hard-mounted to the installation machine, numerous load tests to 200 percent of the design capacity would be necessary to substantiate the allowable pile load. The appropriate number of load tests would need to be determined at the time the contractor and installation method are chosen.

As a minimum, Schedule 40 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.

Seattle Director’s Rule 10-2009 contains several prescriptive requirements related to the use of pipe piles having a diameter of less than 10 inches. Under Director’s Rule 10-2009, load tests are required on 3 percent of the installed piles up to a maximum of 5 piles, with a minimum of one pile load test on each project. Additionally, full-time observation of the pile installation by the geotechnical engineer-of-record is required by Director’s Rule 10-2009.

We recommend a minimum pile length of 15 feet below the ground surface. However, our experience with installation of small-diameter pipe piles indicates that it is likely that they will be longer than this minimum length to reach refusal.

Pile caps and grade beams should be used to transmit loads to the piles. Isolated pile caps should include a minimum of two piles to reduce the potential for eccentric loads being applied to the piles. Subsequent sections of pipe can be connected with slip or threaded couplers, or they can be welded together. If slip couplers are used, they should fit snugly into the pipe sections. This may require that shims be used or that beads of welding flux be applied to the outside of the coupler.

Lateral loads due to wind or seismic forces 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 be surrounded by level compacted fill. We recommend using a passive earth pressure of 300 pounds per cubic foot (pcf) for this resistance. This is an ultimate value that 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.

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.**

**** Not applicable for foundations on piles.**

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. 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 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 the wall and reinforcing design for a distance of 1.5 times the wall 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 walls over 6 feet in height. 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 9**H** 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 section entitled ***General Earthwork and Structural Fill*** contains additional recommendations regarding the placement and compaction of structural fill behind retaining and foundation walls.

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

SLABS-ON-GRADE

The building floors can be constructed as slabs-on-grade atop the existing native or fill soils, or on structural fill. <u>However</u>, for the additions off the western and southwestern sides of the residence, we recommend the existing soils be first recompacted and then at least 12 inches of compacted imported granular structural fill be placed beneath the floor slabs. The subgrade soil must be in a firm, non-yielding condition at the time of slab construction or underslab fill placement. Any soft areas encountered should be excavated and replaced with select, imported structural fill.

Even where the exposed soils appear dry, water vapor will tend to naturally migrate upward through the soil to the new constructed space above it. This can affect moisture-sensitive flooring, cause imperfections or damage to the slab, or simply allow excessive water vapor into the space above the slab. All interior slabs-on-grade should be underlain by a capillary break drainage layer consisting of a minimum 4-inch thickness of clean gravel or crushed rock that has a fines content (percent passing the No. 200 sieve) of less than 3 percent and a sand content (percent passing the No. 4 sieve) of no more than 10 percent. Pea gravel or crushed rock are typically used for this layer.

As noted by the American Concrete Institute (ACI) in the *Guides for Concrete Floor and Slab Structures*, proper moisture protection is desirable immediately below any on-grade slab that will be covered by tile, wood, carpet, impermeable floor coverings, or any moisture-sensitive equipment or products. ACI recommends a minimum 10-mil thickness vapor retarder for better durability and long term performance than is provided by 6-mil plastic sheeting that has historically been used. A vapor retarder is defined as a material with a permeance of less than 0.3 perms, as determined by ASTM E 96. It is possible that concrete admixtures may meet this specification, although the manufacturers of the admixtures should be consulted. Where vapor retarders are used under slabs, their edges should overlap by at least 6 inches and be sealed with adhesive tape. The sheeting should extend to the foundation walls for maximum vapor protection.

If no potential for vapor passage through the slab is desired, a vapor *barrier* should be used. A vapor barrier, as defined by ACI, is a product with a water transmission rate of 0.01 perms when tested in accordance with ASTM E 96. Reinforced membranes having sealed overlaps can meet this requirement.

We recommend that the contractor, the project materials engineer, and the owner discuss these issues and review recent ACI literature and ASTM E-1643 for installation guidelines and guidance on the use of the protection/blotter material.

The ***General***, ***Permanent Foundation and Retaining Walls***, 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 approximately a minimum 2 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. 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.

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.

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 6. 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.

As a minimum, a vapor retarder, as defined in the ***Slabs-On-Grade*** section, should be provided in any crawl space area to limit the transmission of water vapor from the underlying soils. Crawl space grades are sometimes left near the elevation of the bottom of the footings. As a result, an outlet drain is recommended for all crawl spaces to prevent an accumulation of any water that may bypass the footing drains. Providing a few inches of free draining gravel underneath the vapor retarder is also prudent to limit the potential for seepage to build up on top of the vapor retarder.

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).

Structural fill that will be placed in wet weather should consist of a coarse, granular soil with a silt or clay content of no more than 5 percent. The percentage of particles passing the No. 200 sieve should be measured from that portion of soil passing the three-quarter-inch sieve.

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 Steve and Joanne Adams and their 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 - 5	Test Boring Logs
Plate 6	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.

D. ROBERT WARD
STATE OF WASHINGTON
29740
REGISTERED
PROFESSIONAL ENGINEER

12/01/2023

D. Robert Ward, P.E.
Principal

DRW:kg

NORTH

(Source: Microsoft MapPoint, 2013)

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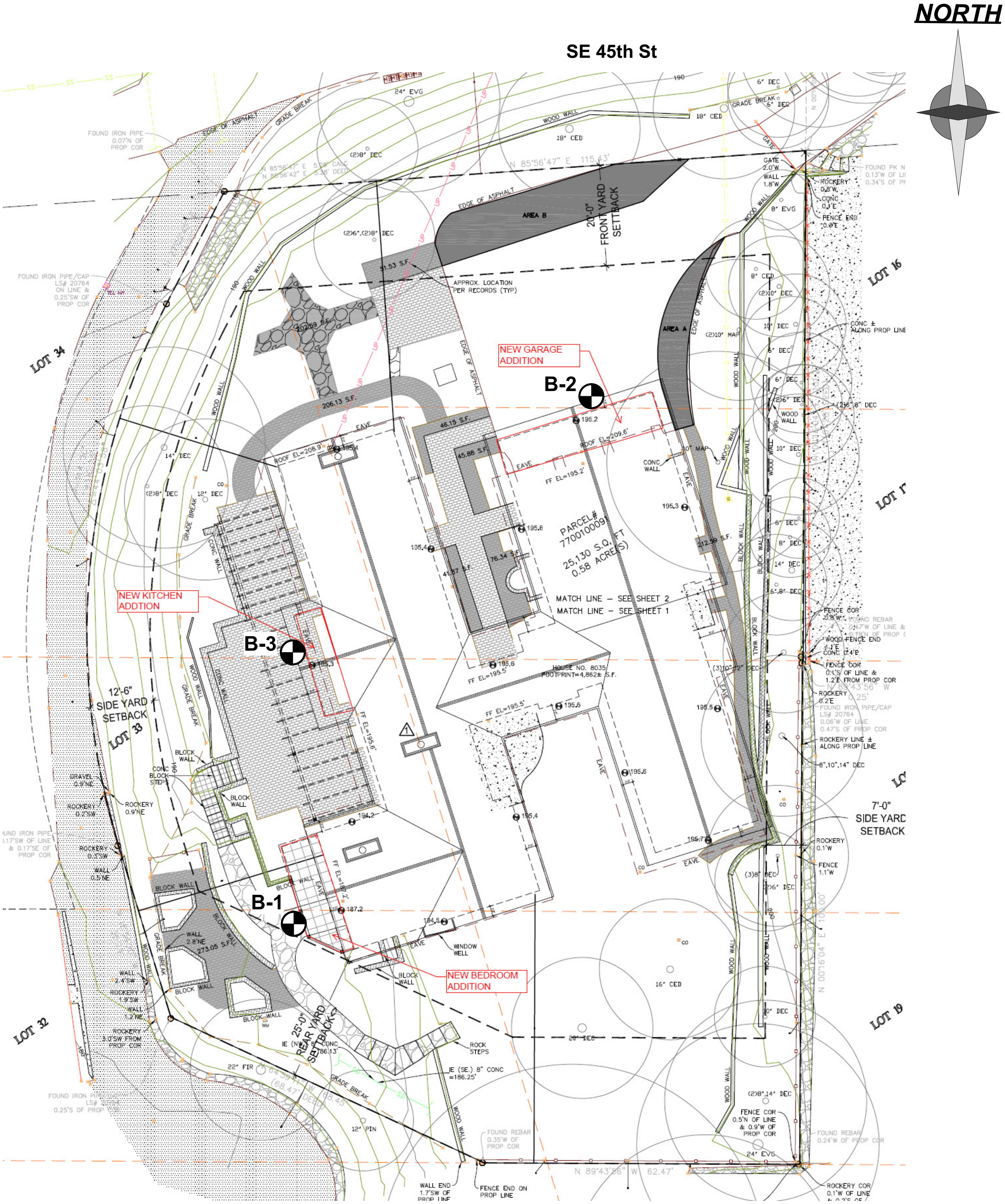
VICINITY MAP

8035 Southeast 45th Street
Mercer Island, Washington

Job No:	Date:		Plate:
23365	Dec. 2023		1



Legend:

Test Boring Location

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SITE EXPLORATION PLAN

8035 Southeast 45th Street
Mercer Island, Washington

Job No:	Date:		Plate:
23365	Dec. 2023	No Scale	2

BORING 1

Elevation ±186.7 feet

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
0–3.5			7	1	FILL	Brown and gray-brown very silty SAND with gravel, organics, and wood debris, fine-grained, moist, loose **(FILL)**
3.5–3.8						TOPSOIL
3.8–8.5			9	2	ML	Brown with rust mottling, sandy SILT with trace gravel and organics, non-plastic, jumbled, loose (Colluvium)
			16	3		-becomes gray with rust mottling, with no organics
8.5–14.9			29	4	ML	Brown SILT with sand and trace gravel, non-plastic, laminated, moist, medium-dense
						-becomes gray with rust mottling, medium-dense to dense, with occasional gravelly sand seams
			**66	5		-becomes slightly plastic, dense
14.9–16.4			50/6"	6	SM SP	Gray-brown gravelly slightly silty SAND, fine- to coarse-grained, moist, very dense
			50/4"	7		

*** Test boring was terminated at 16.4 feet on November 9, 2023.**

*** No groundwater was encountered during drilling.**

**** Overstated blow counts due to driving on gravels.**

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TEST BORING LOG

8035 Southeast 45th Street
Mercer Island, Washington

Job No:	Date:	Logged by:	Plate:
23365	Dec. 2023	ASM	3

BORING 2

Elevation ±195.3 feet

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
					SP	Brown SAND with gravel and silt, fine- to medium-grained, moist, medium-dense
			18	1	SM	Brown with rust mottling, silty SAND with gravel, fine- to medium-grained, moist, medium-dense
5			81	2		-becomes gray with rust mottling, gravelly, fine- to coarse-grained, very dense
			49	3	ML	Gray-brown sandy SILT with occasional thin sand lenses, fine-grained, non-plastic, moist, dense to very dense
10						
15						
20						
25						
30						

*** Test boring was terminated at 9.5 feet on November 9, 2023.**

*** No groundwater was encountered during drilling.**

GEOTECH CONSULTANTS, INC.

TEST BORING LOG

8035 Southeast 45th Street
Mercer Island, Washington

Job No:	Date:	Logged by:	Plate:
23365	Dec. 2023	ASM	4

BORING 3

Elevation ±195.2 feet

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
					FILL	Dark-brown silty SAND / sandy SILT with gravel, fine- to medium-grained, moist, loose to medium-dense **(FILL)**
			16	1		
5			12	2	ML/SM	Brown sandy SILT with occasional gravel, non-plastic, fine-grained, moist, loose to medium-dense
						-grades to silty SAND in part, becomes gray-brown with rust mottling, medium-dense
			21	3		-becomes gray-brown
10			25	4		
					SP	Gray-brown SAND, fine- to medium-grained, moist, medium-dense
			33	5		-becomes dense
15			31	6		-with trace gravel
			38	7	ML	Brown SILT, slightly plastic, moist, very stiff to hard
20			24	8		-with 12-inch, fine-grained, sand seam
25			28	9		-becomes sandy, non-plastic, with occasional thin sand seams
					SP	Gray-brown SAND with silt, fine-grained, moist, dense to very dense
30		▼	45	10		-becomes wet

* **Test boring was terminated at 31.5 feet on November 9, 2023.**

* **Groundwater seepage was encountered at 30.5 feet during drilling.**

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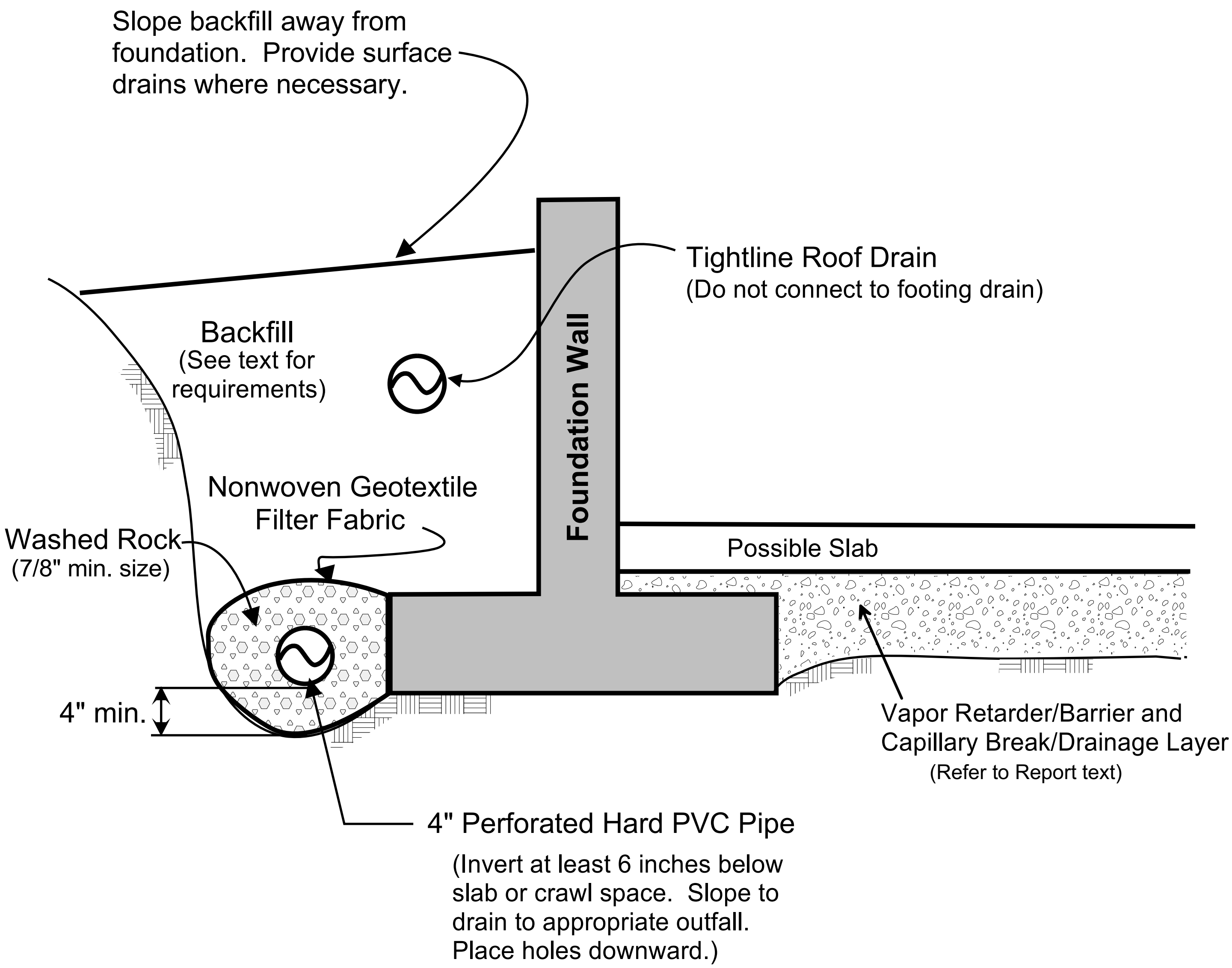
TEST BORING LOG

8035 Southeast 45th Street
Mercer Island, Washington

Job No:	Date:	Logged by:	Plate:
23365	Dec. 2023	ASM	5



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.

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FOOTING DRAIN DETAIL

8035 Southeast 45th Street
Mercer Island, Washington

Job No:	Date:		Plate:
23365	Dec. 2023		6