GEOTECH
CONSULTANTS, INC.

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December 4, 2023

JN 23390

Doug Rosen c/o Neiman Taber Architects
1435 – 34th Avenue
Seattle, Washington 98122
via email: dt@neimantaber.com

Subject: **Geotechnical Engineering Study**
Proposed Terrace Extension Project
5995 Southeast 30th Street
Mercer Island, Washington

Greetings:

This report presents the findings and recommendations of our geotechnical engineering study for the site of the proposed extension to an existing terrace at 5995 Southeast 30th Street on Mercer Island. 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 and critical area considerations. This work was authorized by your acceptance of our proposal, P-11434, dated August 2, 2023.

We were provided with an architectural site plan of the project prepared by Neiman Taber Architects. The plan indicates that the existing terrace on the southwestern portion of the site will be extended to the south/southwest. The terrace will have a slab-on-grade floor. Based on conversations with Neiman Taber, we understand that the terrace will extend above the existing ground about 1.5 to 5.5 feet. Thus, retaining walls are needed on the perimeter of the new terrace.

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 subject site is located at the southwestern corner of Southeast 30th Street and 60th Avenue Southeast in the northwestern portion of Mercer Island. The site is downslope and west of 60th Avenue Southeast. The property slopes downward to the west from the street, ending at the shore of Lake Washington. Approximately the eastern 50 to 60 percent of the site is gently sloped with an overall inclination of about 6 to 7 percent. The existing residence is located within this gently sloped area. A terrace is located just off the western/southwestern sides of the residence. It is situated about 2 feet above the downslope ground; a retaining wall borders the outside edges of the terrace. Over a height of approximately 8 to 10 feet, the ground downslope of the terrace (to the west and southwest) slopes approximately 20 to 25 percent. This ground west of the terrace is landscaped and includes some small retaining walls. To the south, the ground contains several trees and bushes, including an approximate 14-inch-diameter fir tree. Below the 20- to 25-percent slope, the ground declines to the lake at approximately 10 to 15 percent.

Based on the Mercer Island GIS portal, approximately the western half of the property is noted as being a Potential Landslide Hazard Area, while the central and western portions are noted as being an Erosion Hazard Area. In addition, the western edge of the property is a Potential Seismic Hazard Area. No steep slopes are noted in the GIS information on or in the vicinity of the property.

SUBSURFACE

Our firm observed the drilling of several test borings on the adjacent southern property. Two test borings that were drilled closest to the proposed terrace area revealed very stiff silt at depths of approximately 2 feet to 4 feet below the ground surface. We excavated a test hole on the project site near the western side of the proposed terrace. Approximately 2 feet of loose fill soil was revealed overlying soft, native silt. At a depth of 4 feet the silt became very stiff; this is very similar to conditions revealed in the adjacent test borings. We also used a ½-inch steel rod to probe into the ground near the south edge of the existing terrace, and it appears the very stiff silt exists there at approximately 4 feet. We have attached a Site Exploration Plan indicating the location of the onsite explorations. We have also included the logs of the two nearby test borings. A log of the onsite test hole is as follows:

TEST HOLE

Depth (feet)	Soil Description
0 - 1.0	Topsoil fill
1.0 - 2.0	Mottled, silty sand to sandy silt fill, moist, loose
2.0 – 4.0	Dark brown sandy SILT, wet, soft
3.0 – 7.0	Gray, slightly sandy silt, moist, very stiff

Test Hole was terminated at a depth of 4.5 feet on November 13, 2023.
No groundwater seepage was observed in the test hole.

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 1.41g 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 MCE peak ground acceleration adjusted for site class effects (F_{PGA}) equals 0.66g. The soils beneath the site are not susceptible to seismic liquefaction under the ground motions of the MCE because of their very 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 0.44g.

CONCLUSIONS AND RECOMMENDATIONS, AND CRITICAL AREAS STUDY

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.

Based on the test hole and probing done on the site, as well as information from logs of test borings drilled on the adjacent southern property, the core soil at the site and neighboring site is native, very stiff soil. This competent soil was revealed onsite at a depth of approximately 4 feet below the ground surface, while it was revealed at about 2 to 4 feet in the two closest test borings to the proposed terrace area drilled on the adjacent southern side. The foundations needed for walls of the proposed terrace can consist of conventional footings provided they bear on the very stiff silt. It appears that some overexcavation will be needed to reach this competent soil in some/most of the foundation locations.

Based on the Mercer Island GIS portal, approximately the western half of the property is noted as being a Potential Landslide Hazard Area, while the central and western portions are noted as being an Erosion Hazard Area. In addition, the western edge of the property is a Potential Seismic Hazard Area. A discussion of these areas, as well as a Statement of Risk, it provided in the Critical Areas Study below.

An approximate 14-inch-diameter fir tree is located within the envelope of the new terrace and thus needs to be removed to accommodate the construction of the terrace. It is our professional opinion that the tree removal is suitable for this project because 1) the core soil of the site is very stiff silt, and 2) the retaining walls of the terrace will be founded on the very stiff silt, and 3) the retaining walls will provide more stability to the area than the fir tree.

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 approximate western half of the property is mapped as Potential Landslide Hazard Area. This Area generally corresponds to where the slopes at the western side vary from approximately 10 to 25 percent. As noted previously, the core of the subject property and adjacent properties is comprised of very stiff silt soil. This soil has been glacially consolidated. This soil has a high internal shear strength, and thus a very low potential for deep seated landslides in slopes with inclinations that are only moderate (as are the steepest slopes on the property). This soil is also very good for supporting building loads. Because of the existence of this core soil, and because the foundations of the terrace walls will bear on this soil, it is our professional opinion that there is not a potential for a landslide affecting the proposed terrace or the nearby area.

Seismic Hazard Area: This Hazard Area is noted on the GIS portal as located on the western edge of the property adjacent to Lake Washington. The existing residence and proposed terrace are located outside of this Hazard area. Based on the onsite explorations and adjacent test borings, the site soils are not subject to seismic issues such as liquefaction. Thus, no mitigation with regards to the mapped Hazard is needed in our professional opinion from a geotechnical engineering perspective.

Erosion Hazard: The site also meets the City of Mercer Island's criteria for an Erosion Hazard Area. However, because the work area for the proposed terrace is located in only a gently to moderately sloped area and excavations for the project will not be substantial, 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 terrace will render the development as safe as if it were not located in a geologically hazardous area and will not adversely impact adjacent properties.*

RETAINING WALLS

A conventional footing foundation can be used for the retaining walls of the proposed terrace provided it is placed on the very stiff silt. 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.

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
Bearing Capacity	3500 psf
Lateral Earth Pressure *	35 pcf
Passive Earth Pressure	300 pcf
Coefficient of Friction	0.40
Soil Unit Weight	130 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 if needed. 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, 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. If needed, 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 8**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 Drainage and Backfill

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. No formal subsurface drainage is needed for the walls if weep holes are placed at the base of the walls. We recommend that the weep holes be 2 inches in diameter and space no further than 5 feet apart.

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.

It is critical that the wall backfill 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 ***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.

EXCAVATIONS AND SLOPES

No excavation taller than about 3 feet is anticipated for this project. 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 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 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.

GENERAL EARTHWORK AND STRUCTURAL FILL

The terrace area should be stripped of surface vegetation, topsoil, organic soil, heavily rooted 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
Behind retaining walls	92%

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).

<u>The onsite soils are not suitable to use as structural fill for this project.</u> Imported 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. It would be prudent to use similar imported soil even in dry weather.

<u>LIMITATIONS</u>

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 Doug Rosen, Neiman Taber Architects, 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.

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.

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.

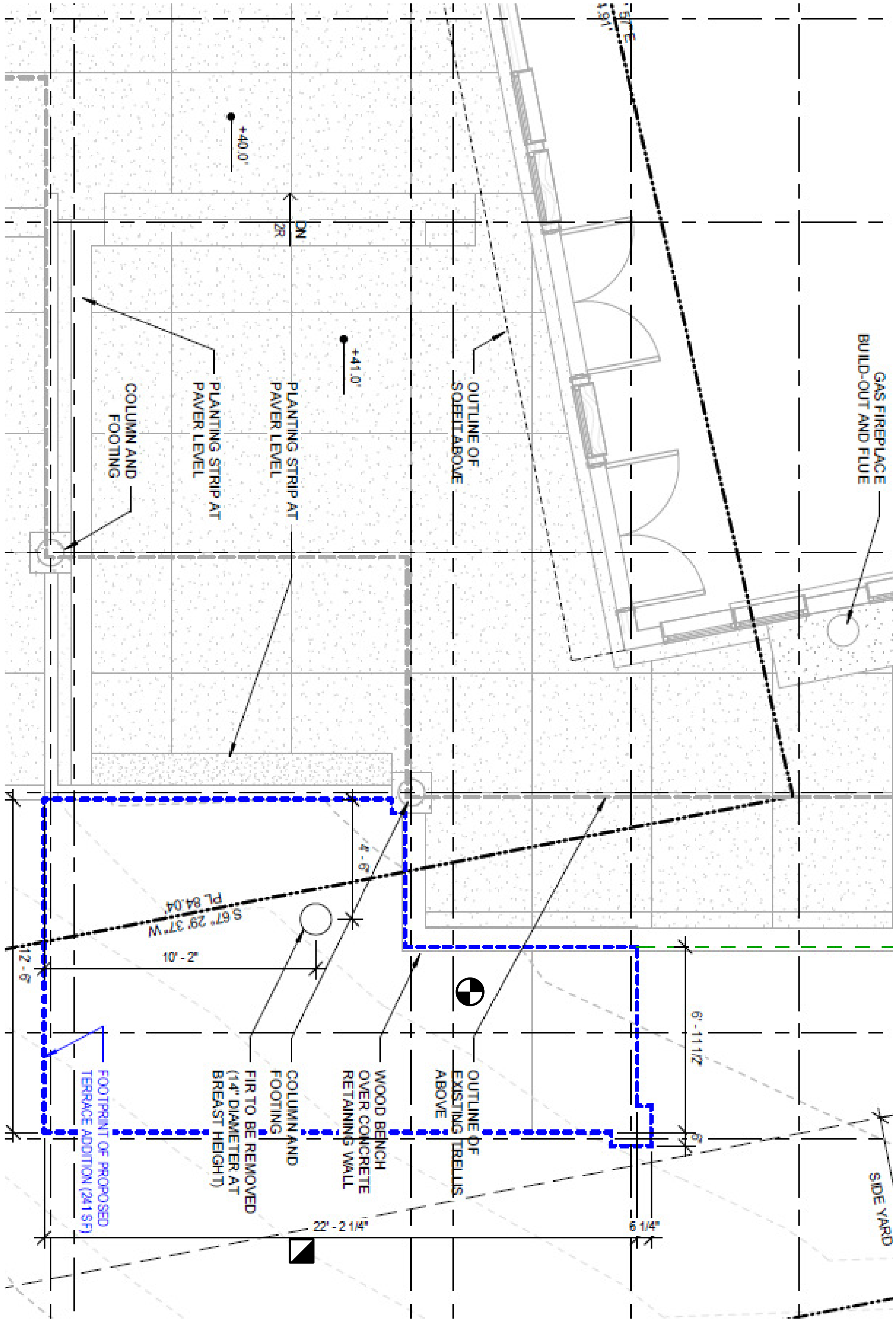
12/4/2023

D. Robert Ward, P.E.
Principal

Attachment: Site Exploration Plan, Two Adjacent Test Borings

DRW:kg

NORTH



Legend:

- Test Probe Location
- Test Hole Location

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SITE EXPLORATION PLAN

5995 Southeast 30th Street
Mercer Island, Washington

Job No:	Date:		Plate:
23390	Dec. 2023	No Scale	

BORING 1

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
						Topsoil
					ML/ MH	Tan SILT to clayey SILT, non-plastic to plastic, moist, very stiff/medium-dense
			26	1		
5			28	2		
10			25	3		-becomes gray
						-with sand, fine to coarse-grained
15			27	4		
20						

* Test boring was terminated on January 5, 2015 at 16.5 feet.
* No groundwater was encountered during drilling.

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TEST BORING LOG

3019 & 3031 - 60th Avenue Southeast
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
14499	Jan. 2015	TRC	3

BORING 2

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
						Topsoil
					ML	Rust-brown, mottled tan SILT with sand, non-plastic, fine to coarse-grained, loose
			7	1		
5			28	2	SM	Tan, silty SAND, fine to coarse-grained, moist, medium-dense
					ML	Tan SILT with sand, non-plastic, fine-grained, moist, medium-dense
10			28	3	ML/ MH	Tan SILT to clayey SILT, non-plastic to plastic, moist, very stiff/medium-dense
15						
20						

*** Test boring was terminated on January 5, 2015 at 11.5 feet.**
*** No groundwater was encountered during drilling.**

GEOTECH
CONSULTANTS, INC.

TEST BORING LOG

3019 & 3031 - 60th Avenue Southeast
Mercer Island, Washington

Job	*Date:*	*Logged by:*	*Plate:*
14499	Jan. 2015	TRC	4