GEOTECH
CONSULTANTS, INC.

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January 26, 2024

JN 23453

Mercer Lakehouse Trust
6236 S.E. 22nd Street
Mercer Island, Washington 98040
via email: shelby@panonorthwest.com

Subject: **Geotechnical and Critical Area Considerations**
Proposed Remodel Sport Court and Driveway Realignment
6236 S.E. 22nd Street
Mercer Island, Washington

Greetings:

This report presents our geotechnical engineering report related to the planned work associated with the planned realignment of the existing driveway and the construction of a new sport court on the property. The scope of our services consisted of assessing the site surface and subsurface conditions, and then developing this summary report.

Based on the 1/12/2024 drawings prepared by Anne James Landscape Architecture, and our discussions with DeForest Architects, we understand that the driveway will be realigned to meander from S.E. 22nd Street to the existing autocourt. This will move the driveway away from the western property line, which will allow planting between the driveway and the western property boundary. A short (one- to 3-foot) cut rockery may be needed to the east of the reconfigured driveway to retain small cuts below the existing grade. A new sport court will be constructed to the south of the existing autocourt and garage, in an area currently covered by grass lawn. The southeast corner of this sport court will abut an existing rockery, which will remain in place. A backfilled retaining wall will need to be constructed along the west side of the sport court, where the existing landscape bed slopes down to the driveway from the grass lawn. This wall will be 4 to 5 feet in height.

SITE CONDITIONS

The subject property extends between Southeast 22nd Street and the shore of Lake Washington. The northern portion of the property is developed with a residence and attached garage, with a terrace area and swimming pool to the north of the house. This northern portion of the site will not be disturbed by the planned work. A asphalt-paved driveway extends along the west side of the property to an autocourt located to the west of the garage. Along the south side of the autocourt is a stone-clad retaining wall that extends westward from the south wall of the garage. The new western retaining wall for the sport court will extend south from the end of this existing retaining wall. The southern portion of the property is covered primarily with trees and underbrush. Along the south side of the garage is a flat, grass-covered lawn area. In the southeast corner of this lawn area is a short, terraced rockery having a maximum height of 6 to 7 feet. Above this rockery are several trees, with the eastern neighbor's driveway located approximately 6 feet beyond the east property line.

Other than the short manmade cuts that are protected by the rockeries in the southeast corner of the lawn area, there are no steeply-sloped areas on the site. There are no steep slopes on, or near the site that are 10 feet or taller. We saw no indications of recent or historic instability on the subject property. From our previous experience with projects on Mercer Island, as well as review of the *Mercer Island Landslide Assessment* (Troost and Wisher) there have been no documented landslides on, or near, the subject site. Previous documented slides have occurred on the steeper areas located 400 to 500 feet to the east of the site.

The City of Mercer Island GIS maps almost the entire lot to lie within Potential Landslide Hazard, Seismic Hazard, and Erosion Hazard areas. The only area that is not mapped as a critical area is the relatively flat area of the autocourt and garage. There are no steep slopes mapped on, or around, your property.

Our firm previously conducted test borings on the southern portion of the site at the approximate locations shown on the attached Site Exploration Plan. Logs of these borings are also attached. Consistent with other explorations our firm has conducted on nearby projects, the on-site borings found medium-stiff silt that became very stiff below a depth of 20 to 25 feet. Groundwater seepage was encountered in only one of the borings, in a sandier zone at a depth of about 23 feet. During our January 8, 2024 visit to the site, we conducted hand-excavated test holes near the southeast and northwest corners of the planned sport court, as shown on the attached Site Exploration Plan. The southeastern test hole revealed approximately 12 inches of mulch and sandy fill overlying the native silt. Shallow water trapped in the sandy fill was observed approximately 6 inches below the existing ground surface. The northwestern test hole encountered fill to the maximum 18-inch depth that could be explored. This fill is relatively compact, having been subjected to vehicle traffic during the recent remodel of the main residence. We expect that the fill is underlain by the native silt soil. Probing at the west end of the autocourt retaining wall revealed the wall footing at a depth of approximately 12 inches below the ground surface.

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 borings and test holes conducted on the site indicate that the areas of the reconfigured driveway and the new sport court are underlain by medium-stiff to stiff silt. Due to the prior development and grading of the property, there is a variable thickness of fill and topsoil overlying the native silt soils. The thickest fill is located in the northwestern corner of the planned sport court, where the existing auto court and garage walls were backfilled after they were constructed.

The reconfigured driveway can be placed on a layer of compacted imported granular fill laid over the underlying soils. In order to support heavy trucks or emergency vehicles, potentially including a firetruck, the new driveway should consist of at least 7 inches of reinforced concrete, or 4 inches of asphalt and 6 inches of crushed rock. Both of these pavement sections would need to be underlain by at least 12 inches of imported granular fill, such as crushed rock, placed over firm subgrade soils. This thickness of imported granular fill may already be present below the existing driveway, which would have served as the access road for the original construction of the house, as well as the recent remodel. Additional granular fill could be needed if soft areas are encountered that would require overexcavation.

The rockery to be installed along the edge of the new driveway will only one to 3 feet in height. This rockery is only a landscape feature, and is not a significant retaining structure. It will not support any surcharges, such as from vehicles. A typical detail for such a short landscape rockery is attached to the end of this report.

The new retaining wall along the west side of the sport court should be constructed as a reinforced concrete wall bearing on native silt. If overexcavation below the new wall footing is needed to reach suitable bearing soil, the overexcavation should be backfilled with compacted quarry spalls or railroad ballast rock. The project geotechnical engineer should assess the bearing soils before the placement of any structural fill beneath the wall footing. The new retaining wall will naturally undergo some deflection as the soil beneath the footing compresses under the backfill loads. Minimizing this deflection will be important to avoid a gap opening where the new wall and the existing autocourt wall meet. In order to accomplish this, we recommend the following:

1. Backfill the new western wall with geofoam, which exerts minimal lateral load on the wall,
2. Remove the existing fill behind at least the western 8 feet of the autocourt retaining wall and replace it with geofoam backfill, and
3. Dowel the new wall and the autocourt wall together where they meet.

The existing surface vegetation and topsoil will need to be removed from beneath the planned sport court. Any other loose/soft soil exposed during this stripping should be removed. Imported granular soil should be used for all new fill used beneath the sport court. We recommend that a minimum 6-inch layer of clean, compacted crushed rock be placed beneath the sport court. Perforated drain pipes should be buried in this gravel layer on 10- to 15-foot centers to collect any shallow water that becomes trapped in the gravel. This is important to reduce the potential for lifting of the sport court due to frost heave. If the sport court is constructed of concrete, it would also be prudent to use at least minimal rebar, such as an 18-inch grid of #4 rebar, within the concrete to reduce the potential for downsets if some settlement occurs.

Subsurface water may perch on top of the native silt and migrate toward the sport court from the higher ground to the east and south. As a result, it would be prudent to install a French Drain along the east and south sides of the sport court to intercept this water. Such a drain would consist of trench excavated at least 12 inches into the silt, with non-woven filter cloth such as Mirafi 140N draped into the trench. A 4-inch perforated PVC pipe surrounded with washed drain rock would then be installed in the bottom of the trench. This perforated pipe should be connected to the storm drainage system via a new solid discharge pipe.

CRITICAL AREA STUDY

Seismic Hazard: The silt soils underlying the site are not susceptible to seismic liquefaction. This is due to the massive, fine-grained nature of the silt, combined with the lack of a shallow groundwater table within the looser silt soils. The foundations for the new construction will also bear on these non-liquefiable soils. No additional mitigation is required to address the mapped Seismic Hazard.

Potential Landslide Hazard: The ground surface in, and around, the planned development area is gently sloped. The native silt soils underlying the site are not susceptible to instability on this gently-sloped ground. The development area is set back from any steep areas located on properties to the east that may be susceptible to ground movement.

The stability of the gently-inclined ground on, and around, the site will not be adversely affected by the shallow excavations needed for the new development. No buffer or other mitigation measures are required to address the Potential Landslide Hazard mapping of the site.

Erosion Hazard: The site disturbance for the proposed development will be limited, will occur primarily on gently-sloped ground, and will be set well back from Lake Washington. The mapped Erosion Hazard can be mitigated by implementing proper temporary erosion control measures that 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 work areas. Existing ground cover and landscaping should be left in place wherever possible to minimize the amount of exposed soil. Small soil stockpiles should be covered with plastic during wet weather. Soil and mud should not be tracked onto the adjoining streets, and silty water must be prevented from traveling off the site. In wet conditions, it will be important to cover areas of bare soil with materials such as mulch, straw, hog fuel, gravel, or plastic sheeting to prevent them from eroding and causing silty runoff. As with any construction project, it can be necessary to periodically maintain or modify temporary erosion control measures to address specific site and weather conditions.

Buffers and Mitigation: As noted above, almost the entire site lies within a mapped Potential Landslide Hazard Area, and the prescriptive buffer would extend far beyond the boundaries of the property and the planned development area. No Steep Slope buffer would apply to this project, and no buffer is required by the MICC for a Seismic or Erosion Hazard Area.

We recognize that the planned development will occur within the designated critical areas. 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 presented in this report 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:

> *The construction practices proposed in this report for the alteration would render the development as safe as if it were not located in a geologically hazardous area and do not adversely impact adjacent properties.*

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).

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 silt soils beneath the site are not susceptible to seismic liquefaction under the ground motions of the MCE because of their fine-grained, glacially-compressed composition and the absence of near-surface groundwater.

CONVENTIONAL FOUNDATIONS

An allowable bearing pressure of 2,000 pounds per square foot (psf) is appropriate for the new retaining wall supported on native silt soil. A one-third increase in this design bearing pressure can 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 less than one inch, with differential settlements on the order of one-quarter-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.

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. As discussed above in the ***General*** section, the lateral design pressure from geofoam backfill is very low. The attached GeoFoam Wall Backfill detail illustrates general considerations for the configuration and placement of geofoam and the compacted fill behind it.

The following recommended parameters are for walls that restrain level backfill:

PARAMETER	VALUE
Active Earth Pressure *	40 pcf (Compacted Free-Draining Backfill) 5 pcf (Geofoam Backfill)
Passive Earth Pressure	300 pcf
Coefficient of Friction	0.40
Soil Unit Weight	130 pcf (Compacted Free-Draining Backfill)

Where: pcf is Pounds per Cubic Foot, and Active 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 active 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 active 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 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 also does not need to be applied to walls that are backfilled with geofoam, as the geofoam is lightweight and self-supporting.

For walls backfilled with compacted fill, 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 Backfill and Waterproofing

The attached Geofoam Backfill Detail provides general guidance for placement of the drainage, and the geofoam itself.

For any walls not backfilled using geofoam, it is important that the backfill consists of coarse, free-draining structural fill containing no organics. This backfill, which will have to be imported, 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 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.

Where geofoam backfill is not used, it is critical that the imported 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 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.

LIMITATIONS

This report has been prepared for the exclusive use of Mercer Lakehouse Trust, and its 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.

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.

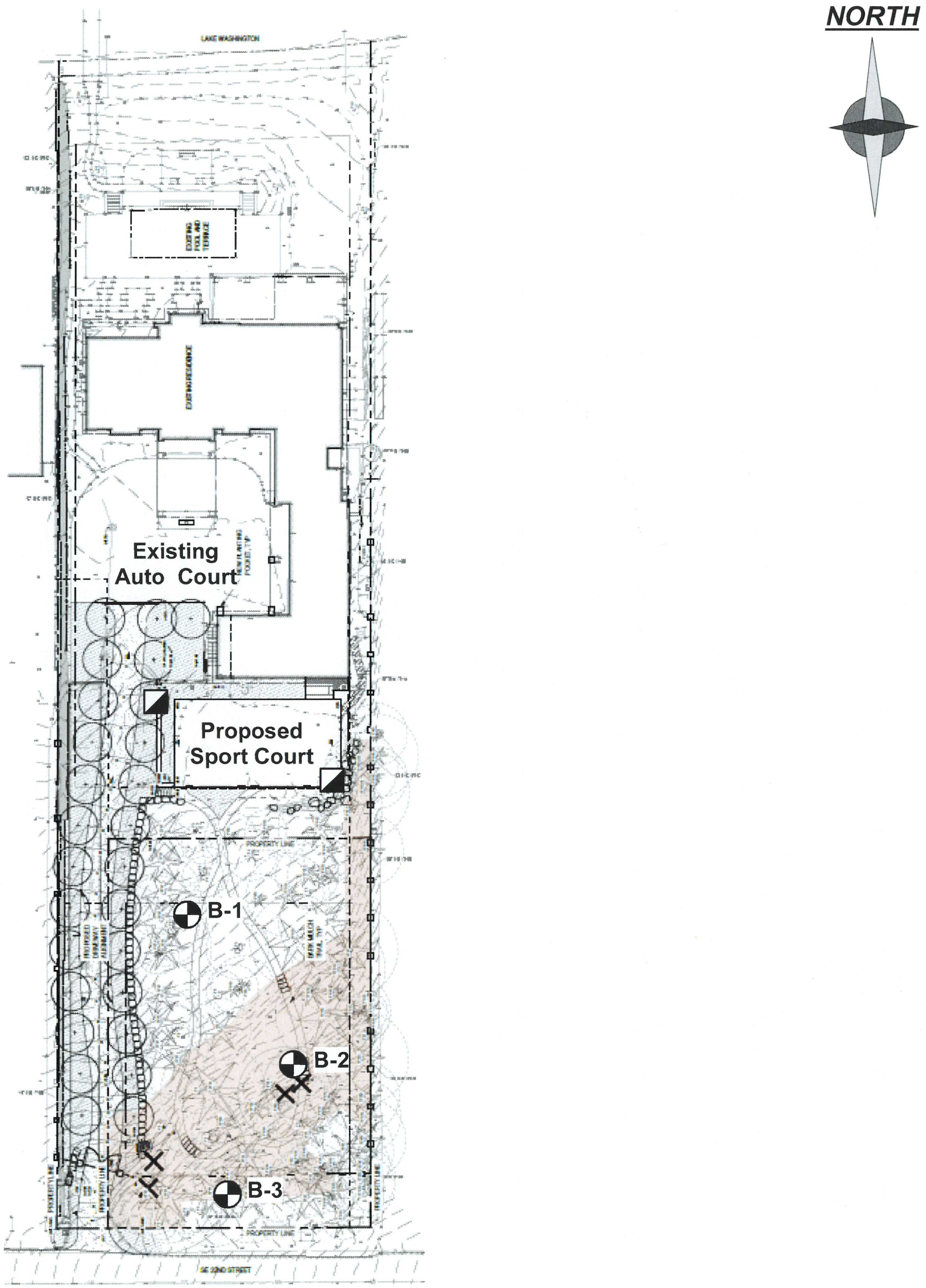
Marc R. McGinnis, P.E.
Principal

MARC R. McGINNIS
STATE OF WASHINGTON
27845
REGISTERED
PROFESSIONAL ENGINEER
1/26/2024

Attachments:

- Site Exploration Plan
- Test Boring Logs
- Footing Drain Detail
- GeoFoam Wall Backfill Detail
- Landscape Rockery Detail

cc: **DeForest Architects** – Riley Coghlan
via email: riley@deforestarchitects.com



Legend:

◩ Test Hole Location

◐ **B-2** Test Boring Location

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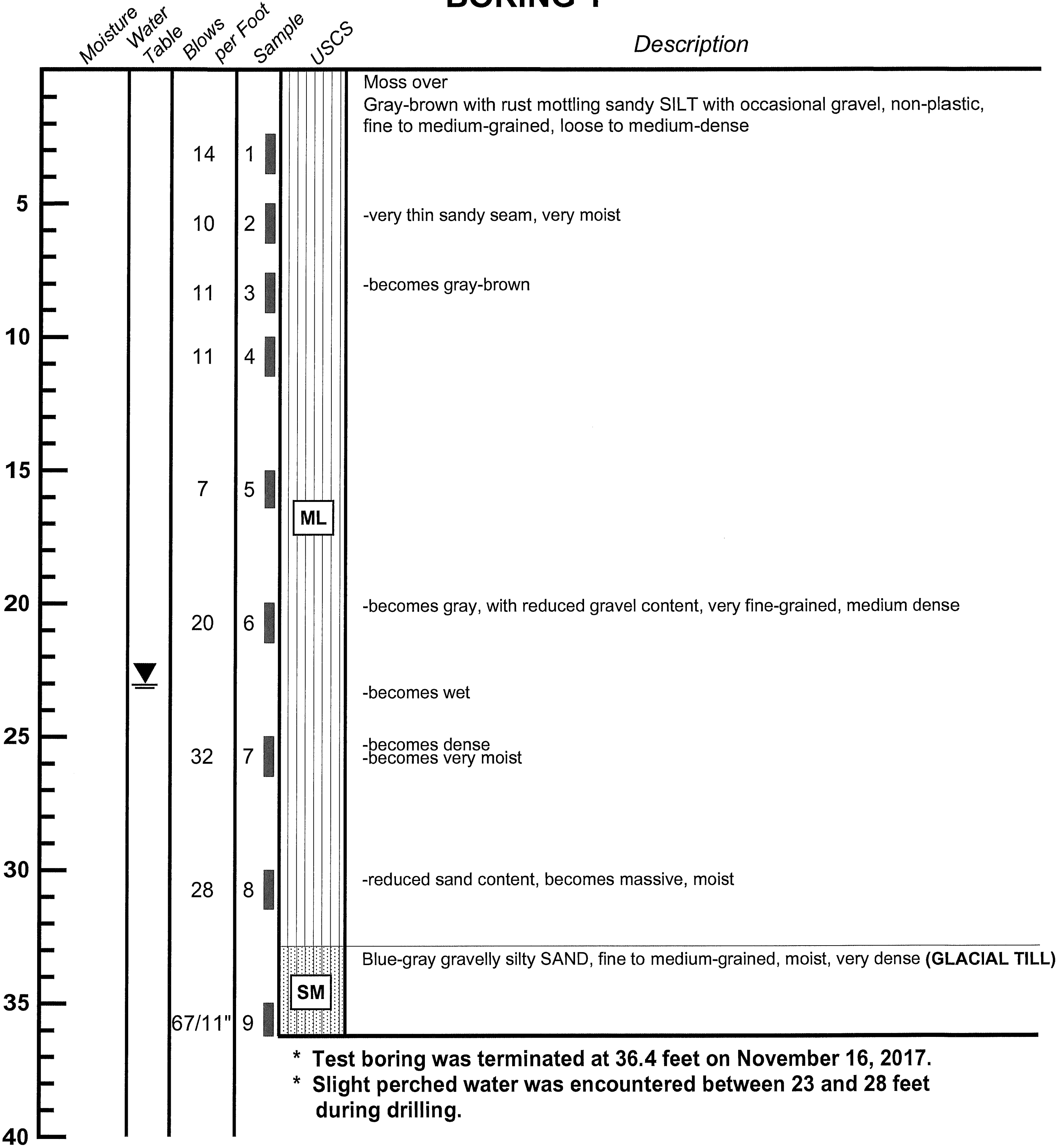
SITE EXPLORATION PLAN

6236 S.E. 22nd Street
Mercer Island, WA

Job No:	Date:		Plate:
23453	Jan. 2024		1

BORING 1



Moss over

Gray-brown with rust mottling sandy SILT with occasional gravel, non-plastic, fine to medium-grained, loose to medium-dense

-very thin sandy seam, very moist

-becomes gray-brown

-becomes gray, with reduced gravel content, very fine-grained, medium dense

-becomes wet

-becomes dense

-becomes very moist

-reduced sand content, becomes massive, moist

Blue-gray gravelly silty SAND, fine to medium-grained, moist, very dense **(GLACIAL TILL)**

*** Test boring was terminated at 36.4 feet on November 16, 2017.**

*** Slight perched water was encountered between 23 and 28 feet during drilling.**

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BORING LOG
6236 S.E. 22nd Street
Mercer Island, Washington

Job	***Date:***	***Logged by:***	***Plate:***
23453	Jan. 2024	ASM	2

BORING 2

	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
			11	1	SM	Gray-brown mottled rust silty SAND with gravel and trace roots, fine to medium-grained, moist, medium-dense
5			16	2		-reduced root content
			8	3		Gray-brown sandy SILT with trace gravel, non-plastic, fine to medium-grained, moist, loose to medium-dense
10			11	4		
15			13	5		-becomes gray, with reduced sand and gravel content, low plasticity, stiff
20			15	6	ML	
25			18	7		-becomes massive, very stiff
30			23	8		-becomes slightly sandy
35			24	9		
40						

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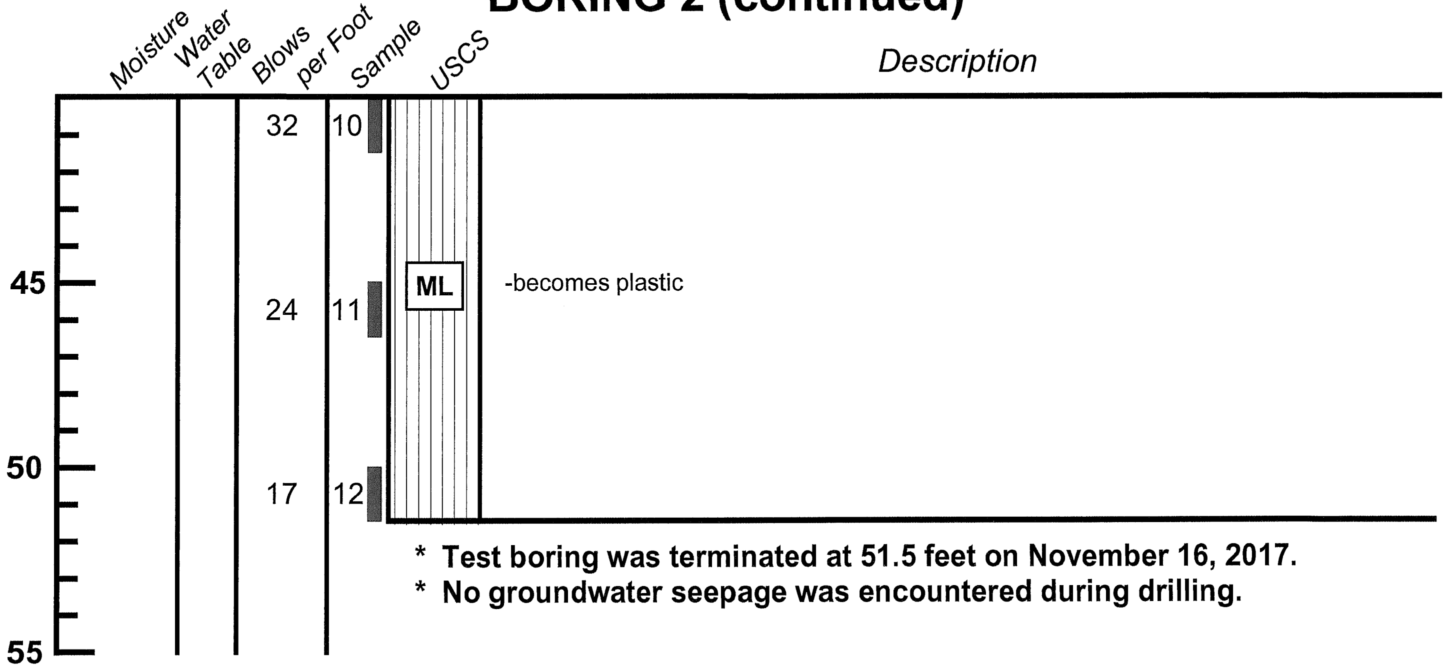
BORING LOG

6236 S.E. 22nd Street
Mercer Island, Washington

Job 23453	***Date:*** Jan. 2024	***Logged by:*** ASM	***Plate:*** 3

BORING 2 (continued)



* **Test boring was terminated at 51.5 feet on November 16, 2017.**
* **No groundwater seepage was encountered during drilling.**

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BORING LOG

6236 S.E. 22nd Street
Mercer Island, Washington

Job	*Date:*	*Logged by:*	*Plate:*
23453	Jan. 2024	ASM	4

BORING 3

	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
5			7	1	ML	Brown sandy SILT with occasional gravel and roots, non-plastic, fine to medium-grained, moist, loose
10			10	2		-reduced root content, slightly plastic, stiff
15			14	3		-becomes gray
20			14	4		
25			18	5		-becomes massive, very stiff
30			15	6		
35						
40						

*** Test boring was terminated at 31.5 feet on November 16, 2017.**
*** No groundwater seepage was encountered during drilling.**

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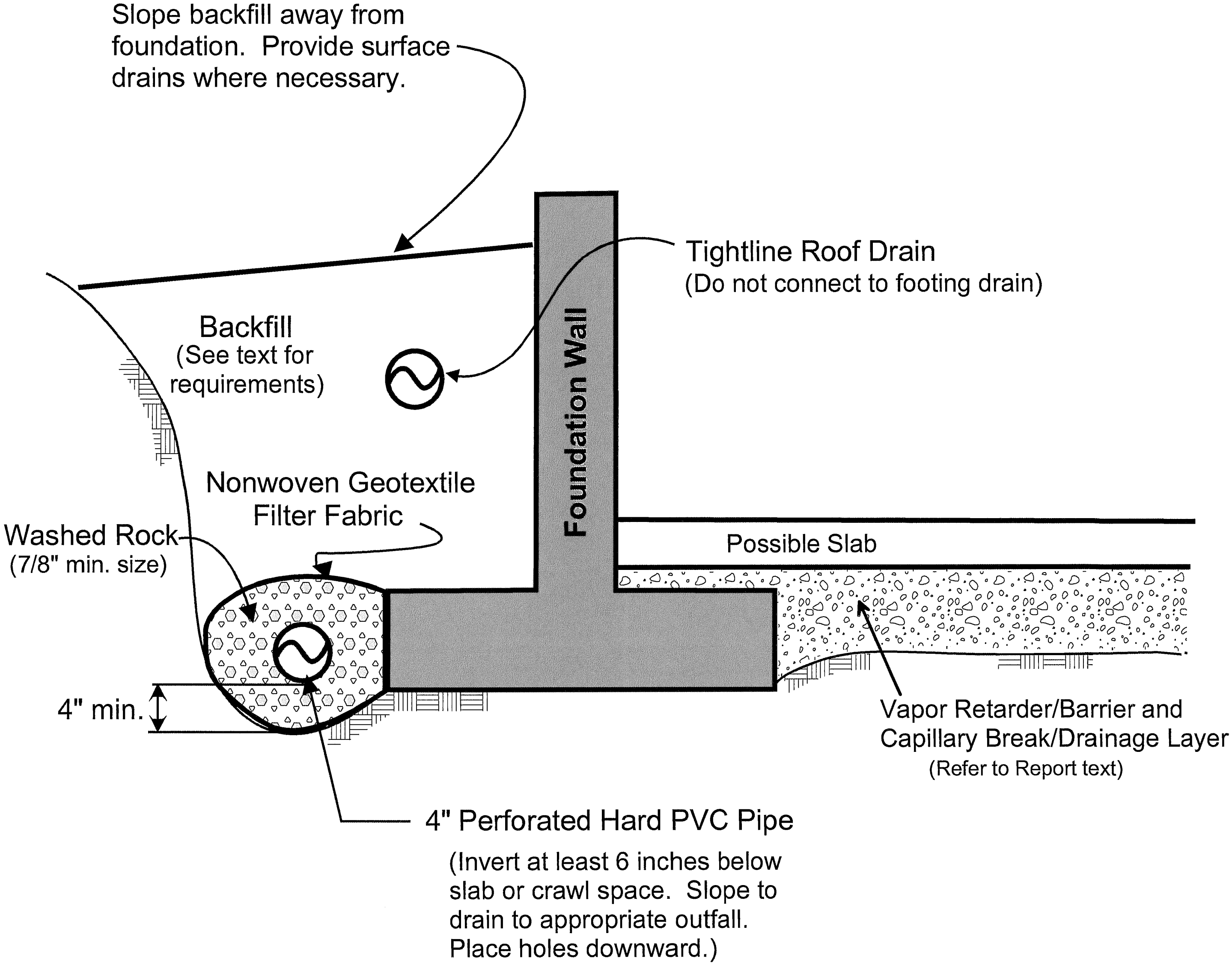
BORING LOG
6236 S.E. 22nd Street
Mercer Island, Washington

Job 23453	***Date:*** Jan. 2024	***Logged by:*** ASM	***Plate:*** 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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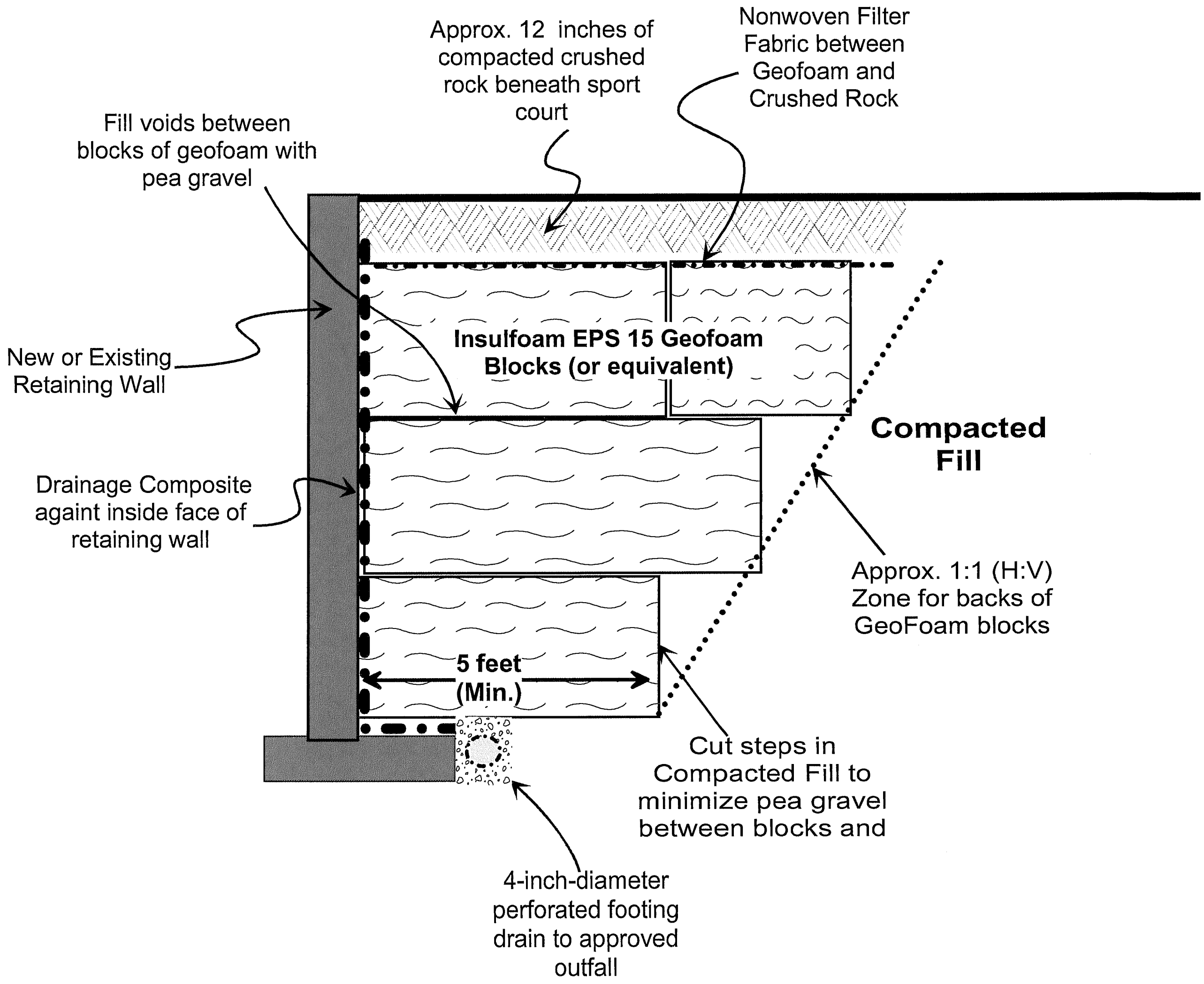
FOOTING DRAIN DETAIL

6236 S.E. 22nd Street
Mercer Island, WA

Job No:	Date:		Plate:
23453	Jan. 2024		6



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GEOFOAM WALL BACKFILL

6236 S.E. 22nd Street
Mercer Island, WA

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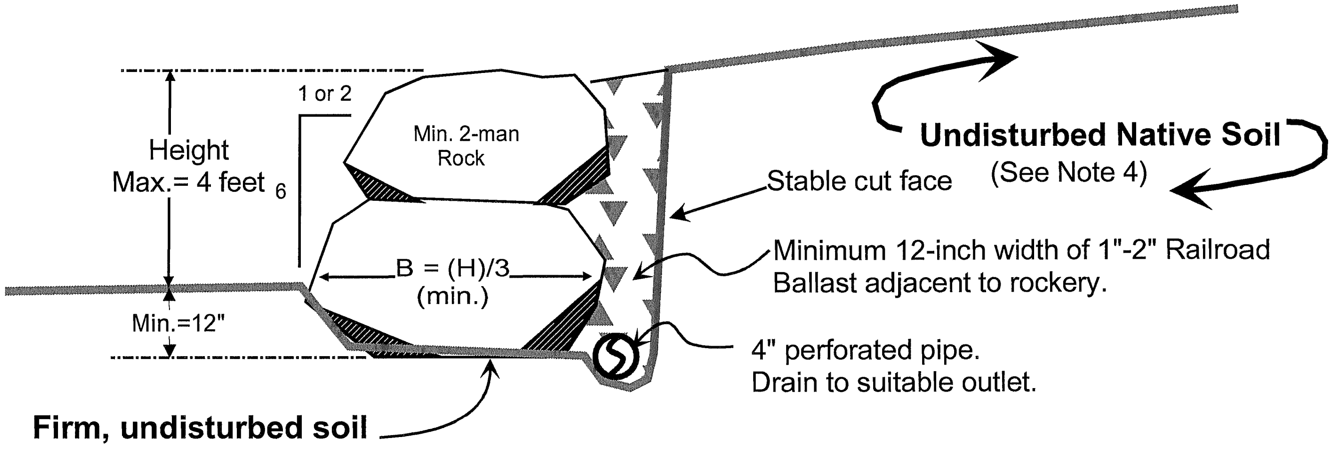
23453	Jan. 2024		7



GENERAL NOTES:

1) Rock shall be sound and have minimum density of 160 pounds per cubic foot.

2) The bottom row of rocks shall be at least 3-man size.

3) The long dimension of all rocks shall be placed perpendicular to the wall. Each rock should bear on two rocks in the tier below.

4) Rockeries are erosion-control structures, not retaining walls. The on-site material must be stable and free-standing in the cut face. Geogrid-reinforced rockeries must be used where they will be subjected to vehicle surcharges.

5) No roadways or parking shall be located within a 1:1 (Horizontal:Vertical) zone upslope from rockery's base. Footings or structures shall not bear within a 2:1 (H:V) zone extending upslope from the rockery's base.

6) No tiered rockeries shall be used.

7) Any deviation in design or in placement of adjacent structures must be reviewed by the geotechnical engineer of record.

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LANDSCAPE ROCKERY DETAIL

6236 S.E. 22nd Street
Mercer Island, WA

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