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JN 20343-1

Bruce and Ann Vanderwall
7179 Holly Hill Drive
Mercer Island, Washington 98040

via email: brucevanderwall@comcast.net & annvanderwall@comcast.net

Subject: **Transmittal Letter – Geotechnical Engineering Study and Critical Area Study**
Proposed Retaining Walls and Accessory Structure
7179 Holly Hill Drive
Mercer Island, Washington

Dear Mr. and Mrs. Vanderwall,

Attached to this transmittal letter is our geotechnical engineering report for the proposed retaining walls and accessory structure to be constructed in Mercer Island, Washington. The scope of our services consisted of exploring site surface and subsurface conditions, and then developing this report to provide recommendations for general earthwork and design considerations for foundations, retaining walls, subsurface drainage, and temporary excavations and shoring.

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.

Matt McL

Matthew K. McGinnis
Geotechnical Engineer

cc: **Conard Romano Architects** – Erik Voris
via email: erik@conardromano.com

MKM/DRW:kg

GEOTECHNICAL ENGINEERING REPORT AND CRITICAL AREA STUDY
Proposed Retaining Walls and Accessory Structure
7179 Holly Hill Drive
Mercer Island, Washington

This report presents the findings and recommendations of our geotechnical engineering study for the site of the proposed retaining walls and accessory structure to be located in Mercer Island.

Development of the property is in the planning stage, and detailed plans were not available to us at the time of this study. However, based on a site plan provided to us, prepared by Conard Romano Architects, we understand that an accessory structure is proposed to be constructed east of the existing, centrally-located residence, and several new retaining walls are also proposed on the property. The accessory structure will be flanked by shorter concrete retaining walls that will replace a failing timber wall north of the proposed accessory structure and will follow the northern edge of the driveway to the south and east of the accessory structure where an existing grass slope is located. Another retaining wall is proposed to be constructed near the eastern extent of the site but has not been sited or dimensioned. We do not anticipate that excavations will need to extend more than a few feet below grade at this time for the shorter walls, but excavations in excess of 10 feet will be needed for the accessory structure. In addition, a new retaining wall is proposed to be constructed near the toe of a western steep slope at the site. This wall will be approximate 4 feet in height and will replace a failing timber wall. Most of the developments will be located well away from the property lines, except for a section of retaining wall near the north property line, which may sit as close as 5 feet to the property line, as well as the eastern retaining wall. Developments for this site are located within several mapped critical areas, per Mercer Island's GIS.

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

SITE CONDITIONS

SURFACE

The Vicinity Map, Plate 1, illustrates the general location of the site in the western side of Mercer Island. The irregular shaped site comprises a total site area of 0.56-acres and has frontage on its eastern side along Holly Hill Drive and on its western side along Lake Washington. The site is long in the east-west direction, and the site slopes downslope to Lake Washington, which is located on the western perimeter of the lot.

The overall site slopes down to the west, with a majority of the site having a gently to moderately downward to the west. Initially, the grade descends across a short steep slope located on the eastern property line into a flat yard area. A driveway enters the property at the eastern end of the site, while the large residence is located in the central portion of the site within the gently to moderately sloped eastern plateau. A garage is located on the eastern end of the residence. A short slope is located east of the residence, east of a parking area by the garage. A large, main-level deck is located at the western edge of the residence, and a new patio underlies the deck, extending west from the residences' basement level. Our firm was involved with the design and construction of the deck and patio in the recent years (2020-2021), and the new deck/patio construction is supported on small diameter pipe piles due to soil conditions found in our previous borings. There is a narrow flat area west of the patio and near the southwestern corner of the residence flat area, with a grade similar to the basement level of the residence. This flat area borders the top of a steep slope that is approximately 25 feet tall. This slope is inclined from approximately 50 to 60 percent and descends to a flat yard that continues to the edge of Lake Washington. A wide, grass covered trail bisects the mid-point of the slope, providing access from the upper to lower yard areas. The toe of this slope is slightly oversteepened, and it appears that this slope has been modified in the past, as old, rotten timbers could be observed at the base of this slope. The slope is mostly covered with grass and landscaping, and we did not observe any indications of instability of this slope.

The City of Mercer Island's online geographic information system (GIS) tool maps the subject site within several geologic hazard areas. A majority of the property is mapped to lie within a Potential Landslide Hazard Area, as well as an Erosion Hazard Area. The western portion of the site, within the lower yard area, is mapped as a Seismic Hazard Area. These mappings continue to the north and south in long bands which encompass many of the waterfront properties throughout the western side of Mercer Island. While not formally mapped by the GIS, the western slope between the residence and lower yard would meet the general criteria for a steep slope due to its height and inclination. The Mercer Island Landslide Hazard Map indicates the potential presence of landslide and mass wasting deposits adjacent to the western perimeter of the site beneath the water surface of Lake Washington. The map does not, however, map the presence of landslide or mass wasting deposits within the boundaries of the site. This mapping is likely based on an interpretation of public bathymetry data of Lake Washington, as well as the public Lidar imaging for King County.

The adjacent northern and southern parcels both contain large single-family residences located well away from the work areas. The grades on the adjacent lots are terraced similar to that of the site, and trend in a downward slope from Holly Hill Drive to the east, to the elevation of Lake Washington.

SUBSURFACE

The subsurface conditions for this site were originally explored for our 2020 study with two test borings drilled for the patio and deck additions on the eastern side of the residence. For the current phase of work, an additional six test borings were drilled, and one test hole was excavated. The approximate location of all of these explorations are shown on the Site Exploration Plan, Plate 2. Our exploration program was based on the proposed construction, anticipated subsurface conditions and those encountered during exploration, and the scope of work outlined in our proposal.

The test borings for our 2020 report (Borings 1 and 2) were drilled on November 12, 2020 using a track-mounted, hollow-stem auger drill. The recent borings (Borings 3 through 8 and Test Hole 1) were drilled on June 22, 2023 and July 20, 2023 using similar drilling equipment, and the test hole was excavated using hand tools on June 22, 2023. 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 and Test Hole Logs are attached as Plates 3 through 9.

Soil Conditions

Test Borings 1 and 2, drilled at the top of the western slope for the previous phase of development, revealed loose fill soil ranging in thickness from 4 to 5 feet. Native, weathered, loose silty sand was encountered beneath the fill, continuing to a depth of approximately 5 to 7.5 feet where it became dense and very dense. This dense and very dense silty sand was observed to be cemented in composition and is geologically referred to as glacial till. The dense and very dense glacial till continued to the base of the borings at depths of 18.8 to 21.5 feet.

Test Borings 3, 4, and 5, drilled at the toe of the western slope near the existing and proposed western retaining wall, the glacial till was revealed at shallow depths. Auger refusal was met shortly thereafter in all three borings due to the density and gravel content of the glacial till.

Test Hole 1 and Test Boring 6, excavated/drilled in the middle of the western slope within the grass trail, loose fill soil was revealed to depths of about 5 to 7 feet. Native, medium-dense, and denser silty sand was revealed beneath the fill; this silty sand continued to the base of the test hole at a depth of 6 feet (where auger refusal occurred), while the glacial till was revealed at a depth of 8 feet in Test Boring 6.

Borings 7 and 8 were drilled near the proposed eastern accessory structure and retaining wall, respectively. A mantle of loose fill and weathered soils from 1.5 to 7.5 feet were revealed at the ground surface that was underlain by the glacial till. The glacial till was encountered shallowest in Test Boring 8, where a previous cut was likely made, and deepest in Test Boring 7, where the resultant cut soil was likely placed as fill to level out this area of yard. The glacial till continued to the base of the borings at depths of 8 to 14 feet where auger refusal was met.

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.

Although our explorations did not encounter cobbles or boulders, they are often found in soils that have been deposited by glaciers or fast-moving water.

Groundwater Conditions

No groundwater seepage was observed during drilling, but it should be noted that groundwater levels vary seasonally with rainfall and other factors. Higher and greater groundwater levels are generally found in winter and spring months. It is possible that groundwater could be found in between the looser near-surface soil and the underlying glacial till during these months.

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

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

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

The test borings conducted for this study within the proposed walls and accessory structure generally encountered glacial till and/or medium-dense silty sand within a few feet of the ground surface. These soils are suitable to support new foundations for the walls and accessory structure. All footings will have to be excavated to bear on these competent soils. However, these soils will be susceptible to disturbance and softening from foot traffic during the placement of forms and rebar. For this reason, all excavated bearing surfaces should be protected with several inches of clean crushed rock after they have been scraped clean with a flat excavator bucket, grade bar, or flat blade shovel. Overexcavations should be anticipated in areas of previous development, such as the utility trenches that run along the northern property line near the proposed northern retaining walls. Overexcavations, where needed, should be backfilled with imported quarry spalls or ballast rock, of the foundations could be lowered to bear directly on the glacial till where no conflicts with a deeper excavation exist.

To prevent excavations from being needing to be made into the toe of the western steep slope, as well as the eastern slope and near the property lines, we recommend that the retaining walls be constructed in a “property line” wall fashion, with the wall heel facing away from the slope/property line, and as limited of a wall toe extending to the slope/property line. If this cannot be accomplished in a reasonable manner due to design, we recommend that the walls be shifted until there are no excavation conflicts with the slopes and property lines. After the walls have been constructed, we recommend that the any areas behind the wall be backfilled with imported, clean angular, washed crushed rock.

Temporary sloped excavations are possible for this project depending on the wall location, footing depth, and wall height. Based on the soils encountered in our explorations the upper fill and looser native soils should not be excavated at an inclination steeper than a 1:1 (H:V). Generally, cuts in the underlying very dense glacial till should not be excavated steeper than a 0.5:1 (H:V). However, based on the dense nature of the glacial till, the excavation for the accessory structure could manifest as a 1:1 (H:V) top with a maximum 5-foot vertical excavation at the toe, provided the vertical slope is in the glacial till. However, vertical excavations should not be made at the base of the western steep slope, or near the shared property lines, as well as near any adjacent settlement sensitive structure. It appears that most of the proposed retaining walls should be able to be excavated using temporary open cut slopes, however if open cuts as noted above cannot be kept within the property at the northern edge of the accessory structure, an excavation agreement or temporary shoring may be needed depending on final foundation elevations. It would be practical to develop an excavation plan within the areas of the new walls area to determine if the excavations can be made in the noted configuration, or if easements or shoring will be needed once a preliminary design has been completed. A nominal working room distance of at least one to two feet should be planned for at the base of the excavations for both room for concrete forms as well as for drainage installation. We can provide further shoring recommendations if it is determined that it is needed.

Excavations and the placement of the easternmost retaining wall should be considered to avoid adversely impacting both the adjacent roadway, as well as the public utility lines in the street. The top of this slope has been filled out to create parking space adjacent to Holly Hill Drive, and the fill soils were likely not well compacted. Oversteepened cuts, or vertical cuts in this area could adversely affect this sloped area.

The excavated soil will generally be unusable as fill for the project and should be hauled off the site. In general, imported free-draining soil should be used to backfill the retaining walls, and imported, clean, angular rock should be used where structural fill is needed beneath foundations.

Due to the silty, fine-grained nature of the upper fill and native soils onsite, the impervious nature of the glacial till, it is our professional opinion that onsite infiltration or dispersion of stormwater are infeasible for this project. All collected stormwater, even from paved surfaces, should be discharged to an approved stormwater system. Pervious pavements should not be used for this project.

The test borings confirmed that the core of the site is underlain at varying depths by very dense glacial till which has a high internal strength and is not susceptible to deep seated instability. However, the looser surficial soils on the western steep slope are susceptible to shallow instability, particularly during periods of extended rainfall or a seismic event. Such a failure would likely manifest as a localized debris/mud flow, which would travel downslope over the western retaining wall, onto the flat yard area at the base of the slope. This would have no effect on the adjacent properties and should pose a low risk, and in reality, the western retaining wall should act to slightly increase the surficial stability of the toe of the western steep slope. While this statement is made, the current, and any future property owner should be made aware of the potential risks associated with owning properties containing steep slopes, and that future shallow instabilities may occur. Predicting the behavior of steep slopes over time is an inexact science and can be influenced by outside factors.

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: A majority of the subject site is located within a mapped Potential Landslide Hazard area. The site is mostly gently to moderately sloped on its eastern majority with localized steeper portions and is steeply inclined on its western extent. As discussed previously, the core of the site is comprised of very dense glacial till, which has a very high internal shear strength and a low potential for deep seated landslides. The mapping of the Potential Landslide Hazard Area is apparently due to the inference based on geologic maps and lidar data. However, we observed no signs of landslide debris in any of our borings for this property, as well as in other borings located within the nearby vicinity of the site. Consistent with many lots in this area along the shore of Lake Washington, the topography of the western site slopes are both the result of historic erosion by Lake Washington, which would have covered the lower yard area of the subject property until the Montlake Cut was constructed in the early 1900s, as well as from previous lot grading over the years. To our knowledge, no recent large-scale movement has been documented in this area.

Steep Slope Hazard Areas: Based on the topographic survey for the site, the western slope at the property has an inclination of 50 to 60 percent over an elevation relief of 25 feet, which meets Mercer Island's code criteria for a steep slope hazard. A steep slope is also a qualification for a Landslide Hazard Area under the Mercer Island Code. As discussed previously, the proposed new western retaining wall is planned to be located at, or close to the toe of the western steep slope and would lie well within the City of Mercer Island prescriptive slope buffers. Based on the soils encountered in our test borings at the toe of the western slope, it is apparent that competent glacial till lies within a few feet of the ground surface and is not susceptible to deep-seated instability. Provided that the recommendations in this report are incorporated into the project plans and construction, the construction of the new wall will act to slightly increase the surficial stability of the slope once constructed due to the engineered fashion of the wall, as well as the backfilled slope behind the wall helping to buttress the toe of the slope slightly.

It is our opinion that no buffer or setback from the toe of the western steep slope is needed provided that the recommendations in this report are followed. The recommendations presented in this report are intended to allow the alteration to the prescriptive buffer, while: 1) preventing adverse impacts to the stability of the steep slope both on and off the site, and 2) protecting the planned development from foreseeable future shallow soil movement on the steep slope.

Seismic Hazard Area: The western extent of the site, near the area of the proposed new western retaining wall, is mapped to lie within a mapped Seismic Hazard area. The test borings conducted for our previous report, as well as the recent borings located near the new work area, encountered very dense glacial till at relatively shallow depths, with this competent soil layer shallowing to the west. In addition, no groundwater was encountered in our explorations. Considering this, the site does not meet the criteria for a Seismic Hazard Area. The new foundations will bear on the underlying glacial till, and no additional mitigation to address the mapped seismic hazard is warranted from a geotechnical perspective at this time.

Erosion Hazard: The site also meets the City of Mercer Island's criteria for an Erosion Hazard Area. We have worked on numerous waterfront projects on Mercer Island that have avoided siltation of the lake and surrounding properties by exercising care and being proactive with the maintenance and potential upgrading of the erosion control system through the entire construction process. The location of the proposed work near the shore of Lake Washington will make proper erosion control implementation important to prevent adverse impacts to the lake. The temporary erosion control measures needed during the site development will depend heavily on the weather conditions that are encountered during the site work. One of the most important considerations, particularly during wet weather, is to immediately cover any bare soil areas to prevent accumulated water or runoff from the work area from becoming silty in the first place. Silty water cannot be discharged to the lake, so a temporary holding tank should be planned for wet weather earthwork until the bare soil is covered. A wire-backed silt fence bedded in compost, not native soil, or sand, should be erected as close as possible to the planned work area, and the existing vegetation between the silt fence and the lake left in place. Straw wattles may also be used in tandem with the silt fence as needed. Typically, if wet weather construction is anticipated, two parallel silt fences should be installed along the shoreline. Rocked construction access and staging areas should be established wherever trucks will have to drive off of pavement, in order reduce the amount of soil or mud carried off the property by trucks and equipment. It will also be important to cap any existing drain lines found running toward the lake until excavation is completed. This will reduce the potential for silty water finding an old pipe and flowing into the lake. Covering the base of the excavation with a layer of clean gravel or rock is also prudent to reduce the amount of mud and silty water generated. Utilities reaching between the wall and the lake should not be installed during rainy weather, and any disturbed area caused by the utility installation should be minimized by using small equipment. Cut slopes and soil stockpiles should be covered with plastic during wet weather. Soil stockpiles should be minimized. Following rough grading, it may be necessary to mulch or hydroseed bare areas that will not be immediately covered with landscaping or an impervious surface.

Buffers and Mitigation: As noted above, the majority of the site lies within a mapped Potential Landslide Hazard Area. Based on the MICC, a prescriptive buffer of 25 feet is required from all sides of a shallow landslide hazard area. This buffer would extend outside of the property extents based on the mapping. However, the potential for a shallow landslide affecting the subject property is negligible. As a result, a buffer or other forms of mitigation are not necessary to protect the planned development from potential landslides. The recommendations presented in this geotechnical report is intended to allow the project to be constructed in the proposed configuration without adverse impacts to critical areas on the site or the neighboring properties. The geotechnical recommendations associated with foundations will mitigate any potential hazards associated with the Steep Slope and Erosion Hazard, as well as the mapped Seismic Hazard.

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

We understand that the construction of the planned retaining walls and accessory structure will occur within the designated critical areas and their applicable prescriptive buffers. The recommendations presented in this geotechnical report are intended to allow the project to be constructed in the proposed configuration without adverse impacts to critical areas on the site or the neighboring properties. The geotechnical recommendations associated with foundations, retaining walls, excavations, subsurface drainage, and erosion control are intended to mitigate any potential hazards to geologic critical areas on the site.

Summary of Slope Stability Analysis: We utilized the program Slope/W to assess the stability of the western steep slope with respect to the anticipated new western retaining wall location. The results of the slope stability analysis for both static and dynamic scenarios are attached to this report as Appendix A, and the location of the representative cross section can be found on the Site Exploration Plan, Plate 2. Based on recent projects on Mercer Island, a horizontal seismic coefficient equal to one half of the Maximum Considered Earthquake was utilized for slope stability analysis on this project. We have utilized this value (MCE=0.696g, k_h=0.35g) for our dynamic analysis.

The slope stability analysis shows the new western retaining wall bearing atop the underlying, very dense glacial till, and is backfilled using granular structural fill. The slope stability analysis confirms that the safety factor against a failure upslope of the wall in its anticipated configuration is in excess of 1.1 and 1.5 for seismic and static conditions, respectively.

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

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

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 1.47g and 0.51g, 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 0.69g. The soils beneath the site are not susceptible to seismic liquefaction under the ground motions of the MCE because of their dense nature and the absence of near-surface groundwater.

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 0.46g.

CONVENTIONAL FOUNDATIONS

The proposed walls and accessory structure can be supported on conventional continuous and spread footings bearing on undisturbed, native, medium-dense silty sand or glacial till. 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 2,500 pounds per square foot (psf) is appropriate for footings supported on competent, undisturbed, native glacial till. 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, or on structural fill up to 5 feet in thickness, will be about one-half-inch, with differential settlements on the order of one-half-inch in a distance of 30 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	0.50
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. The following recommended parameters are for walls that restrain <u>level</u> backfill:

PARAMETER	VALUE
Lateral Earth Pressure *	40 pcf (flat backslope) 55 pcf (3:1 (H:V) or steeper backslope)
Passive Earth Pressure	300 pcf
Coefficient of Friction	0.5
Soil Unit Weight	135 pcf

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

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

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

The values given above are to be used to design only permanent foundation and retaining walls that are to be backfilled, such as conventional walls constructed of reinforced concrete or masonry. It is not appropriate to use the above earth pressures and soil unit weight to back-calculate soil strength parameters for design of other types of retaining walls, such as soldier pile, reinforced earth, modular or soil nail walls. We can assist with the design of these types of walls, if desired.

The passive pressure given is appropriate only for a shear key poured directly against undisturbed native soil, or for the depth of level, well-compacted fill placed in front of a retaining or foundation wall. The values for friction and passive resistance are ultimate values and do not include a safety factor. Restrained wall soil parameters should be utilized 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. A minimum 12-inch width of free-draining gravel or a drainage composite similar to Miradrain 6000 should be placed against the backfilled retaining walls. The gravel or drainage composites should be hydraulically connected to the foundation drain system. Free-draining backfill should be used for the entire width of the backfill where seepage is encountered. For increased protection, drainage composites should be placed along cut slope faces, and the walls should be backfilled entirely with free-draining soil. 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.

The wall backfill be placed in lifts and 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 the 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.

SLABS-ON-GRADE

The building floors can be constructed as slabs-on-grade atop competent native soil or on structural fill placed atop the competent native soils. 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 newly 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.

EXCAVATIONS AND SLOPES

Temporary excavation slopes should not exceed the limits specified in local, state, and national government safety regulations. Also, temporary cuts should be planned to provide a minimum 2 to 3 feet of space for construction of foundations, walls, and drainage. Temporary cuts to a maximum overall depth of about 4 feet may be attempted vertically in unsaturated soil if there are no indications of slope instability. However, vertical cuts should not be made near property boundaries, near existing utilities and structures, or at the base of sloped cuts for this project. Based upon Washington Administrative Code (WAC) 296, Part N, the upper fill and loose native 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 underlying dense and very dense glacial till soils encountered at depth at the subject site would generally be classified as Type A. Therefore, temporary cut slopes greater than 4 feet in height should not be excavated at an inclination steeper than 0.5:1 (Horizontal:Vertical), extending continuously between the top and the bottom of a cut. In addition, it is our professional opinion that the cut slope geometry could consist of 1:1 (H:V) at the top with a maximum 5-foot-tall vertical base; this vertical portion must only be in glacial till soil. We further recommend that the entire cut should be covered with plastic to protect the exposed soil from the weather conditions, regardless of the time of year.

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.

All permanent cuts into native soil should be inclined no steeper than 2.5:1 (H:V). Compacted fill slopes should not be constructed with an inclination greater than 2.5:1 (H:V). To reduce the potential for shallow sloughing, fill must be compacted to the face of these slopes. This can be accomplished by overbuilding the compacted fill and then trimming it back to its final inclination. Adequate compaction of the slope face is important for long-term stability and is necessary to prevent excessive settlement of patios, slabs, foundations, or other improvements that may be placed near the edge of the slope.

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

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

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 to 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 11. 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.

If the client can tolerate potential water seepage on the face of the walls, the wall drainage could be accomplished by installing weep holes near the base of the wall instead of installing a footing drain behind the wall. This will allow for any accumulated water behind the wall to exit through the wall face and onto the yard area in front of the wall. These weep holes could either be constructed by installing PVC sleeves in the wall forms prior to pouring concrete or could be cored through the wall face after the concrete has been poured. Weep pipes would be spaced approximately 6 feet in the center, and the holes should be at least 2-inches in diameter. Typically, a filter media is placed on the backside of the wall to prevent the wall backfill from plugging the weep holes.

No groundwater was observed during our field work. However, 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 the wall 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 footings, 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).

<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.

The recommendations presented in this report are directed toward the protection of only the proposed wall from damage due to slope movement. Predicting the future behavior of steep slopes and the potential effects of development on their stability is an inexact and imperfect science that is currently based mostly on the past behavior of slopes with similar characteristics. Landslides and soil movement can occur on steep slopes before, during, or after the development of property. The owner of any property containing or located close to steep slopes must ultimately accept the possibility that some slope movement could occur.

This report has been prepared for the exclusive use of Bruce and Ann Vanderwall, 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 sitework 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 - 11	Test Boring and Test Hole Logs
Plate 12	Typical Footing Drain Detail
Appendix A	Slope Stability Analysis

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,

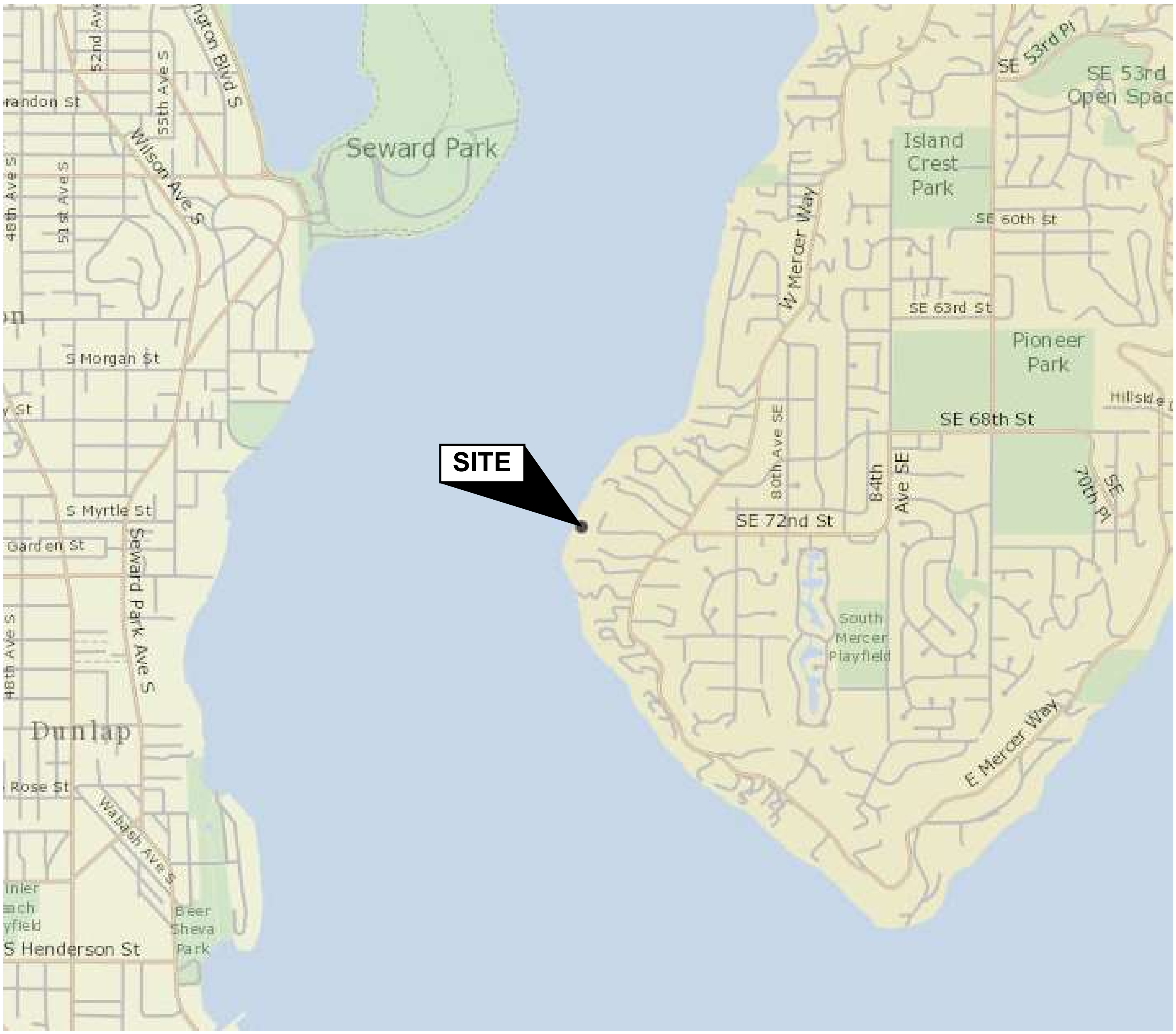
GEOTECH CONSULTANTS, INC.

7/31/2023

D. Robert Ward, P.E.
Principal

MKM/DRW:kg

NORTH



(Source: King County iMap)

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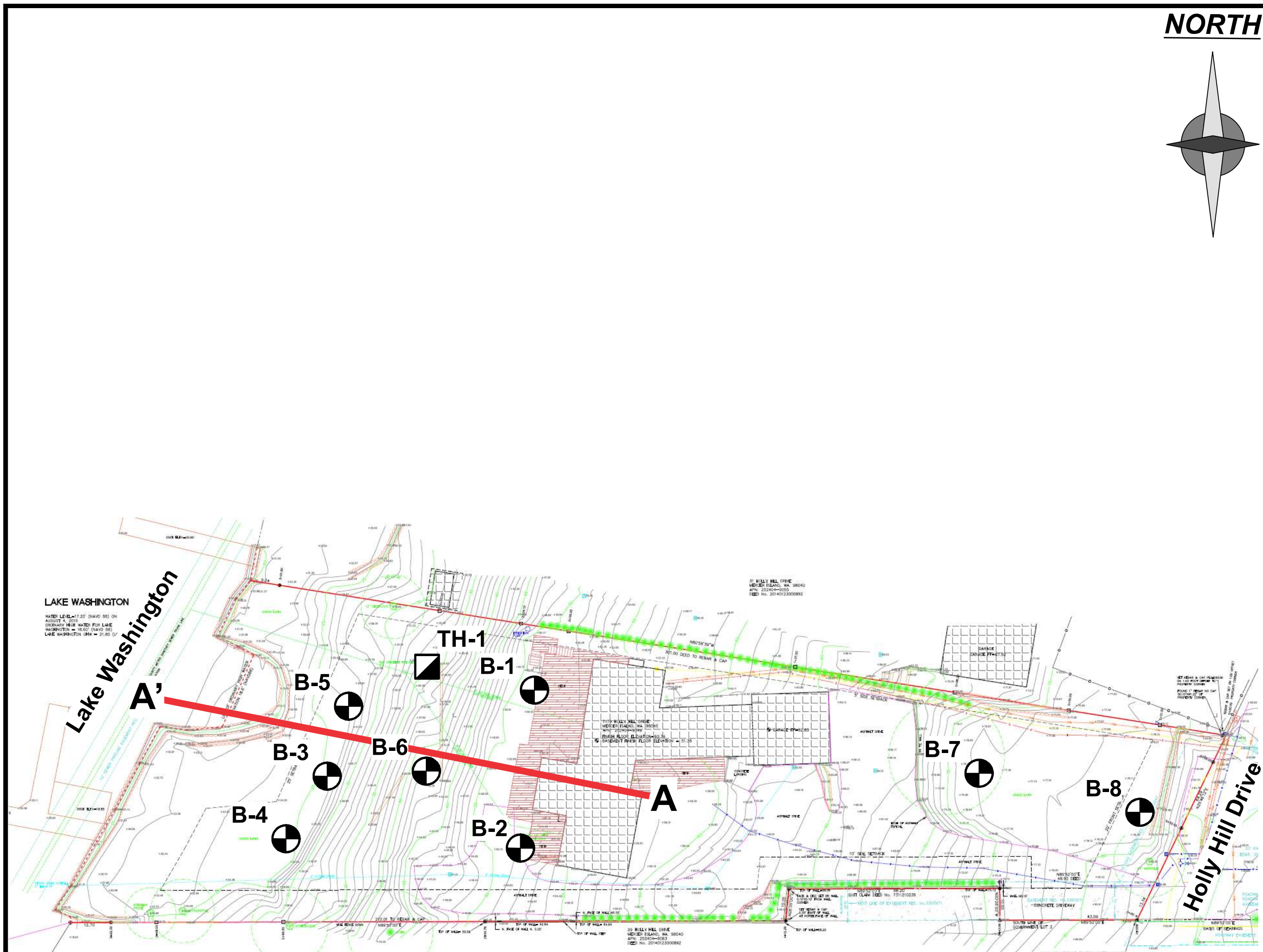
VICINITY MAP

7179 Holly Hill Drive
Mercer Island, Washington

Job No:	Date:		Plate:
20343-1	June 2023		1



Legend:

Test Boring Location

Test Hole Location

(AA') Slope Stability Cross Section Location

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SITE EXPLORATION PLAN

7179 Holly Hill Drive
Mercer Island, Washington

Job No:	Date:		Plate:
20343-1	June 2023	No Scale	2

BORING 1

Elevation ±50 feet

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
0					FILL	Topsoil Brown mottled orange, slightly gravelly, very silty SAND, fine-grained, moist, jumbled, loose **(FILL)**
5			8	1	SM	Gray mottled orange, slightly gravelly, silty SAND, fine-grained, moist, loose
			30	2		-becomes gray and gray-brown mottled orange, slightly cemented, dense
10			61	3		-becomes gray mottled orange, cemented, very dense **(Glacial Till)**
15			50/5”	4		
20			95/11”	5		
25						

*** Test boring was terminated at 21.5 feet on November 12, 2020.**
*** No groundwater seepage was observed during drilling.**

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TEST BORING LOG
7179 Holly Hill Drive
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20343	Nov. 2020	MKM	3

BORING 2

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description (Elevation ±51 feet)
						Topsoil
					FILL	Dark-brown silty SAND with organics, fine-grained, moist, loose **(FILL)**
						Brown mottled orange, silty SAND with roots, fine-grained, moist, loose
5			67	1		-becomes gray and gray-brown with trace rust, slightly gravelly, very dense **(Glacial Till)** -with small black specks
			76	2		-with a thin dark-brown layer at tip
10			19	3	SM	-with thin clean sand seams, becomes dense (Blow counts slightly understated) -becomes very moist at tip
						-driller noted increased drilling difficulty
15			50/6”	4		-becomes gray mottled orange, very dense -becomes blue-gray
			50/4”	5		-becomes very silty, with thin angular sand seams
20						
25						

*** Test boring was terminated at 18.8 feet on November 12, 2020 due to auger refusal.**
*** No groundwater seepage was observed during drilling.**

GEOTECH CONSULTANTS, INC.

TEST BORING LOG

7179 Holly Hill Drive
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20343	Nov. 2020	MKM	4

BORING 3

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description — Elevation ±25 feet
						Topsoil
					SM	Gray gravelly, silty SAND, fine-grained, moist, dense
			50/6"	1		-becomes very dense **(Glacial Till)**
5			50/5"	2		-with rusting
			50/6"	3		
10						

* **Test boring was terminated at 8 feet on June 22, 2023 due to auger refusal.**
* **No groundwater seepage was observed during drilling.**

GEOTECH
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TEST BORING LOG

7179 Holly Hill Drive
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20343	Nov. 2020	MKM	5

BORING 4

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description	Elevation ±25 feet
					SM	Topsoil Brown silty SAND with gravel and roots, fine-grained, moist, loose -becomes gray-brown mottled orange, dense -becomes cemented, very dense **(Glacial Till)**	
			50/4"	1			
5			50/6"	2			
10							

* **Test boring was terminated at 5.5 feet on June 22, 2023 due to auger refusal.**
* **No groundwater seepage was observed during drilling.**

GEOTECH CONSULTANTS, INC.

TEST BORING LOG

7179 Holly Hill Drive
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20343	Nov. 2020	MKM	6

BORING 5

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description — Elevation ±25 feet
					SM	Topsoil
						Brown, gravelly, silty SAND, fine-grained, moist, loose
						-becomes gray-brown mottled orange, dense
			50/6"	1		-becomes gray with rusting, cemented, very dense **(Glacial Till)**
5			50/4"	2		
10						

* **Test boring was terminated at 5.33 feet on June 22, 20223 due to auger refusal.**

* **No groundwater seepage was observed during drilling.**

GEOTECH
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TEST BORING LOG

7179 Holly Hill Drive
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20343	Nov. 2020	MKM	7

BORING 6

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description (Elevation ±43 feet)
						Topsoil
			10	1	FILL	Brown and gray silty SAND with gravel and decayed organics, fine-grained, moist, jumbled, loose to medium-dense **(FILL)**
5			6	2		-becomes dark-brown to black, loose
			83	3		Bluish-gray mottled orange, silty SAND with trace organics, fine-grained, moist medium-dense -becomes gray mottled orange, gravelly, cemented, very dense **(Glacial Till)**
10			50/6”	4	SM	
			50/4”	5		
15						
20						
25						

*** Test boring was terminated at 14.8 feet on June 22, 2023 due to auger refusal.**
*** No groundwater seepage was observed during drilling.**

GEOTECH
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TEST BORING LOG

7179 Holly Hill Drive
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20343	Nov. 2020	MKM	8

BORING 7

Elevation ±76 feet

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
			20	1	FILL	Dark-gray and dark-brown silty SAND with decayed organics, fine-grained, moist, medium-dense **(FILL)**
5			25	2	SM	Gray to gray-brown, heavily mottled, silty SAND with gravel, fine-grained, moist, medium-dense
			50/5”	3		-becomes gray, gravelly, cemented, very dense **(Glacial Till)**
10			50/6”	4		-with thin, very moist sand seams
			50/0”	5		
15						
20						
25						

*** Test boring was terminated at 14 feet on July 20, 2023 due to auger refusal.**

*** No groundwater seepage was observed during drilling.**

GEOTECH CONSULTANTS, INC.

TEST BORING LOG

7179 Holly Hill Drive
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20343	Nov. 2020	MKM	9

BORING 8

Elevation ±78 feet

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
						Topsoil
					SM	Gray-brown, gravelly, silty SAND, fine-grained, moist, dense
			50/6"	1		-becomes gray to gray-brown mottled orange, very dense **(Glacial Till)**
5			50/5"	2		-with thin, very moist sand seams
			50/6"	3		
10						
15						
20						
25						

*** Test boring was terminated at 8 feet on July 20, 2023 due to auger refusal.**

*** No groundwater seepage was observed during drilling.**

GEOTECH CONSULTANTS, INC.

TEST BORING LOG

7179 Holly Hill Drive
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20343	Nov. 2020	MKM	10

TEST HOLE 1

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
0–5			FILL	Brown, gray, and black, jumbled silty SAND with organics, fine-grained, moist, loose **(FILL)**
5–6			SM	Gray-brown mottled orange, gravelly, silty SAND, fine-grained, moist, medium-dense to dense

*** Test Hole terminated at 6 feet on June 22, 2023 due to refusal on a rock.**
*** No groundwater seepage was observed during excavation.**
*** No caving observed during excavation.**

GEOTECH
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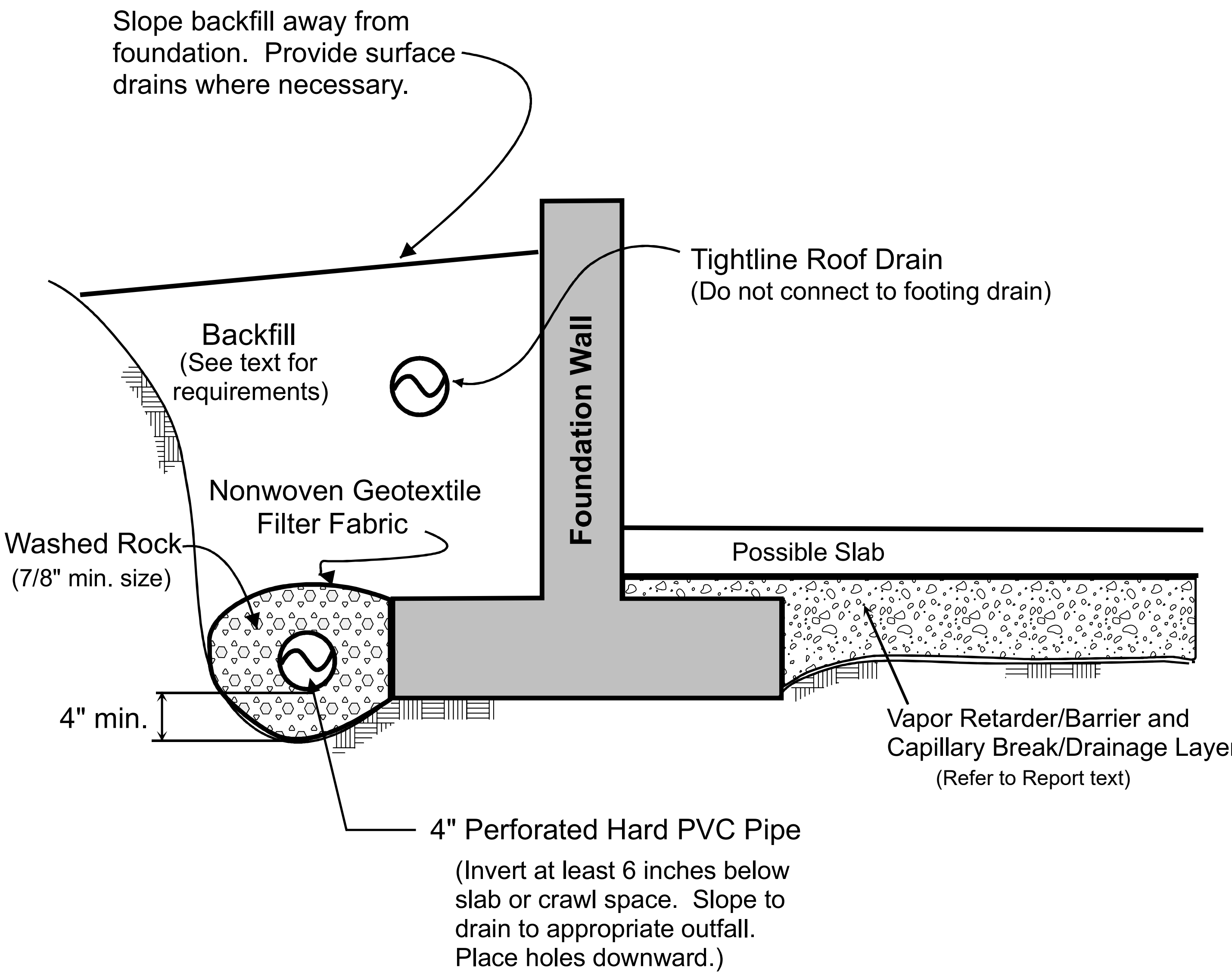
TEST HOLE LOG

7179 Holly Hill Drive
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
20343-1	June 2023	MKM	11



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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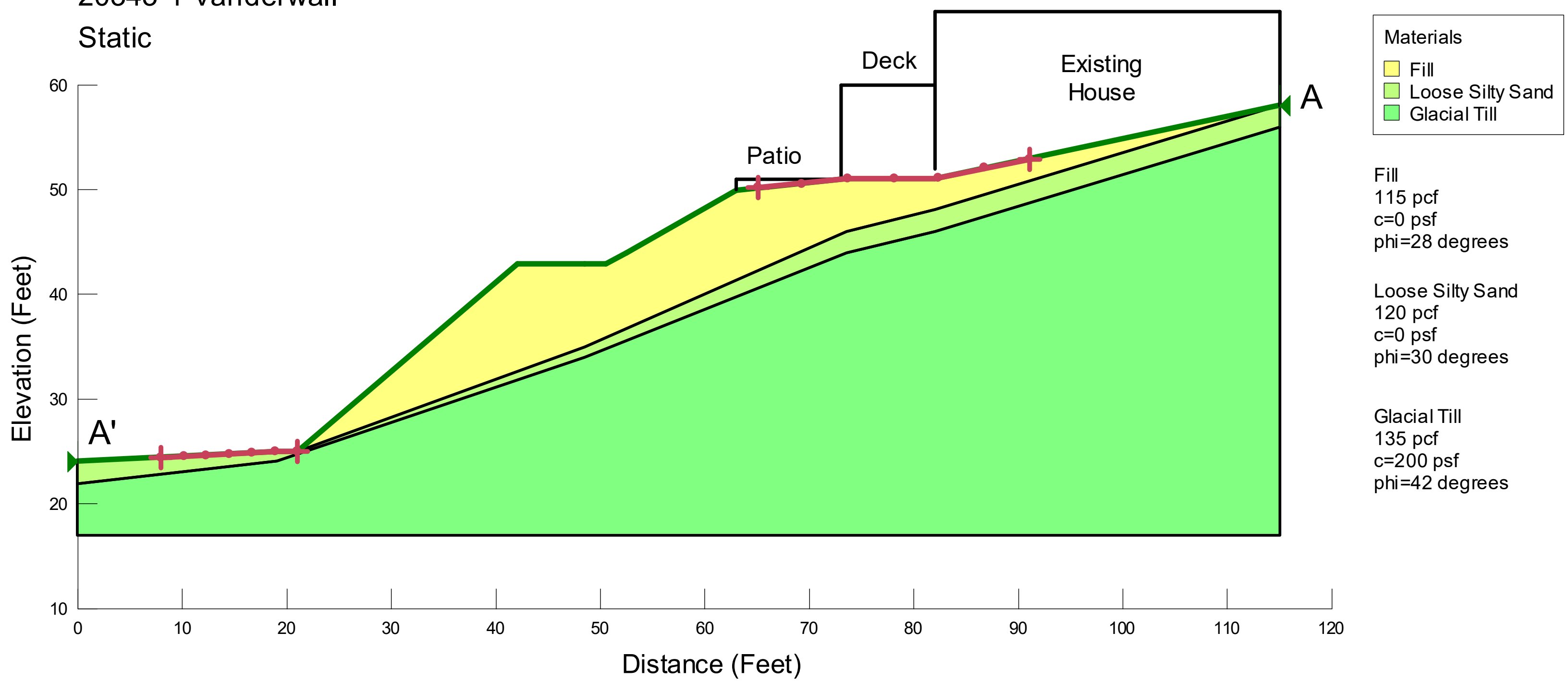
FOOTING DRAIN DETAIL

7179 Holly Hill Drive
Mercer Island, Washington

Job No:	Date:		Plate:
20343-1	June 2023		12

Appendix A
Slope Stability Analysis
20343-1
Vanderwall

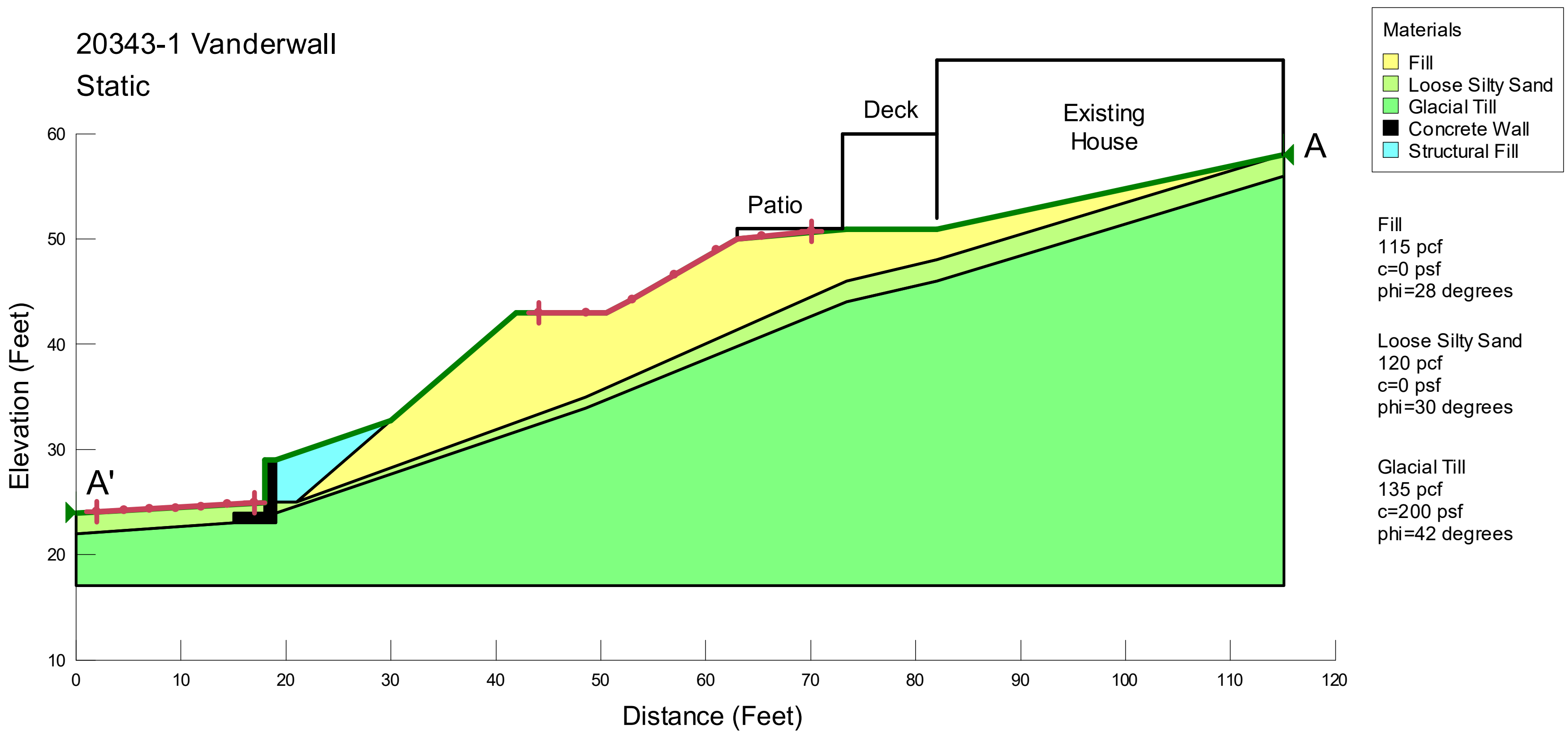
20343-1 Vanderwall
Static

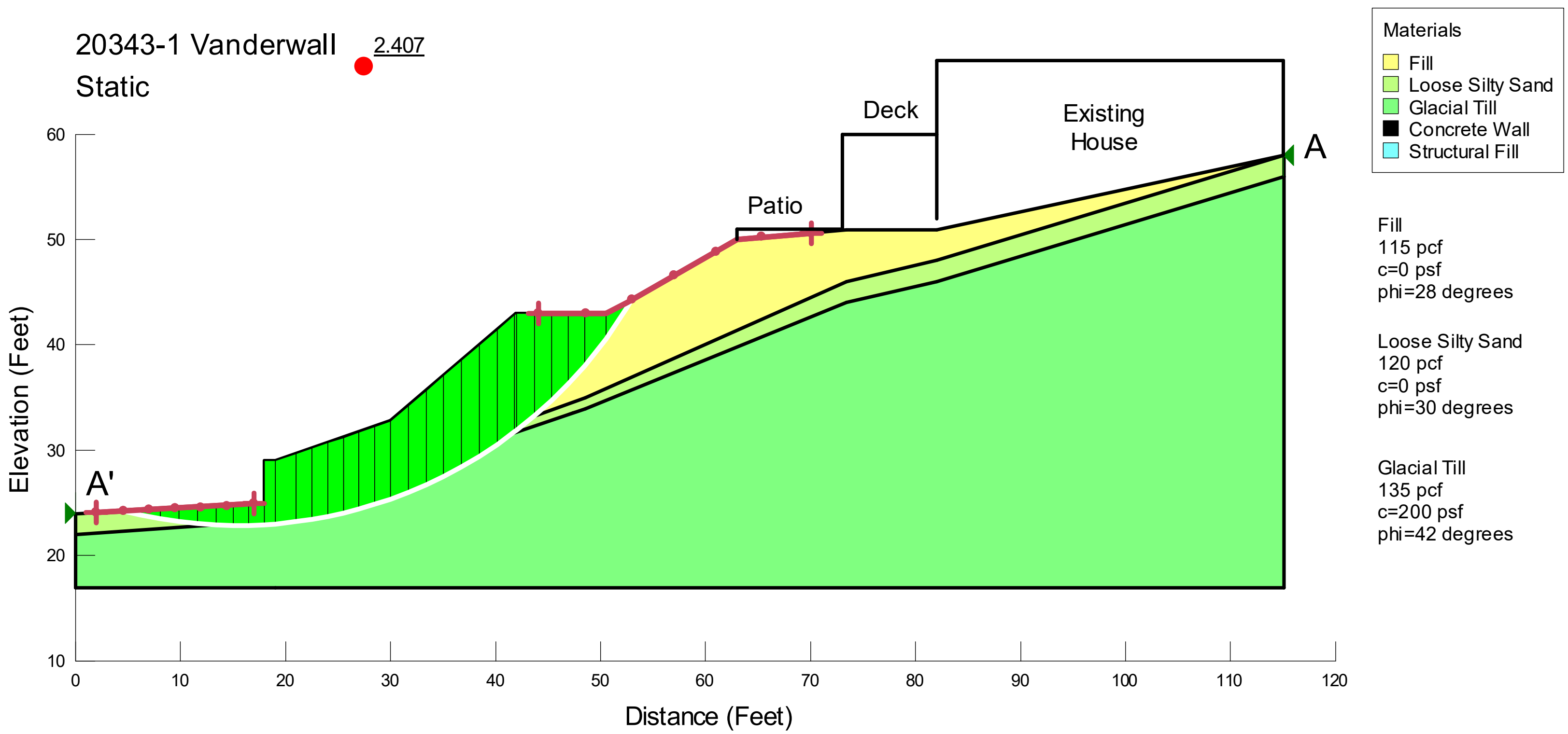


Fill
115 pcf
c=0 psf
phi=28 degrees

Loose Silty Sand
120 pcf
c=0 psf
phi=30 degrees

Glacial Till
135 pcf
c=200 psf
phi=42 degrees


20343-1 Vanderwall
Static
Deck
Existing House
Patio
A
A'
Elevation (Feet)
Distance (Feet)
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
90
100
110
120
Materials
Fill
Loose Silty Sand
Glacial Till
Concrete Wall
Structural Fill
Fill
115 pcf
c=0 psf
phi=28 degrees
Loose Silty Sand
120 pcf
c=0 psf
phi=30 degrees
Glacial Till
135 pcf
c=200 psf
phi=42 degrees



20343-1 Vanderwall
Static
2.407
Materials
Fill
Loose Silty Sand
Glacial Till
Concrete Wall
Structural Fill
Deck
Existing House
Patio
A
A'
Fill
115 pcf
c=0 psf
phi=28 degrees
Loose Silty Sand
120 pcf
c=0 psf
phi=30 degrees
Glacial Till
135 pcf
c=200 psf
phi=42 degrees
Elevation (Feet)
Distance (Feet)

Static

File Information

File Version: 8.15
Title: 20343-1 Vanderwall
Created By: Matt McGinnis
Last Edited By: Matt McGinnis
Revision Number: 11
Date: 7/14/2023
Time: 8:24:23 AM
Tool Version: 8.15.6.13446
File Name: 20343-1 AA' Low wall.gsz
Directory: C:\Users\MattM\Geotech Consultants\Shared Documents - Documents\2020 Jobs\20343 Vanderwall (DRW)\20343-1 Vanderwall (DRW)\20343-1 Slope Stability\
Last Solved Date: 7/14/2023
Last Solved Time: 8:24:58 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Static

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: (none)

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Root Finder

Tolerable difference between starting and converged F of S: 3

Maximum iterations to calculate converged lambda: 20

Max Absolute Lambda: 2

Materials

Fill

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 28 °

Phi-B: 0 °

Loose Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Glacial Till

Model: Mohr-Coulomb

Unit Weight: 135 pcf

Cohesion': 200 psf

Phi': 42 °

Phi-B: 0 °

Concrete Wall

Model: High Strength

Unit Weight: 150 pcf

Structural Fill

Model: Mohr-Coulomb

Unit Weight: 135 pcf

Cohesion': 0 psf

Phi': 45 °

Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range

Left-Zone Left Coordinate: (2, 24.10526) ft

Left-Zone Right Coordinate: (17, 24.89474) ft

Left-Zone Increment: 6

Right Projection: Range

Right-Zone Left Coordinate: (44, 43) ft

Right-Zone Right Coordinate: (70, 50.66667) ft
Right-Zone Increment: 6
Radius Increments: 6

Slip Surface Limits

Left Coordinate: (0, 24) ft
Right Coordinate: (115, 58) ft

Points

	X (ft)	Y (ft)
Point 1	0	24
Point 2	19	25
Point 3	21	25
Point 4	42	43
Point 5	48.5	43
Point 6	50.5	43
Point 7	52.5	44
Point 8	63	50
Point 9	73.5	51
Point 10	82	51
Point 11	115	58
Point 12	73.5	46
Point 13	73.5	44
Point 14	73.5	30
Point 15	82	48
Point 16	82	46
Point 17	82	33
Point 18	19	24
Point 19	19	17
Point 20	48.5	35
Point 21	48.5	34
Point 22	48.5	28
Point 23	0	22
Point 24	115	56
Point 25	0	17
Point 26	115	17
Point 27	19	29
Point 28	19	23
Point 29	15	23
Point 30	15	24
Point 31	18	24
Point 32	18	29
Point 33	18	24.94737
Point 34	30	32.71429

Regions

	Material	Points	Area (ft²)
Region 1	Fill	11,10,9,8,7,6,5,4,34,3,20,12,15	436.25
Region 2	Glacial Till	24,16,13,21,18,28,29,23,25,19,26	2,370.5
Region 3	Concrete Wall	27,32,33,31,30,29,28,18,2	9
Region 4	Loose Silty Sand	11,15,12,20,3,2,18,21,13,16,24	140
Region 5	Loose Silty Sand	1,23,29,30,31,33	31.026
Region 6	Structural Fill	27,34,3,2	29.714

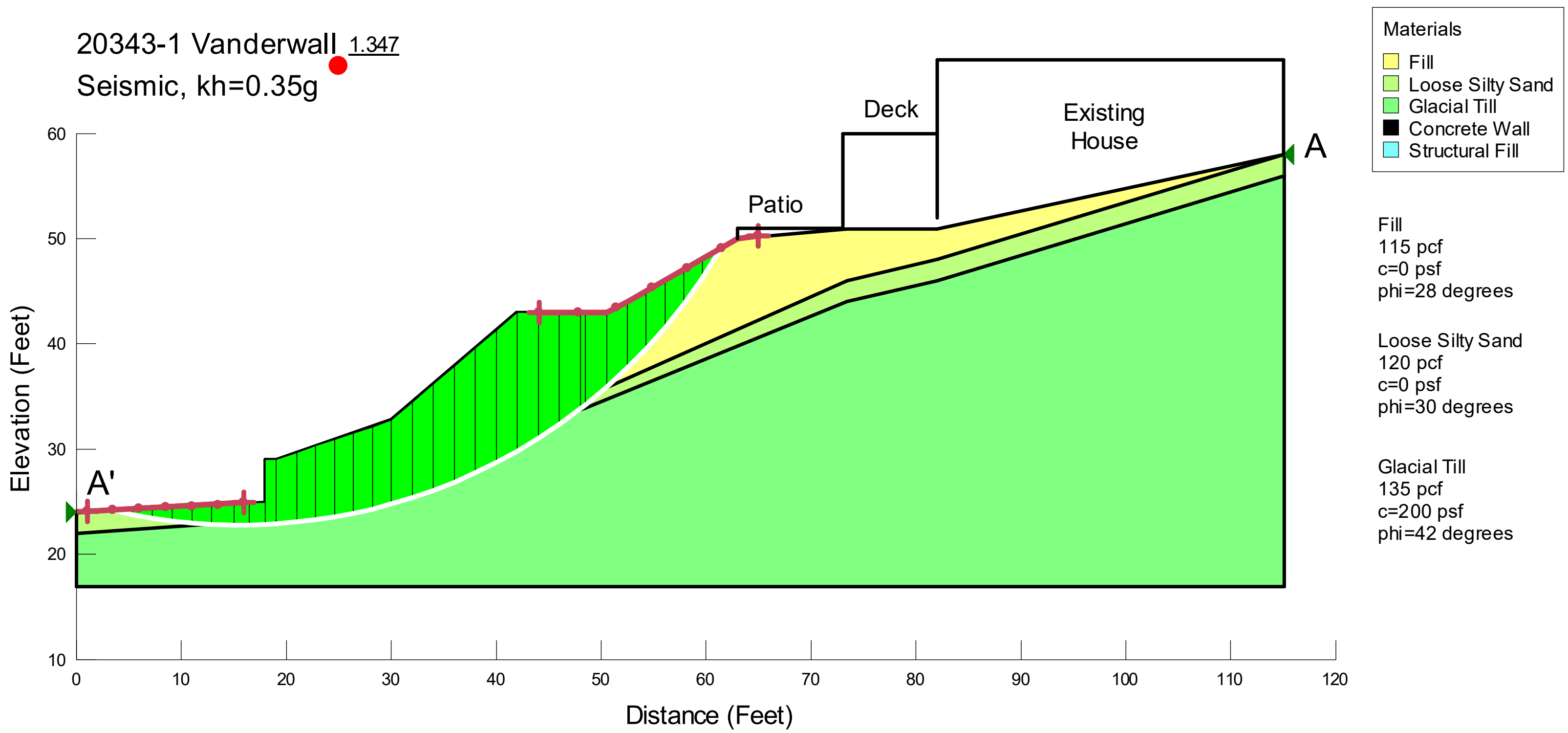
Current Slip Surface

Slip Surface: 67
F of S: 2.407
Volume: 280.65621 ft³
Weight: 34,140.63 lbs
Resisting Moment: 1,438,757.8 lbs-ft
Activating Moment: 597,756.23 lbs-ft
Resisting Force: 29,993.368 lbs
Activating Force: 12,461.862 lbs
F of S Rank (Analysis): 1 of 343 slip surfaces
F of S Rank (Query): 1 of 343 slip surfaces
Exit: (4.4999999, 24.236842) ft
Entry: (52.97838, 44.27336) ft
Radius: 43.604938 ft
Center: (15.43324, 66.448866) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	5.3882593	24.026516	0	33.792013	19.509828	0
Slice 2	7.1647781	23.644605	0	98.898236	57.098923	0
Slice 3	8.9412969	23.339256	0	156.45073	90.326869	0
Slice 4	10.717816	23.108849	0	204.52899	118.08487	0
Slice 5	12.494334	22.952189	0	241.50633	139.43375	0
Slice 6	14.191297	22.869126	0	319.66638	287.8289	200
Slice 7	15.75	22.851529	0	375.36729	337.98222	200
Slice 8	17.25	22.888258	0	381.57255	343.56947	200
Slice 9	18.5	22.954793	0	1,088.5135	980.10195	200
Slice 10	20	23.095386	0	990.50293	891.85284	200
Slice 11	21.75	23.310546	0	1,013.2234	912.31044	200
Slice 12	23.25	23.557052	0	1,000.37	900.73719	200
Slice 13	24.75	23.857796	0	973.7348	876.75475	200
Slice 14	26.25	24.21394	0	935.42723	842.26246	200
Slice 15	27.75	24.626901	0	887.52991	799.13552	200

Slice 16	29.25	25.098382	0	831.95784	749.09821	200
Slice 17	30.844574	25.668157	0	817.8454	736.39131	200
Slice 18	32.533723	26.347481	0	840.5192	756.80688	200
Slice 19	34.222872	27.111043	0	851.77839	766.9447	200
Slice 20	35.912021	27.963871	0	853.51879	768.51177	200
Slice 21	37.60117	28.912065	0	847.25026	762.86756	200
Slice 22	39.290319	29.963086	0	834.04371	750.97633	200
Slice 23	40.979468	31.126147	0	814.48896	733.36915	200
Slice 24	41.912021	31.804205	0	858.77507	495.81402	0
Slice 25	42.857991	32.565902	0	797.91484	460.67634	0
Slice 26	44.513319	33.974351	0	688.07211	365.85443	0
Slice 27	46.107991	35.478059	0	573.31773	304.83844	0
Slice 28	47.702664	37.145825	0	449.24745	238.86911	0
Slice 29	49.5	39.277658	0	289.56926	153.96671	0
Slice 30	51.5	42.007058	0	119.11662	63.33543	0
Slice 31	52.73919	43.878018	0	21.405584	11.381551	0


20343-1 Vanderwall 1.347
Seismic, kh=0.35g
Materials
Fill
Loose Silty Sand
Glacial Till
Concrete Wall
Structural Fill
Deck
Existing
House
Patio
A
A'
Fill
115 pcf
c=0 psf
phi=28 degrees
Loose Silty Sand
120 pcf
c=0 psf
phi=30 degrees
Glacial Till
135 pcf
c=200 psf
phi=42 degrees
Elevation (Feet)
Distance (Feet)
10
20
30
40
50
60
0
10
20
30
40
50
60
70
80
90
100
110
120

Seismic

File Information

File Version: 8.15
Title: 20343-1 Vanderwall
Created By: Matt McGinnis
Last Edited By: Matt McGinnis
Revision Number: 11
Date: 7/14/2023
Time: 8:24:23 AM
Tool Version: 8.15.6.13446
File Name: 20343-1 AA' Low wall.gsz
Directory: C:\Users\MattM\Geotech Consultants\Shared Documents - Documents\2020 Jobs\20343 Vanderwall (DRW)\20343-1 Vanderwall (DRW)\20343-1 Slope Stability\
Last Solved Date: 7/14/2023
Last Solved Time: 8:24:58 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Seismic

- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: (none)
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Resisting Side Maximum Convex Angle: 1 °
  - Driving Side Maximum Convex Angle: 5 °
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- F of S Distribution

F of S Calculation Option: Constant

Advanced

Number of Slices: 30

F of S Tolerance: 0.001

Minimum Slip Surface Depth: 0.1 ft

Search Method: Root Finder

Tolerable difference between starting and converged F of S: 3

Maximum iterations to calculate converged lambda: 20

Max Absolute Lambda: 2

Materials

Fill

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion': 0 psf

Phi': 28 °

Phi-B: 0 °

Loose Silty Sand

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion': 0 psf

Phi': 30 °

Phi-B: 0 °

Glacial Till

Model: Mohr-Coulomb

Unit Weight: 135 pcf

Cohesion': 200 psf

Phi': 42 °

Phi-B: 0 °

Concrete Wall

Model: High Strength

Unit Weight: 150 pcf

Structural Fill

Model: Mohr-Coulomb

Unit Weight: 135 pcf

Cohesion': 0 psf

Phi': 45 °

Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range

Left-Zone Left Coordinate: (1, 24.05263) ft

Left-Zone Right Coordinate: (16, 24.84211) ft

Left-Zone Increment: 6

Right Projection: Range

Right-Zone Left Coordinate: (44, 43) ft

Right-Zone Right Coordinate: (65, 50.19048) ft
Right-Zone Increment: 6
Radius Increments: 6

Slip Surface Limits

Left Coordinate: (0, 24) ft
Right Coordinate: (115, 58) ft

Seismic Coefficients

Horz Seismic Coef.: 0.35

Points

	X (ft)	Y (ft)
Point 1	0	24
Point 2	19	25
Point 3	21	25
Point 4	42	43
Point 5	48.5	43
Point 6	50.5	43
Point 7	52.5	44
Point 8	63	50
Point 9	73.5	51
Point 10	82	51
Point 11	115	58
Point 12	73.5	46
Point 13	73.5	44
Point 14	73.5	30
Point 15	82	48
Point 16	82	46
Point 17	82	33
Point 18	19	24
Point 19	19	17
Point 20	48.5	35
Point 21	48.5	34
Point 22	48.5	28
Point 23	0	22
Point 24	115	56
Point 25	0	17
Point 26	115	17
Point 27	19	29
Point 28	19	23
Point 29	15	23
Point 30	15	24
Point 31	18	24
Point 32	18	29
Point 33	18	24.94737

Point 34	30	32.71429

Regions

	Material	Points	Area (ft²)
Region 1	Fill	11,10,9,8,7,6,5,4,34,3,20,12,15	436.25
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Region 4	Loose Silty Sand	11,15,12,20,3,2,18,21,13,16,24	140
Region 5	Loose Silty Sand	1,23,29,30,31,33	31.026
Region 6	Structural Fill	27,34,3,2	29.714

Current Slip Surface

Slip Surface: 88
F of S: 1.347
Volume: 369.63949 ft³
Weight: 44,894.75 lbs
Resisting Moment: 2,158,159 lbs-ft
Activating Moment: 1,603,003.3 lbs-ft
Resisting Force: 37,718.119 lbs
Activating Force: 28,006.272 lbs
F of S Rank (Analysis): 1 of 343 slip surfaces
F of S Rank (Query): 1 of 343 slip surfaces
Exit: (3.5, 24.184211) ft
Entry: (61.439448, 49.108256) ft
Radius: 53.08782 ft
Center: (15.594059, 75.87609) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	4.4371736	23.982722	0	34.29316	19.799165	0
Slice 2	6.3115209	23.614774	0	100.40732	57.970192	0
Slice 3	8.1858681	23.316223	0	159.42935	92.046578	0
Slice 4	10.060215	23.08589	0	209.22118	120.79391	0
Slice 5	11.934563	22.922882	0	247.63501	142.97214	0
Slice 6	13.935868	22.824855	0	459.67039	413.88908	200
Slice 7	15.75	22.793797	0	560.23076	504.43404	200
Slice 8	17.25	22.819409	0	591.48273	532.57345	200
Slice 9	18.5	22.870228	0	1,363.578	1,227.7711	200
Slice 10	20	22.980935	0	1,270.5488	1,144.0073	200
Slice 11	21.9	23.171914	0	1,292.4687	1,163.744	200
Slice 12	23.7	23.418669	0	1,257.6647	1,132.4064	200
Slice 13	25.5	23.728705	0	1,192.2241	1,073.4834	200
Slice 14	27.3	24.103161	0	1,104.2675	994.28688	200

Slice 15	29.1	24.543448	0	1,002.0155	902.21878	200
Slice 16	31	25.083555	0	941.52433	847.75232	200
Slice 17	33	25.733998	0	917.97396	826.54747	200
Slice 18	35	26.473947	0	885.97145	797.73227	200
Slice 19	37	27.307499	0	851.82586	766.98745	200
Slice 20	39	28.239579	0	819.6181	737.98745	200
Slice 21	41	29.276116	0	791.52477	712.6921	200
Slice 22	43.001564	30.425266	0	713.22959	642.19481	200
Slice 23	45.004691	31.695962	0	588.71207	530.07873	200
Slice 24	47.007818	33.098195	0	469.69556	422.91578	200
Slice 25	48.254691	34.025129	0	434.25397	250.71665	0
Slice 26	49.5	35.047005	0	381.68207	220.36425	0
Slice 27	51.5	36.796225	0	328.45106	174.64053	0
Slice 28	53.393945	38.622051	0	301.63054	160.3798	0
Slice 29	55.181834	40.530325	0	269.98798	143.55515	0
Slice 30	56.969724	42.644584	0	223.84957	119.02293	0
Slice 31	58.757614	45.007619	0	156.72933	83.334462	0
Slice 32	60.545503	47.682941	0	59.044879	31.394719	0