Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services

GEOTECHNICAL ENGINEERING STUDY
4740 WEST MERCER WAY
MERCER ISLAND, WASHINGTON

ES-8380

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PREPARED FOR

JAYMARC CUSTOM HOMES, LLC

April 4, 2022

Stephen H. Avril
Project Manager

04/04/2022

Kyle R. Campbell, P.E.
Principal Engineer

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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will <u>not</u> likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will <u>not</u> be adequate to develop geotechnical design recommendations for the project.

Do <u>not</u> rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do <u>not</u> rely on an executive summary. Do <u>not</u> read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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Earth Solutions NW LLC

Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

April 4, 2022
ES-8380

JayMarc Custom Homes, LLC
7525 Southeast 24th Street, Suite 520
Mercer Island, Washington 98040

Attention: Mr. Rob de Clerk

Dear Mr. de Clerk:

Earth Solutions NW, LLC (ESNW) is pleased to present this report titled "Geotechnical Engineering Study, 4740 West Mercer Way, Mercer Island, Washington".

In general, the native soil underlying the site consists of lacustrine deposits based on our observation of the subsurface conditions. In our opinion, the proposed residence can be supported on conventional continuous and spread footing foundations bearing on competent native soils, competent existing fill, or new structural fill. We anticipate suitable bearing soils will be encountered at depths of about two feet below existing grades. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with a suitable structural fill material will be necessary.

Groundwater seepage was not observed during our site investigation (January 26, 2022). However, the client should anticipate perched groundwater seepage on the site. The maximum depth-of-exploration was four feet below the existing surface elevations.

Recommendations for foundation design, site preparation, drainage, and other pertinent recommendations are provided in this study. We appreciate the opportunity to be of service to you on this project. If you have questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Stephen H. Avril
Project Manager

Table of Contents

ES-8380

Table of Contents

Cont'd

ES-8380

GEOTECHNICAL ENGINEERING STUDY
4740 WEST MERCER WAY
MERCER ISLAND, WASHINGTON

ES-8380

INTRODUCTION

General

The project area consists of a site located on the east side of West Mercer Way, near the intersection with Southeast 48th Street in Mercer Island, Washington. The parcel is currently developed with a single-family residence, and associated improvements.

Site redevelopment plans include the demolition of the existing structure that occupies the site, and construction of a new residence roughly mimicking the current footprint of the home on-site. The redevelopment will include installation of associated improvements.

The purpose of this study was to explore subsurface conditions across the site and develop geotechnical recommendations for the proposed redevelopment. Our scope of services for completing this geotechnical engineering study included the following:

- Site exploration consisting of hand-auger borings advanced across the property;
- Laboratory testing of soil samples obtained during subsurface exploration;
- Engineering analyses of data gathered during site exploration, and;
- Preparation of this report.

The following documents/maps were reviewed as part of our report preparation:

- Geologic Map of Washington, Northwest Quadrant, Dragovich, Logan, et al, 2002;
- Washington State USDA Soil Conservation Survey (SCS), and;
- Client Provided Site Plan.

Project Description

We understand the property will be redeveloped with a new single-family residence and associated improvements, following the demolition of the existing residence that occupied the subject site at the time of this report production.

Given the topographic change across the site (about four feet in total across the building envelope), we anticipate grading activities may involve cuts, walls, and fills of up to four feet to establish the final design grades.

There are two slopes of about ten feet in vertical relief which ascend from the proposed building area to the north and east. The slopes are designated as a "protected slopes" and in our opinion are the remnant of past legal grading activities, where the overall global slope complex in the neighborhood was graded to create level building areas and yards, with steepened slopes on the margins of the lots. We understand there are no planned modifications to the subject slopes, and as the slopes ascend from the subject site towards neighboring properties, there will be no net increase in surcharging on these slopes as a result of the planned site re-development.

Building construction is anticipated to consist of relatively lightly loaded wood framing and slab-on-grade floors. Perimeter foundation loading is expected to range from approximately one to two kips per foot. Slab-on-grade loading is expected to be on the order of 150 pounds per square foot (psf).

If the above design assumptions are incorrect or change, ESNW should be contacted to review the recommendations in this report. ESNW should review the final design to confirm that the geotechnical recommendations included in this report have been incorporated into the project plans.

SITE CONDITIONS

Surface

The project area consists of a site located on the east side of West Mercer Way, near the intersection with Southeast 48th Street in Mercer Island, Washington. The site is developed with a single-family residence and general landscape areas. The site is roughly flat in nature across the proposed building envelope and yard located on the south side of the existing residence, then descends several feet towards the road grade on the southwest side of the site.

Two rockeries which are present in landscape areas form the slopes previously-mentioned on the margins of the site, and are the remnant of past legal grading activities. These are located on the north and east sides of the site.

Subsurface

ESNW representatives observed, logged and sampled three hand-auger borings across accessible portions of the site. The borings were advanced using hand tools, and advanced to a maximum depth of four feet. The approximate location of the borings is depicted on the Hand Auger Boring Location Plan (Plate 2). Please refer to the soil logs provided in Appendix A for a more detailed description of the subsurface conditions.

Topsoil

Topsoil was encountered at the test locations on the order of two to 12 inches in thickness. Where topsoil is encountered during site grading activities, it is not suitable for use as structural fill nor should it be mixed with material to be used as structural fill. Topsoil or otherwise unsuitable material can be used in landscaping areas if desired.

Fill

Fill soil was not encountered at test locations. Fill soil will likely be encountered surrounding the existing building, roads, and utility alignments, and will have to be evaluated during construction for use as structural fill.

Native Soil

Underlying the topsoil at the test locations, native soils consisting of silty sand with gravel (Unified Soil Classification, SM) were encountered. The native soils were observed in a medium dense condition. These soil types were observed extending to the maximum exploration depth of four feet below existing grades. The soil density was observed to increase with depth.

Geologic Setting

The referenced geologic map resource identifies glacial till deposits (Qvt) across the site. The referenced SCS soil survey describes Kitsap silt loam, 2 to 8 percent slopes (KpB) series soils for the site and surrounding area. Kitsap silt loam series soils are typified by lacustrine deposits sometimes with a minor amount of volcanic ash deposits. The native soil observed at the test locations are consistent with lacustrine deposits, and are in-line with the Soil Survey descriptions for the area.

Groundwater

Groundwater seepage was not observed at any of the test locations during the fieldwork (January 2022). Seepage should be expected in deeper excavations at this site; particularly during the winter, spring, and early summer months. Groundwater seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the wetter, winter months. However, the groundwater table was not observed on the subject site.

ENVIRONMENTALLY CRITICAL AREA ASSESSMENT

As part of our report preparation, we assessed the site for potential critical areas utilizing the City of Mercer Island geologic hazard map available on-line. The subject slopes are not proposed to be modified, and the current building footprint will be mimicked with the proposed residence.

The City of Mercer Island municipal code requires the following for a critical areas study:

1. *Disclosure of the presence of critical areas, including a delineation and type or category of critical area, on the development proposal site and any mapped or identifiable critical areas on or off site within the distance equal to the largest potential required buffer applicable to the development proposal area on the applicant's property;*

The subject site is described as possessing an erosion hazard and potential slide hazards surrounding the existing residence. The slopes on the north, east, and southwest portions of the site appear to be the remnant of past legal grading activities, where slopes in the overall neighborhood were flattened and terraced into lots and buildable areas. This resulted in the slope configuration present on the subject slope where rockeries and landscape areas are oversteep and designated as geologically hazardous areas.

2. *A topographic and boundary survey;*

We have provided a site plan which does not include topographic information on it including the areas designated as geologically hazardous areas. We recommend when site survey is complete, it be submitted along with this report.

3. *A statement specifying the accuracy of the report and all assumptions made and relied upon;*

This report can be relied upon for design of the proposed single-family residence in our professional opinion. The report was authored with site-specific information gleaned through subsurface and surface explorations in January of 2022.

4. *A description of the methodologies used to conduct the critical area study, including references;*

ESNW representatives were on-site in January of 2022 to obtain subsurface data through excavation and observation of three hand-auger borings surrounding the existing residential structure. The borings were advanced to four feet maximum depth, and terminated in dense native soil. We also reviewed the geologic maps for the region (referenced previously), and the Web Soil Survey.

5. *A scale map of the development proposal site;*

We have provided a site plan. The subject slopes are located on the north and west sides of the residence depicted on Plate 2.

6. *Photographic records of the site before the proposed alteration occurs;*

We have provided as an attachment in Appendix C.

7. An assessment of the probable effects to critical areas and associated buffers, including impacts caused by the development proposal and associated alterations to the subject property and impacts to other properties and any critical areas or buffers located on them resulting from the development of the site and the proposed development;

We have analyzed the proposed site re-development from a slope stability standpoint. The new residence will not increase instability on and around the subject site as there are no planned alterations for the slopes designated as steep. Additionally, the buffers from the toe-of-slope on the subject site will remain similar in many respects which will not result in any alteration in the stability characteristics of the slopes on and off-site.

8. A description of mitigation sequencing implementation described in section 19.07.100 including steps taken to avoid and minimize critical areas impacts to the greatest extent feasible;

In our opinion, provided best management practices (BMP) are utilized during and after construction for stormwater management and erosion control measures, there will be no impacts to the critical areas on the site.

9. Detailed studies, as required by this chapter, for individual critical area types in order to ensure critical area protection;

We have evaluated the slopes on the subject site and based on our observations, the slopes are stable in their current condition and configuration. The primary basis for this opinion is the lack of indications of prior instability, and the fact that there are no planned alterations for the slopes dictated as possessing an erosion and landslide hazard. The subject development will be occurring outside of the sloped regions, and the site lies at the toe-of-slope on the north and east sides of the site. As such there will be no net-gain in surcharge conditions on the subject slopes. The slopes on the south side of the site are minor in height (eight feet), and will not be impacted by the proposed structure which is well outside the surcharge prism of the south slopes.

10. Assessment of potential impacts that may occur on adjacent sites, such as sedimentation or erosion, where applicable; and

We have evaluated the currently available plan, and there will be no change in the sedimentation or erosion risks on adjacent sites given BMP are employed during and after construction. This should consist of grading the site such that there is no net increase in the volume of water running towards the south side of the site. This can be achieved through grading and installation of stormwater features that collect and vector surface water to approved discharge points.

11. A post-design memorandum prepared by a qualified professional confirming that the proposed improvements comply with the design recommendations.

We can provide upon request.

It is our opinion that there are no geologic hazards located on the subject site. We base this opinion on the subsurface data collected during our fieldwork, our review of the topographic survey for the subject site, and geologic hazard map. The soils appear to be uniform across the entirety of the subject site. There is no evidence of more permeable soil types (such as sand and clean gravel) sited above the lacustrine deposits, which would be cause for concern over soil mobilization in the future on the subject site.

We recommend foundation elements for the residential be seated in the firm native material, anticipated to be encountered at depths below two feet. Additionally Best Management Practices (BMP) will need to be employed during and after site development. This includes site grading to minimize erosion and soil mobilization, temporary erosion control measures during construction, and permanent vegetation to protect sloped areas from the effects of erosive forces.

DISCUSSION AND RECOMMENDATIONS

General

In our opinion, construction of the proposed structure is feasible from a geotechnical standpoint. The proposed buildings can be supported on conventional continuous and spread footing foundations bearing on competent native soils, competent existing fill, or new structural fill. Slab-on-grade floors should be supported on competent native soil or structural fill. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with a suitable structural fill material will be necessary. Recommendations for foundation design, site preparation, drainage, and other pertinent geotechnical recommendations are provided in the following sections of this study.

This study has been prepared for the exclusive use of JayMarc Custom Homes, LLC. and their representatives. No warranty, expressed or implied, is made. This study has been prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area.

Site Preparation and Earthwork

Site preparation activities will involve demolition of the existing structure, site clearing and stripping, and implementation of temporary erosion control measures. The primary geotechnical considerations associated with site preparation activities include erosion control installation, building pad subgrade preparation, retaining wall construction, underground utility installations, and preparation of pavement subgrade areas.

Temporary construction entrances and drive lanes, consisting of at least six inches of quarry spalls (potentially placed over geotextile) can be considered in order to minimize off-site soil tracking and to provide a stable access entrance surface. Erosion control measures should consist of silt fencing placed along the down gradient side of the site. Soil stockpiles should be covered or otherwise protected to reduce soil erosion. Temporary sedimentation ponds or other approaches for controlling surface water runoff should be in place prior to beginning earthwork activities.

Where encountered, topsoil and organic-rich soil is not suitable for foundation support, nor is it suitable for use as structural fill. Topsoil or organic-rich soil can be used in non-structural areas if desired. Over-stripping of the site, however, should be avoided. A representative of ESNW should observe the initial stripping operations, to provide recommendations for stripping depths based on the soil conditions exposed during stripping.

Structural fill soils placed throughout foundation, slab, and pavement areas should be placed over a firm base. Loose or otherwise unsuitable areas of native soil exposed at subgrade elevations should be compacted to structural fill requirements or overexcavated and replaced with a suitable structural fill material. Where structural fill soils are used to construct foundation subgrade areas, the soil should be compacted to the requirements of structural fill described in the following section. Foundation subgrade areas should be protected from disturbance, construction traffic, and excessive moisture. Where instability develops below structural fill areas, use of a woven geotextile below the structural fill areas may be required. A representative of ESNW should observe structural fill placement in foundation, slab, and pavement areas.

The process of removing existing structures may produce voids where foundations and basements were present. Complete restoration of voids caused by the removal of existing structure must be executed as part of overall subgrade and building pad preparation activities, unless the excavation for the new building will be lower than existing basements. The following guidelines for preparing building subgrade areas should be incorporated into the final design:

- Removal of the existing stem walls to an elevation where a four-foot vertical separation between the bottom of new foundations is maintained, and demolition of the slab present in the existing basement, or;

- Complete removal of all foundation elements, stem walls, footing drains, sewer and storm drainage pipes, etc. within the footprint of the existing structure.

- Where voids and related demolition disturbances extend below planned subgrade elevations, restoration of these areas should be completed. Structural fill should be used to restore voids or unstable areas resulting from the removal of existing structural improvements.

- Where pipes for stormwater and sanitary sewer are encountered, they should be plugged and abandoned.

- Recompact, or overexcavate and replace, areas of existing fill, if present, exposed at building subgrade elevations. ESNW should confirm subgrade conditions and the required level of recompaction, or overexcavation and replacement, during site preparation activities. Overexcavations should extend into competent native soils, and structural fill should be used to restore subgrades areas.

- ESNW should confirm the overall suitability of prepared subgrade areas following site preparation activities.

In-situ Soils

The soils encountered at the test sites have a moderate to high sensitivity to moisture and were generally in a moist condition at the time of the exploration (January 2022). In this respect, the in-situ soils may not be suitable for use as structural fill if the soil moisture content is more than about 3 percent above the optimum level at the time of construction. In general, soils encountered during the site excavations that are excessively over the optimum moisture content will require moisture conditioning prior to placement and compaction. Conversely, soils that are below the optimum moisture content will require moisture conditioning through the addition of water prior to use as structural fill. If the in-situ soils are determined to not be suitable for use as structural fill, then use of a suitable imported soil may be necessary. In our opinion, a contingency should be included in the project budget for exporting unsuitable soil and importing structural fill; or moisture conditioning recommendations can be provided upon request based on field observations during the construction phase of on-site work.

Imported Soils

Imported soil intended for use as structural fill should consist of a well graded granular soil with a moisture content that is at or near the optimum level. During wet weather conditions, imported soil intended for use as structural fill should consist of a well graded granular soil with a fines content of 5 percent or less defined as the percent passing the #200 sieve, based on the minus three-quarter inch fraction.

Structural Fill

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, and roadway areas. Fills placed to construct permanent slopes and throughout retaining wall and utility trench backfill areas are also considered structural fill. Soils placed in structural areas should be placed in loose lifts of 12 inches or less and compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by the Modified Proctor Method (ASTM D-1557). Additionally, more stringent compaction specifications may be required for utility trench backfill zones, depending on the responsible utility district or jurisdiction.

Foundations

Based on the results of our study, the proposed residential structure can be supported on conventional spread and continuous footings bearing on competent native soils, competent existing fill or new structural fill. Based on the soil conditions encountered at the test sites, competent native soils suitable for support of foundations should be encountered at depths of two feet below existing surface elevations in most areas. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with structural fill, may be necessary.

Provided foundations will be supported as described above, the following parameters can be used for design of new foundations:

- Allowable soil bearing capacity 2,500 psf
- Passive earth pressure 300 pcf (equivalent fluid)
- Coefficient of friction 0.40

A one-third increase in the allowable soil bearing capacity can be assumed for short-term wind and seismic loading conditions. The above passive pressure and friction values include a factor-of-safety of 1.5. With structural loading as expected, total settlement in the range of one inch and differential settlement of about one-half inch is anticipated. The majority of the settlements should occur during construction, as dead loads are applied.

Seismic Design Considerations

The 2018 International Building Code (2018 IBC) recognizes the most recent edition of the Minimum Design Loads for Buildings and Other Structures manual (ASCE 7-16) for seismic design, specifically with respect to earthquake loads. Based on the soil conditions encountered at the test pit locations, the parameters and values provided below are recommended for seismic design per the 2018 IBC.

Parameter	**Value**
Site Class	D*
Mapped short period spectral response acceleration, S_S (*g*)	1.440
Mapped 1-second period spectral response acceleration, S_1 (*g*)	0.500
Short period site coefficient, F_a	1.000
Long period site coefficient, F_v	1.800
Adjusted short period spectral response acceleration, S_{MS} (*g*)	1.440
Adjusted 1-second period spectral response acceleration, S_{M1} (*g*)	0.900
Design short period spectral response acceleration, S_{DS} (*g*)	0.960
Design 1-second period spectral response acceleration, S_{D1} (*g*)	0.600

* *Assumes very dense soil conditions, encountered to a maximum depth of four feet bgs during the January 2022 field exploration, remain dense to at least 100 feet bgs. Based on our experience with the project geologic setting (lacustrine deposits) across the Puget Sound region, soil conditions are likely consistent with this assumption.*

Further discussion between the project structural engineer, the project owner (or their representative), and ESNW may be prudent to determine the possible impacts to the structural design due to increased earthquake load requirements under the 2018 IBC. ESNW can provide additional consulting services to aid with design efforts, including supplementary geotechnical and geophysical investigation, upon request.

Liquefaction is a phenomenon where saturated or loose soil suddenly loses internal strength and behaves as a fluid. This behavior is in response to increased pore water pressures resulting from an earthquake or another intense ground shaking. In our opinion, site susceptibility to liquefaction may be considered negligible. The absence of a shallow groundwater table and the dense characteristics of the native soil were the primary bases for this opinion.

Slab-On-Grade Floors

Slab-on-grade floors for the proposed buildings constructed at this site should be supported on a firm and unyielding subgrade. Where feasible, the soil exposed at the slab-on-grade subgrade level can be compacted in place to the specifications of structural fill. Unstable or yielding areas of the subgrade should be recompacted or overexcavated and replaced with suitable structural fill prior to construction of the slab. A capillary break consisting of a minimum of four inches of free draining crushed rock or gravel should be placed below the slab. The free draining material should have a fines content of 5 percent or less (percent passing the #200 sieve, based on the minus three-quarter inch fraction). In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. If a vapor barrier is to be utilized, it should be a material specifically designed for use as a vapor barrier and should be installed in accordance with the manufacturer's specifications.

Retaining Walls

Retaining walls must be designed to resist earth pressures and applicable surcharge loads. The following parameters can be used for retaining wall design:

- Active earth pressure (yielding condition) 35 pcf (equivalent fluid)
- At-rest earth pressure (restrained condition) 55 pcf
- Traffic surcharge for passenger vehicles (where applicable) 70 psf (rectangular distribution)
- Passive earth pressure 300 pcf (equivalent fluid)
- Coefficient of friction 0.40
- Seismic surcharge (active condition) 8H (where H equals retained height)

Additional surcharge loading from adjacent foundations, sloped backfill, or other loads should be included in the retaining wall design. Drainage should be provided behind retaining walls such that hydrostatic pressures do not develop. If drainage is not provided, hydrostatic pressures should be included in the wall design.

Retaining walls should be backfilled with free draining material that extends along the height of the wall, and a distance of at least 18 inches behind the wall. The upper one foot of the wall backfill can consist of a less permeable soil, if desired. A perforated drain pipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3.

Drainage

Seepage will likely be encountered in excavations on the site, particularly during winter, spring, and early summer months. Temporary measures to control surface water runoff and groundwater during construction would likely involve interceptor trenches and sumps. ESNW should be consulted during preliminary grading to identify areas of seepage and to provide recommendations to reduce the potential for instability related to seepage effects.

Finish grades must slope away from the building at an inclination of at least 2 percent for a distance of at ten feet or as adjacent building setbacks allow. In addition, surface water should be controlled utilizing best management practices (BMP) during, and after, construction on the subject site.

Footing drains should be installed given the nature of the soils on the site. A typical foundation drain detail for footings not placed directly against shoring is provided as Plate 4.

Infiltration Evaluation

The subject site is underlain by silty lacustrine deposits based on our observation of the subsurface conditions. The soil on the subject site consists of silty sand soils, which typically have a non-favorable infiltration capacity.

Infiltration testing was not a part of our scope of services for this phase of the project. However, based on our observation of the subsurface and past work and experience in similar soil conditions, full infiltration should be considered infeasible on the site due to the presence of a confining layer of soil within the upper three feet of the subsurface.

Excavations and Slopes

The Federal Occupation Safety and Health Administration (OSHA) and the Washington Industrial Safety and Health Act (WISHA) provide soil classification in terms of temporary slope inclinations. Based on the soil conditions encountered at the test locations, existing fill, loose native soil and any soil where groundwater seepage is exposed, are classified as Type C by OSHA/WISHA. Temporary slopes over four feet in height in Type C soils must be sloped no steeper than 1.5H:1V (Horizontal:Vertical). The presence of perched groundwater may cause caving of the temporary slopes due to hydrostatic pressure. The medium dense to dense native silty sand soils observed are classified as Type B. Temporary slopes over four feet in height in Type B soils must be sloped no steeper than 1H:1V. Temporary excavations with inclinations steeper than those described may be acceptable from a geotechnical standpoint. ESNW should be consulted during the design phase to provide recommendations for steeper temporary excavations if necessary. ESNW should observe site excavations to confirm the soil type and allowable slope inclination. If the recommended temporary slope inclination cannot be achieved, temporary shoring may be necessary to support excavations.

Permanent slopes should maintain a gradient of 2H:1V, or flatter, and should be planted with vegetation to enhance stability and to minimize erosion. A representative of ESNW should observe temporary and permanent slopes to confirm the slope inclinations, and to provide additional excavation and slope recommendations, as necessary.

Utility Support and Trench Backfill

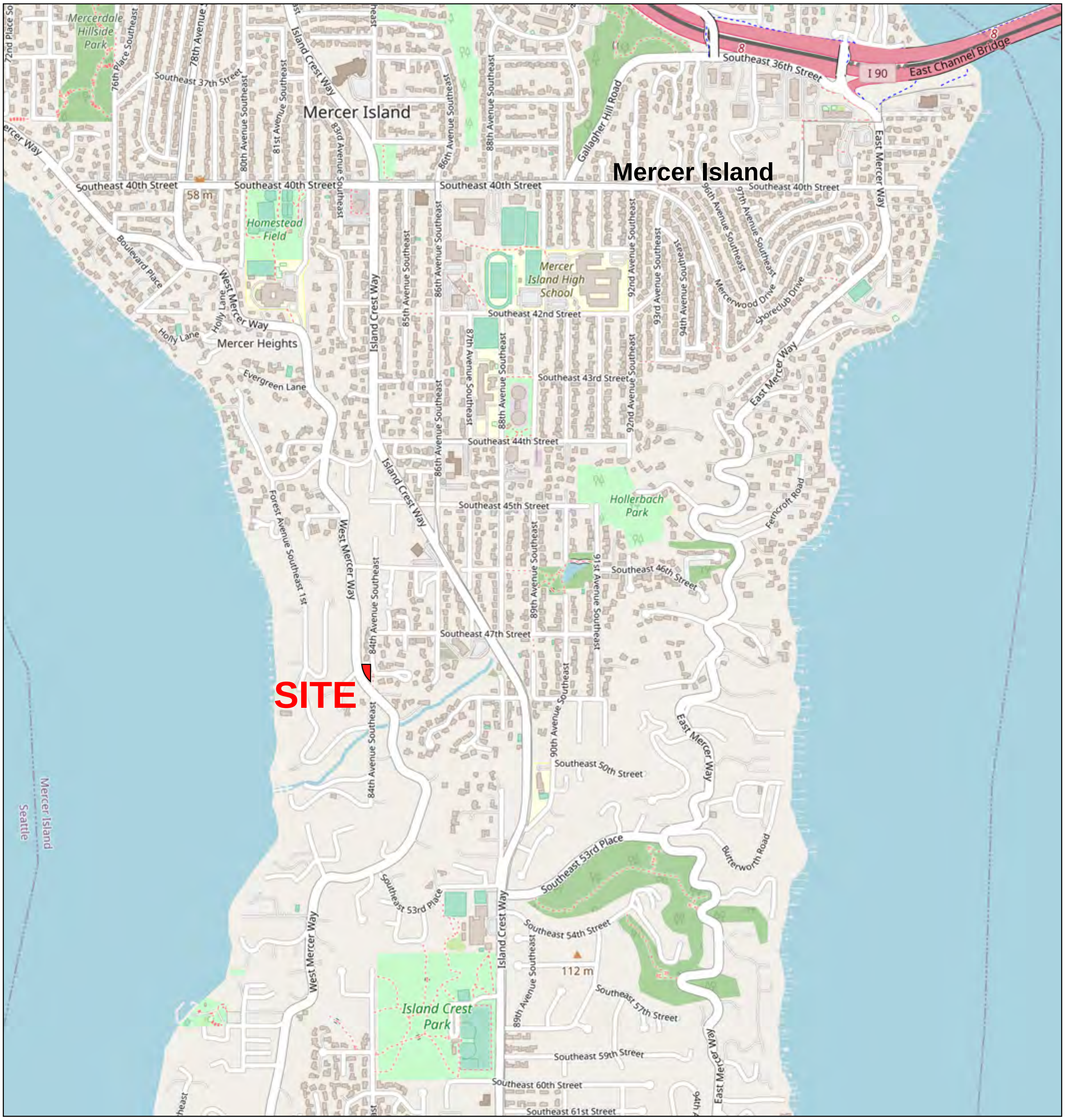
In our opinion, the soils anticipated to be exposed in utility excavations should generally be suitable for support of utilities. Organic or highly compressible soils encountered in the trench excavations should not be used for supporting utilities. The on-site soil may not be suitable for use as trench backfill if the soil moisture content is too high at the time of compaction. Utility trench backfill should be placed and compacted to the specifications of structural fill provided in this report, or to the applicable City of Mercer Island specifications. Seepage should be anticipated within utility trench excavations. Caving of the trench sidewalls should also be anticipated given the nature of the site soil where groundwater is present.

LIMITATIONS

The recommendations and conclusions provided in this geotechnical engineering study are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. A warranty is not expressed or implied. Variations in the soil and groundwater conditions observed at the test locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions in this geotechnical engineering study if variations are encountered.

Additional Services

ESNW should have an opportunity to review the final design with respect to the geotechnical recommendations provided in this report. ESNW should also be retained to provide testing and consultation services during construction.



Reference:
King County, Washington
OpenStreetMap.org

NORTH

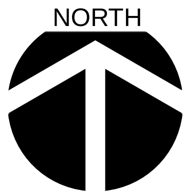
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

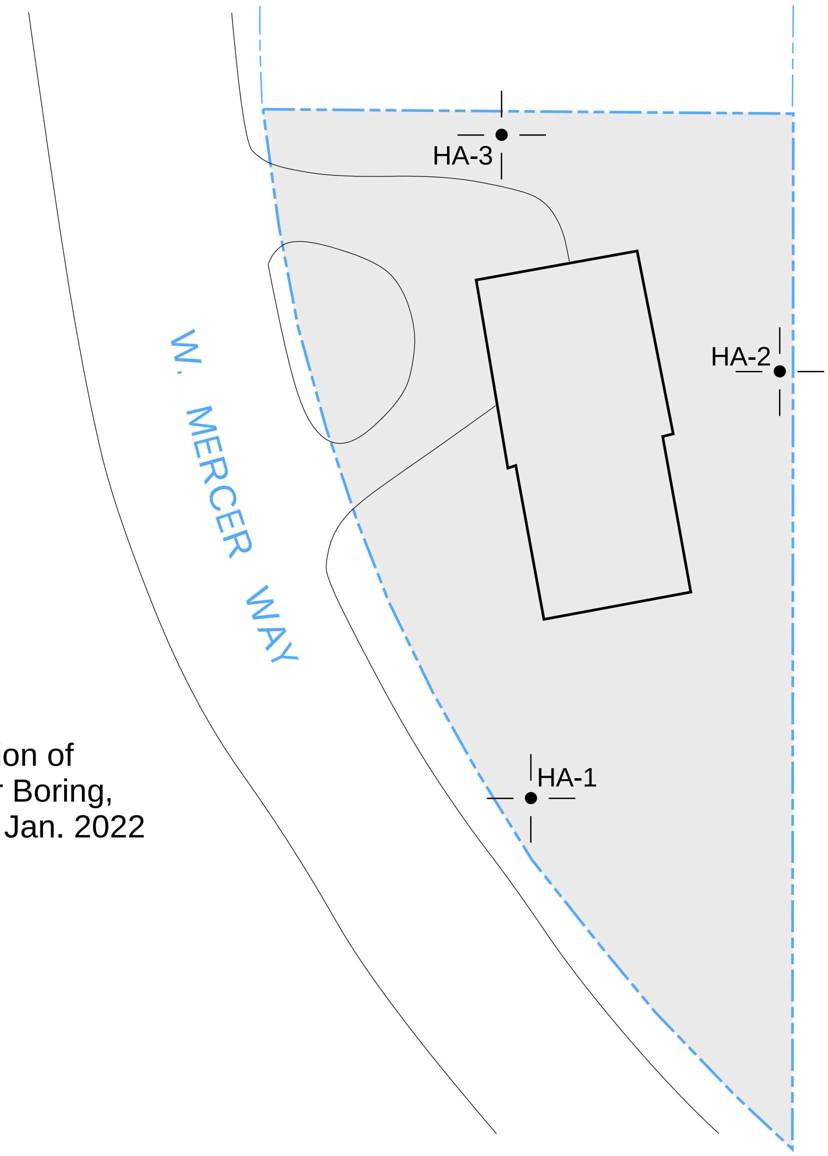
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Vicinity Map
4740 W. Mercer Way
Mercer Island, Washington

Drwn. MRS	Date 03/23/2022	Proj. No. 8380
Checked SES	Date Mar. 2022	Plate 1



NOT - TO - SCALE



LEGEND

HA-1 — Approximate Location of ESNW Hand Auger Boring, Proj. No. ES-8380, Jan. 2022

Subject Site

Existing Building

NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

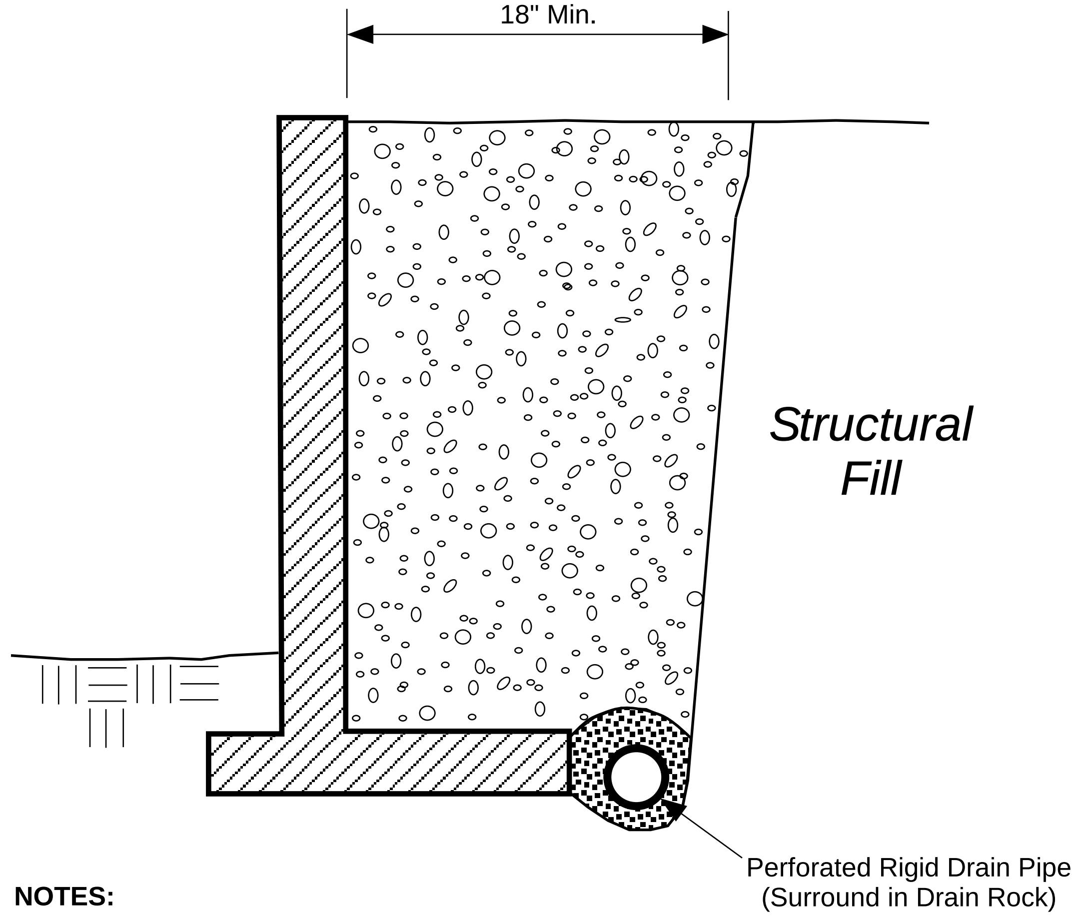
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Hand Auger Boring Location Plan
4740 W. Mercer Way
Mercer Island, Washington

Drwn. MRS	Date 03/23/2022	Proj. No. 8380
Checked SES	Date Mar. 2022	Plate 2



NOTES:

- Free-draining Backfill should consist of soil having less than 5 percent fines. Percent passing No. 4 sieve should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free-draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1-inch Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

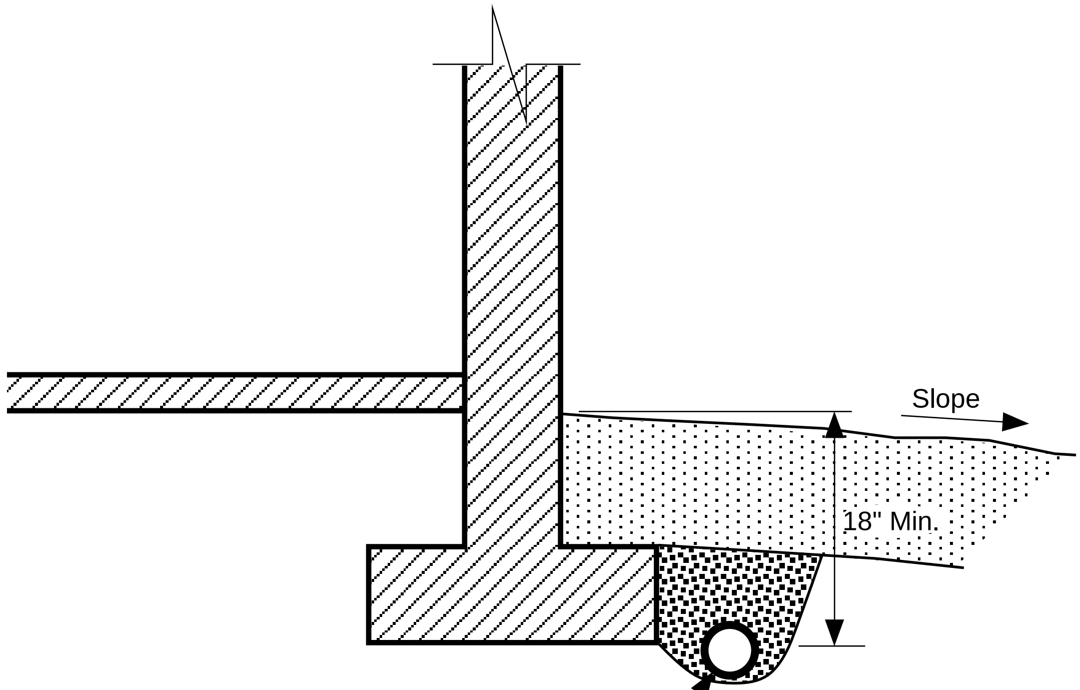
Free-draining Structural Backfill

1-inch Drain Rock

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Retaining Wall Drainage Detail
4740 W. Mercer Way
Mercer Island, Washington

Drwn. CAM	Date 04/04/2022	Proj. No. 8380
Checked SHA	Date April 2022	Plate 3

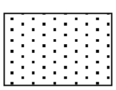


NOTES:

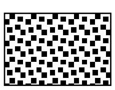
- Do NOT tie roof downspouts to Footing Drain.
- Surface Seal to consist of 12" of less permeable, suitable soil. Slope away from building.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:



Surface Seal: native soil or other low-permeability material.



1-inch Drain Rock

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Footing Drain Detail
4740 W. Mercer Way
Mercer Island, Washington

Drwn. CAM	Date 04/04/2022	Proj. No. 8380
Checked SHA	Date April 2022	Plate 4

Appendix A

Subsurface Exploration
Hand-Auger Boring Logs

ES-8380

The subsurface conditions at the site were explored by excavating a total of three hand-auger borings across accessible portions of the property. The subsurface explorations were completed in January of 2022. The approximate test locations are illustrated on Plate 2 of this report. Logs of the borings are provided in this Appendix. The borings were excavated to a maximum depth of four feet below existing grades.

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

DUAL SYMBOLS are used to indicate borderline soil classifications.

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

BORING NUMBER HA-1

PROJECT NUMBER ES-8380
PROJECT NAME 4740 W. Mercer Way
DATE STARTED 1/26/22 **COMPLETED** 1/26/22
GROUND ELEVATION
DRILLING CONTRACTOR ESNW Rep
LATITUDE 47.56064 **LONGITUDE** -122.22728
DRILLING METHOD Hand Auger
GROUND WATER LEVEL:
LOGGED BY SES **CHECKED BY** SHA
∇ **AT TIME OF DRILLING**
NOTES Depth of Topsoil & Sod 3": planter strip

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			SM		Brown silty SAND with gravel, medium dense, damp
2.5					-becomes gray, becomes wet
		MC = 17.0% Fines = 37.3%		4.0	[USDA Classification: gravelly sandy LOAM]
					Hand auger boring terminated at 4.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

Earth Solutions NW LLC

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BORING NUMBER HA-2

PROJECT NUMBER ES-8380
PROJECT NAME 4740 W. Mercer Way
DATE STARTED 1/26/22 **COMPLETED** 1/26/22
GROUND ELEVATION
DRILLING CONTRACTOR ESNW Rep
LATITUDE 47.56082 **LONGITUDE** -122.22708
DRILLING METHOD Hand Auger
GROUND WATER LEVEL:
LOGGED BY SES **CHECKED BY** SHA
∇ **AT TIME OF DRILLING**
NOTES Depth of Topsoil & Sod 2": duff/rockery

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			SM		Gray silty SAND with gravel, medium dense, moist
					-becomes wet
2.5					
		MC = 19.0% Fines = 39.3%		3.5	[USDA Classification: gravelly sandy LOAM]
					Hand auger boring terminated at 3.5 feet below existing grade. No groundwater encountered during excavation. No caving observed.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

BORING NUMBER HA-3

PROJECT NUMBER ES-8380
PROJECT NAME 4740 W. Mercer Way
DATE STARTED 1/26/22 **COMPLETED** 1/26/22
GROUND ELEVATION
DRILLING CONTRACTOR ESNW Rep
LATITUDE 47.56099 **LONGITUDE** -122.22732
DRILLING METHOD Hand Auger
GROUND WATER LEVEL:
LOGGED BY SES **CHECKED BY** SHA
∇ **AT TIME OF DRILLING**
NOTES Depth of Topsoil & Sod 12": duff

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			TPSL	1.0	Dark brown TOPSOIL, shallow root intrusions
2.5		MC = 13.9% Fines = 35.1%	SM	4.0	Brown silty SAND with gravel, loose to medium dense, damp -becomes moist [USDA Classification: gravelly LOAM]
					Hand auger boring terminated at 4.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

Appendix B

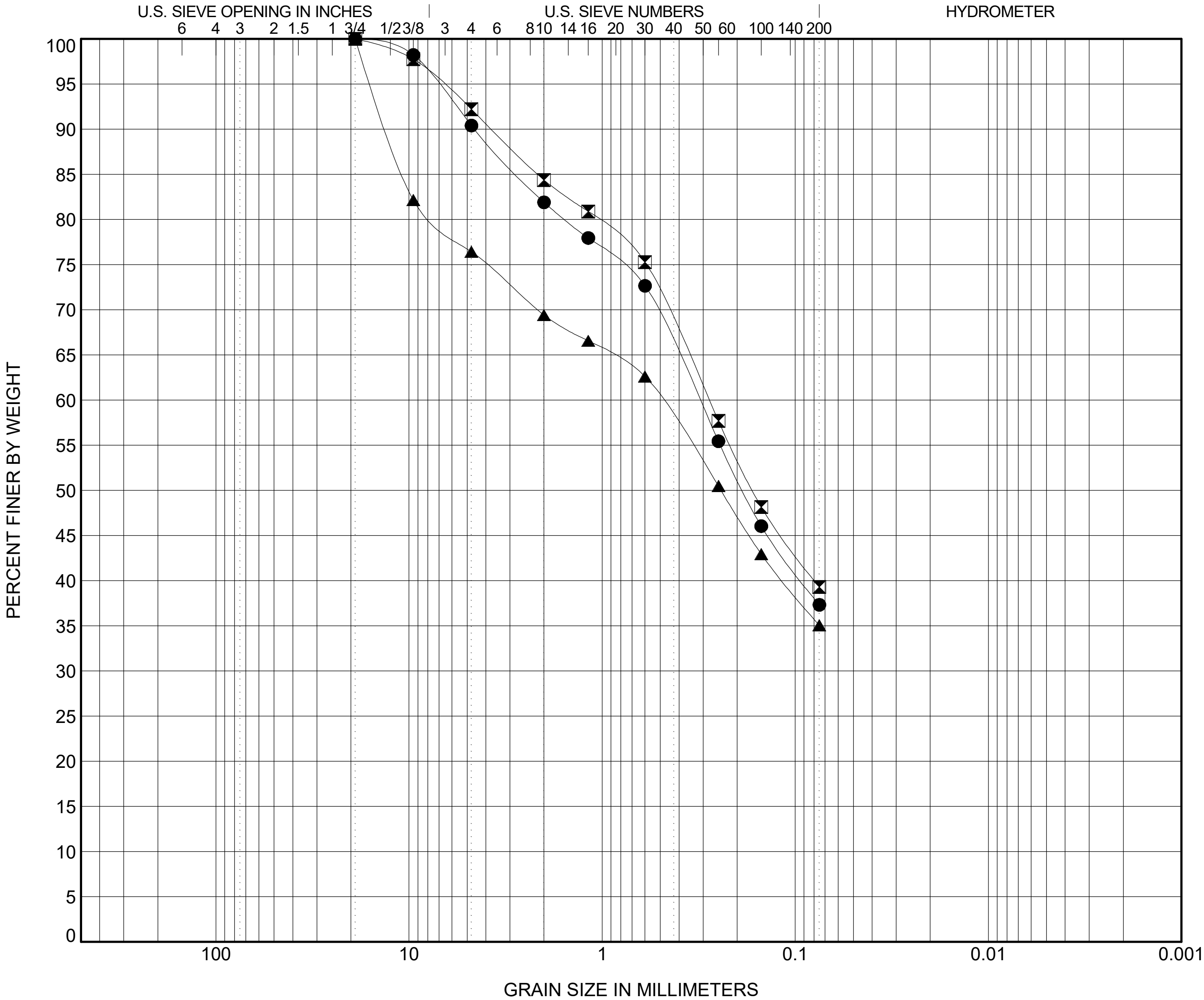
Laboratory Test Results

ES-8380

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-8380 **PROJECT NAME** 4740 W. Mercer Way



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	Cc	Cu
● HA-01	4.00ft.	USDA: Brown Gravelly Sandy Loam. USCS: SM.		
⧗ HA-02	3.50ft.	USDA: Brown Gravelly Sandy Loam. USCS: SM.		
▲ HA-03	4.00ft.	USDA: Brown Gravelly Loam. USCS: SM with Gravel.		

Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● HA-01	4.0ft.	19	0.315						37.3	
⧗ HA-02	3.5ft.	19	0.28						39.3	
▲ HA-03	4.0ft.	19	0.497						35.1	

Appendix C

Photographs

ES-8380

Report Distribution

ES-8380

EMAIL ONLY

JayMarc Custom Homes, LLC
7525 Southeast 24th Street, Suite 520
Mercer Island, Washington 98040

Attention: Mr. Rob de Clerk