CITY OF MUKILTEO

Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services

GEOTECHNICAL ENGINEERING STUDY
DAFFRON PROPERTY
9110 – 53RD AVENUE WEST
MUKILTEO, WASHINGTON

ES-7975

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PREPARED FOR

SEA PAC HOMES

July 30, 2021

Brian C. Snow, G.I.T.
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HENRY T. WRIGHT
STATE OF WASHINGTON
53803
REGISTERED
PROFESSIONAL ENGINEER

07/30/2021

Henry T. Wright, P.E.
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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 not 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 not be adequate to develop geotechnical design recommendations for the project.

Do not 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 not rely on an executive summary. Do not 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

July 30, 2021
ES-7975

Sea Pac Homes
120 Southwest Everett Mall Way, Suite 100
Everett, Washington 98204

Attention: Mr. Glen Belew

Dear Mr. Belew:

Earth Solutions NW, LLC (ESNW), is pleased to present this report titled "Geotechnical Engineering Study, Daffron Property, 9110 – 53rd Avenue West, Mukilteo, Washington". Our field observations indicate the site is underlain primarily by medium dense to very dense silty sand glacial till deposits. Based on the results of our investigation, construction of the proposed residential short plat is feasible from a geotechnical standpoint.

The site will be mass graded to create access drives and building pads. New structural fill should be placed on competent native soil. If earthwork activities occur during wet weather, additional drainage measures, cement treatment of native soil, and the use of select fill material may be necessary. After completing earthwork activities in accordance with recommendations in this report, the proposed structures can be supported on conventional spread and continuous foundations bearing on undisturbed, competent native soil, recompacted native soil, or new structural fill. If structural building pads are disturbed during wet weather, remediation measures such as cement treatment or overexcavation and replacement with rock may be necessary in some areas.

This report provides geotechnical analyses and recommendations for the proposed residential short plat. The opportunity to be of service to you is appreciated. If you have any questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Brian C. Snow, G.I.T.
Senior Staff Geologist

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GEOTECHNICAL ENGINEERING STUDY
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MUKILTEO, WASHINGTON

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INTRODUCTION

General

This geotechnical engineering study (study) was prepared for the proposed short plat to be constructed on the west side of 53rd Avenue West, approximately 250 to 500 feet north of the intersection with 92nd Street Southwest in Mukilteo, Washington. To complete our scope of services, we performed the following:

- Subsurface exploration to characterize the soil and groundwater conditions;
- Laboratory testing of representative soil sample collected on site;
- Review of on-site geologically hazardous areas;
- Engineering analyses and recommendations for the proposed residential short plat, and;
- Preparation of this report.

The following documents and resources were reviewed as part of our report preparation:

- Distribution and Description of Geologic Units in the Mukilteo Quadrangle, Washington, Minard, J.P., 1982;
- Web Soil Survey (WSS) online resource, maintained by the Natural Resources Conservation Service (NRCS) under the United States Department of Agriculture (USDA);
- Soil Survey of Snohomish County Area, Washington, compiled by the USDA Soil Conservation Service, issued July 1983;
- Snohomish County Geologic Hazards Seismic Hazard Areas Map, dated February 1, 2016;
- Snohomish County Geologic Hazards Mine Hazard Areas Map, dated February 1, 2016;
- Liquefaction Susceptibility Map of Snohomish County, Washington, by Palmer, S.P. et al., dated September 2004;
- Geologic Information Portal online resource, maintained by the Washington Department of Natural Resources, and;
- Mukilteo Municipal Code.

Project Description

The subject site is located at 9110 – 53rd Avenue West in Mukilteo, Washington, as illustrated on Plate 1 (Vicinity Map). The site consists of one tax parcel (Snohomish County Parcel No. 00611600015901) totaling approximately 1.33 acres of land area.

We understand site development plans include construction of seven new residential lots, an access road, a stormwater vault, and associated improvements; the existing structure and site improvements will be demolished. We anticipate grade cuts and fills on the order of five to ten feet will be necessary to establish level building pads in some areas of the site.

At the time of report submission, specific building load values were not available for review; however, we anticipate the proposed residential structures will consist of relatively lightly loaded wood framing supported on conventional foundations. Based on our experience with similar developments, we estimate wall loads of about 1 to 2 kips per linear foot and slab-on-grade loading of 150 pounds per square foot (psf) will be incorporated into the final design.

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

SITE CONDITIONS

Surface

The site is currently developed with an existing single-family residence, detached garage, and associated site improvements. The existing topography consists of a localized high area within the central portion of the site, which gently descends to the west, south, and east, with approximately 30 feet of vertical relief across the parcel. Vegetation consists primarily of forested areas with mature trees, underbrush, landscaping, and yard areas.

Subsurface

A representative of ESNW observed, logged, and sampled eight test pits at accessible locations within the property boundaries, on June 21, 2021. The test pits were completed using a machine and operator retained by our firm, to assess and classify the site soils, and to characterize the groundwater conditions within areas proposed for new development. The maximum exploration depth was approximately 13 feet below the existing ground surface (bgs).

The approximate locations of the test pits are depicted on Plate 2 (Test Pit Location Plan). Please refer to the test pit logs provided in Appendix A for a more detailed description of subsurface conditions. Representative soil samples collected at the exploration locations were analyzed in general accordance with Unified Soil Classification System (USCS) and USDA methods and procedures.

Topsoil and Fill

Topsoil was generally encountered within the upper 8 to 12 inches of existing grades at the test pit locations. Deeper pockets of topsoil up to 24 inches may be encountered locally across the site, as observed at test location TP-2; shallower sections of topsoil may also be present. The topsoil was characterized by its dark brown color, the presence of fine organic material, and small root intrusions.

Isolated fill was encountered at test location TP-2, characterized as topsoil intermixed with imported crushed rock gravel, extending to a maximum observed depth of 24 inches below existing grades. Additional fill will likely be encountered surrounding the existing foundations, utility lines, and other existing site improvements. Where encountered, fill intended for reuse as structural fill should be evaluated by ESNW at the time of construction and should be primarily free of organics and other deleterious material.

Native Soil

Underlying the topsoil and fill, native soils consisting primarily of medium dense to very dense silty sand (USCS: SM) glacial till deposits were observed. The glacial till soil was observed to be in a lightly to moderately weathered, medium dense condition near surface, becoming very dense and unweathered (hardpan) between about one to four feet bgs. Unweathered glacial till deposits were observed extending to the termination depth of each test pit, except for test location TP-6.

The native soils at test location TP-6 were characterized as poorly to well-graded gravel with silt and sand (USCS: GP-GM, GW-GM), with fines contents ranging between about 7 and 10 percent by weight. The gravelly soil deposits were overlain by approximately three feet of silty sand with gravel deposits (USCS: SM) and topsoil, and were generally in a medium dense to dense and damp condition at the time of exploration.

Geologic Setting

Geologic mapping of the area identifies Vashon glacial till (Qvt) as the primary geologic unit underlying the site. As reported on the geologic map resource, glacial till is a non-sorted mixture of clay, silt, sand, and gravel in variable amounts (commonly referred to as “hardpan”), deposited directly beneath the glacier as it advanced over bedrock and older Quaternary deposits

The online WSS resource identifies Alderwood-Urban land complex (Map Unit Symbols: 5 and 6) as the primary soil unit underlying the site. Alderwood soils formed over glacial till; designation as urban land indicates the potential for man-made modifications to the native soil stratigraphy, including artificial grade cuts and fill. Alderwood-Urban land soils are characterized in the referenced USDA soil survey with slow surface water runoff and slight hazard of water erosion.

In our opinion, the soils observed during our subsurface exploration are generally representative of glacial till deposits, consistent with the geologic and soils mapping resources outlined in this section.

Groundwater

Groundwater seepage was not observed during our June 2021 subsurface exploration. However, discrete zones of groundwater seepage are typical within glacial deposits, particularly during the wet season. In our opinion, zones of perched groundwater should be expected within site excavations. Groundwater seepage rates and elevations may 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 winter, spring, and early summer months.

Geologically Sensitive Areas Evaluation

As part of this study, we reviewed Chapter 17.52A.020 – Designation of Geologic Sensitive Areas of the Mukilteo Municipal Code (MMC) to evaluate the presence of geologic hazards at the subject site. We also reviewed the City of Mukilteo Critical Areas online interactive map and the referenced hazard mapping resources. Geologically hazardous areas in the City of Mukilteo include areas susceptible to erosion, landslide, earthquake, or other geological events and conditions.

Based on our review of the geologic sensitive areas designation criteria outlined in MMC 17.52A.020, the site does not contain geologically sensitive areas. Additional justification for this conclusion is provided below.

Landslide Hazard Areas

Criterion H. of MMC 17.52A.020 designates “areas of steep slopes; slopes that have forty percent or steeper gradients and having a vertical relief greater than ten feet”. Our review of the readily available online hazard mapping resources indicates an area of steep slope is present within the southwestern site corner; however, the vertical relief across the identified area of steep slope appears to be less than ten feet. In our opinion, the area of steep slope identified by the referenced online mapping resource does not meet the City’s designation criteria for geologically sensitive areas.

Seismic Hazard Areas

We reviewed the referenced seismic hazards maps to assess the presence of seismic hazards on the subject site. The mapping resources indicate an inferred Class B fault trace (Structure “G”), in association with the Southern Whidbey Island Fault Zone, is located within about 500 to 1,000 feet north of the property, trending in a northwest-southeast orientation.

Class B faults are defined as faults for which Quaternary-age (within the past 2,588,000 years) deformation is suspected but insufficient evidence has been gathered to support the determination. The locations and activity of Class B faults are inferred based on the best available data but have not been confirmed.

During our fieldwork, we did not observe any evidence of faulting, deformation, or other disturbances within the native stratigraphy or surficial geomorphology. We also reviewed available LIDAR mapping resources for evidence of fault scarps or associated linear features on site and in the surrounding area. No evidence of surficial deformation was observed during our LIDAR review. Based on the results of our analysis, no active fault was identified, and the seismic hazard at the subject site is no greater than the surrounding area.

DISCUSSION AND RECOMMENDATIONS

General

In our opinion, construction of the proposed short plat is feasible from a geotechnical standpoint. The primary geotechnical considerations associated with the proposed project include earthwork, foundations and soil bearing capacity, utility support and trench backfill, and stormwater control and drainage.

The site will be mass graded to create access drives and building pads. New structural fill should be placed on competent native soil. If earthwork activities occur during wet weather, additional drainage measures, cement treatment of native soil, and the use of select fill material may be necessary. After completing earthwork activities in accordance with recommendations in this report, the proposed structures can be supported on conventional spread and continuous foundations bearing on undisturbed, competent native soil, recompacted native soil, or new structural fill. If structural building pads are disturbed during wet weather, remediation measures such as cement treatment or overexcavation and replacement with rock may be necessary in some areas.

This study has been prepared for the exclusive use of Sea Pac Homes and its representatives. A warranty is neither expressed nor implied. 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 should consist of installing temporary erosion control measures and performing site stripping within the designated clearing limits. Subsequent earthwork activities may involve additional mass grading and infrastructure and utility installations.

Temporary Erosion Control

The following temporary erosion control measures should be considered:

- Temporary construction entrances and drive lanes, consisting of at least six inches of quarry spalls, should be considered to both minimize off-site soil tracking and provide stable surfaces at site entrances. Placing geotextile fabric underneath the quarry spalls will provide greater stability if needed.

- Silt fencing should be placed around the appropriate portions of the site perimeter.

- When not in use, soil stockpiles should be covered or otherwise protected to reduce the potential for soil erosion, especially during periods of wet weather.

- Temporary measures for controlling surface water runoff, such as interceptor trenches, sumps, or interceptor swales, should be installed prior to beginning earthwork activities.

- Dry soils disturbed during construction should be wetted to minimize dust and airborne soil erosion.

- When appropriate, permanent planting or hydroseeding will help to stabilize site soils.

Additional Best Management Practices, as specified by the project civil engineer and indicated on the plans, should be incorporated into construction activities. Temporary erosion control measures may be modified during construction as site conditions require, as approved by the site erosion control lead.

Stripping

Topsoil was generally encountered within the upper 8 to 12 inches, locally extending as deep as 24 inches bgs. Root intrusions generally extended below the topsoil into the upper weathered soil. The organic-rich topsoil should be stripped and segregated into a stockpile for later use on site or to haul off site. The material remaining immediately below the topsoil may have some root zones and will likely be variable in composition, density, and/or moisture content. The material exposed after initial topsoil stripping will likely not be suitable for direct structural support as is and will likely need to either be compacted in place or stripped and stockpiled for reuse as fill; depending on the time of year stripping occurs, the soil exposed below the topsoil may be too wet to compact and will likely need to be aerated or treated. ESNW should observe initial stripping activities to provide recommendations regarding stripping depths and material suitability.

Excavations and Slopes

Excavation activities are likely to expose loose to medium dense native soils within the upper four feet of existing grades, becoming dense to very dense with depth. Based on the soil conditions observed at the subsurface exploration locations, the following maximum allowable temporary slope inclinations may be used.

The applicable Federal Occupation Safety and Health Administration and Washington Industrial Safety and Health Act soil classifications are also provided:

- Areas exposing groundwater seepage — 1.5H:1V (Type C)
- Loose soil — 1.5H:1V (Type C)
- Medium dense soil — 1H:1V (Type B)
- Dense to very dense “hardpan” native soil — 0.75H:1V (Type A)

Permanent slopes should be planted with vegetation to both enhance stability and minimize erosion and should maintain a gradient of 2H:1V or flatter. The presence of perched groundwater may cause localized sloughing of temporary slopes; groundwater seepage should be expected within site excavations, particularly if excavations take place during the wet season. An ESNW representative should observe temporary and permanent slopes to confirm the slope inclinations are suitable for the exposed soil conditions and to provide additional excavation and slope recommendations, as necessary. If the recommended temporary slope inclinations cannot be achieved, temporary shoring may be necessary to support excavations.

Structural Fill

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, roadway, permanent slope, retaining wall, and utility trench backfill areas. Structural fill placed and compacted during site grading activities should meet the following specifications and guidelines:

- Structural fill material — Granular soil*
- Moisture Content — At or slightly above optimum**
- Relative compaction (minimum) — 95 percent (Modified Proctor)***
- Loose lift thickness (maximum) — 12 inches

* *Existing soil may not be suitable for use as structural fill unless at (or slightly above) the optimum moisture content at the time of placement of and compaction.*

** *Soil shall not be placed dry of optimum and should be evaluated by ESNW during construction.*

*** *Minimum relative compaction of 90% may be feasible for mass grading activities and should be evaluated by ESNW during construction.*

With respect to underground utility installations and backfill, local jurisdictions may dictate the soil type(s) and compaction requirements. Unsuitable material or debris must be removed from structural areas if encountered.

In-situ and Imported Soil

The in-situ soils encountered at the subject site have a moderate to high sensitivity to moisture and were generally in a damp to moist condition at the time of exploration. Soils anticipated to be exposed on site will degrade if exposed to wet weather and construction traffic. Compaction of the soils to the levels necessary for use as structural fill may be difficult or infeasible during wet weather conditions. Soils encountered during site excavations that are excessively over the optimum moisture content will likely require aeration or treatment prior to placement and compaction. Conversely, soils that are substantially below the optimum moisture content will require moisture conditioning through the addition of water prior to use as structural fill. An ESNW representative should determine the suitability of in-situ soils for use as structural fill at the time of construction.

Imported soil intended for use as structural fill should be evaluated by ESNW during construction. The imported soil must be workable to the optimum moisture content, as determined by the Modified Proctor Method (ASTM D1557), at the time of placement and compaction. 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 (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction).

Wet-Season Grading

Earthwork activities that occur during the wet season may require additional measures to protect both structural subgrades and soil intended for use as structural fill. Site specific recommendations can be provided at the time of construction and may include leaving cut areas several inches above design subgrade elevations, covering working surfaces with crushed rock, protecting structural fill soil from adverse moisture conditions, and additional TESC recommendations. ESNW can assist in obtaining a wet-season grading permit if required by the governing jurisdiction.

Void Space Restoration

The process of removing the existing structures may produce voids where old foundations are removed and where crawl space areas may have been present. Complete restoration of voids from old foundation areas must be executed as part of the subgrade preparation activities. The following guidelines for preparing structural subgrade areas should be incorporated into the final design:

- 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 elements.

- Recompact, or overexcavate and replace, areas of existing fill exposed at structural subgrade elevations. Overexcavations should extend into competent native soils and structural fill should be utilized to restore subgrade elevations as necessary.

- ESNW should confirm subgrade conditions, as well as the required level of recompaction and/or overexcavation and replacement, during site preparation activities. ESNW should also evaluate the overall suitability of prepared subgrade areas following site preparation activities.

Foundations

The proposed residential structures can be supported on conventional spread and continuous footings bearing on undisturbed, competent native soil, recompacted native soil, or new structural fill. Provided site earthwork activities are completed in accordance with our recommendations, suitable soil conditions should be exposed in building pad structural subgrade areas.

Due to the high moisture sensitivity of the site soils, foundation subgrade areas should be protected from wet weather or areas of remediation should be anticipated; a layer of crushed rock can be considered to protect foundation subgrade areas. If structural building pads are disturbed during wet weather, remediation measures such as cement treatment or overexcavation and replacement with rock may be necessary in some areas. Provided the structures will be supported as described above, the following parameters may be used for design of the new foundations:

- Allowable soil bearing capacity 2,500 psf
- Passive earth pressure 300 pcf
- 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 passive earth pressure and coefficient of friction values include a safety factor of 1.5. With structural loading as expected, total settlement in the range of one inch is anticipated, with differential settlement of about one-half inch. The majority of the settlement should occur during construction as dead loads are applied.

Retaining Walls

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

- Active earth pressure (unrestrained condition) 35 pcf
- At-rest earth pressure (restrained condition) 55 pcf
- Traffic surcharge (passenger vehicles) 70 psf (rectangular distribution)
- Passive earth pressure 300 pcf
- Coefficient of friction 0.40
- Seismic surcharge 8H psf*

* *Where H equals the retained height (in feet)*

The passive earth pressure and coefficient of friction values include a safety factor of 1.5. Additional surcharge loading from adjacent foundations, sloped backfill, or other loads should be included in the retaining 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 12 inches of the wall backfill may consist of a less permeable soil, if desired.

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. A perforated drainpipe 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.

Slab-on-Grade Floors

Slab-on-grade floors should be supported on a firm and unyielding subgrade consisting of competent native soil or at least 12 inches of new structural fill. Unstable or yielding areas of the subgrade should be recompacted or overexcavated and replaced with suitable structural fill prior to slab construction.

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 defined as the percent passing the number 200 sieve, based on the minus three-quarters-inch fraction. In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. If used, the vapor barrier should consist of a material specifically designed to function as a vapor barrier and should be installed in accordance with the manufacturer's specifications.

Utility Support and Trench Backfill

The soils observed at the subsurface exploration locations are generally suitable for support of utilities. The presence of perched groundwater seepage should be anticipated within utility excavations at depth. Use of the native soil as structural backfill in the utility trench excavations will depend on the in-situ moisture content at the time of placement and compaction. If native soil is placed below the optimum moisture content, settlement will likely occur once wet weather impacts the trenches. Native soil will be difficult or impossible to use as utility trench backfill during wet weather conditions. Moisture conditioning or treatment of the soils may be necessary at some locations prior to use as structural fill. Utility trench backfill should be placed and compacted to the specifications of structural fill provided in this report or to the applicable requirements of the presiding jurisdiction.

Preliminary Pavement Sections

The performance of site pavements is largely related to the condition of the underlying subgrade. To ensure adequate pavement performance, the subgrade should be in a firm and unyielding condition when subjected to proof rolling with a loaded dump truck. Structural fill in pavement areas should be compacted to the specifications previously detailed in this report. Soft, wet, or otherwise unsuitable or yielding subgrade conditions will require remedial measures, such as overexcavation and/or placement of thick crushed rock or structural fill sections, prior to pavement.

We anticipate new pavement sections will be subjected primarily to passenger vehicle traffic. For lightly loaded pavement areas subjected primarily to passenger vehicles, the following preliminary pavement sections may be considered:

- A minimum of two inches of hot-mix asphalt (HMA) placed over four inches of crushed rock base (CRB), or;

- A minimum of two inches of HMA placed over three inches of asphalt-treated base (ATB).

Heavier traffic areas generally require thicker pavement sections depending on site usage, pavement life expectancy, and site traffic. For preliminary design purposes, the following pavement sections for occasional truck traffic and access roadways may be considered:

- Three inches of HMA placed over six inches of CRB, or;

- Three inches of HMA placed over four and one-half inches of ATB.

A representative of ESNW should be requested to observe subgrade conditions prior to placement of CRB or ATB. As necessary, supplemental recommendations for achieving subgrade stability and drainage can be provided. If on-site roads will be constructed with an inverted crown, additional drainage measures may be recommended to assist in maintaining road subgrade and pavement stability.

Final pavement design recommendations, including recommendations for heavy traffic areas, access roads, and frontage improvement areas, can be provided once final traffic loading has been determined. Road standards utilized by the governing jurisdiction may supersede the recommendations provided in this report. The HMA, ATB, and CRB materials should conform to WSDOT specifications. All soil base material should be compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by ASTM D1557.

Drainage

Groundwater seepage will likely be encountered within site excavations depending on the time of year grading operations take place. Temporary measures to control surface water runoff and groundwater during construction would likely involve interceptor trenches, interceptor swales, and sumps. ESNW should be consulted during preliminary grading to identify areas of seepage and provide recommendations to reduce the potential for seepage-related instability.

Finish grades must be designed to direct surface drain water away from structures and slopes. Water must not be allowed to pond adjacent to structures or slopes. In our opinion, a foundation drain should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4.

Infiltration Evaluation

The dense, cemented, and unweathered glacial till soils (hardpan) observed at depths beginning at about one to four feet bgs across the site generally exhibit very poor soil infiltration characteristics. In our opinion, the unweathered glacial soils should be considered impermeable for design purposes, and the use of infiltration systems at the subject site is not recommended.

Stormwater Vault Design

We anticipate site stormwater will be managed using a stormwater vault. Vault foundations should be supported on competent native soil or crushed rock placed on competent native soil. Final storm vault designs must incorporate adequate buffer space from the property boundaries such that temporary excavations to construct the vault structure can be successfully completed. Perimeter drains should be installed around the vault and conveyed to an approved discharge point. The presence of perched groundwater seepage should be anticipated during excavation activities for the vault, particularly during the wet season, which may dictate temporary slope inclinations required for the vault excavation (as described in the *Excavations and Slopes* section of this report).

The following parameters can be used for stormwater vault design:

- Allowable soil bearing capacity (dense native soil) 5,000 psf
- Active earth pressure (unrestrained) 35 pcf
- Active earth pressure (unrestrained, hydrostatic) 80 pcf
- At-rest earth pressure (restrained) 55 pcf
- At-rest earth pressure (restrained, hydrostatic) 100 pcf
- Coefficient of friction 0.40
- Passive earth pressure 300 pcf
- Seismic surcharge 8H*

* *Where H equals the retained height.*

The passive earth pressure and coefficient of friction values include a safety factor of 1.5. The vault walls should be backfilled with free-draining material or suitable common earth if a sheet drain material is used. The upper one foot of the vault backfill can consist of a less permeable soil, if desired. A perforated drain pipe should be placed along the base of the vault walls and connected to an approved discharge location. If the elevation of the vault bottom is such that gravity flow to an outlet is not possible, the portion of the vault below the drain should be designed to include hydrostatic pressure. Design values accounting for hydrostatic pressure are included above.

ESNW should observe grading operations for the vault and the subgrade conditions prior to concrete forming and pouring to confirm conditions are as anticipated, and to provide supplemental recommendations as necessary. Additionally, ESNW should be contacted to review final vault designs to confirm that appropriate geotechnical parameters have been incorporated.

We anticipate native soil will be used as vault backfill. We recommend placing the native soil at or slightly above optimum moisture. Native soil placed substantially above optimum moisture will require additional time or remediation prior to supporting a structure.

Seismic Design

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 boring locations, the parameters and values provided below are recommended for seismic design per the 2018 IBC.

Parameter	Value
Site Class	C*
Mapped short period spectral response acceleration, S_S (*g*)	1.401
Mapped 1-second period spectral response acceleration, S_1 (*g*)	0.500
Short period site coefficient, F_a	1.200
Long period site coefficient, F_v	1.500
Adjusted short period spectral response acceleration, S_{MS} (*g*)	1.682
Adjusted 1-second period spectral response acceleration, S_{M1} (*g*)	0.750
Design short period spectral response acceleration, S_{DS} (*g*)	1.121
Design 1-second period spectral response acceleration, S_{D1} (*g*)	0.500

* *Assumes very dense soil conditions, encountered to a maximum depth of 13 feet bgs during the June 2021 field exploration, remain very dense to at least 100 feet bgs. Based on our experience with the project geologic setting (glacial till) 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.

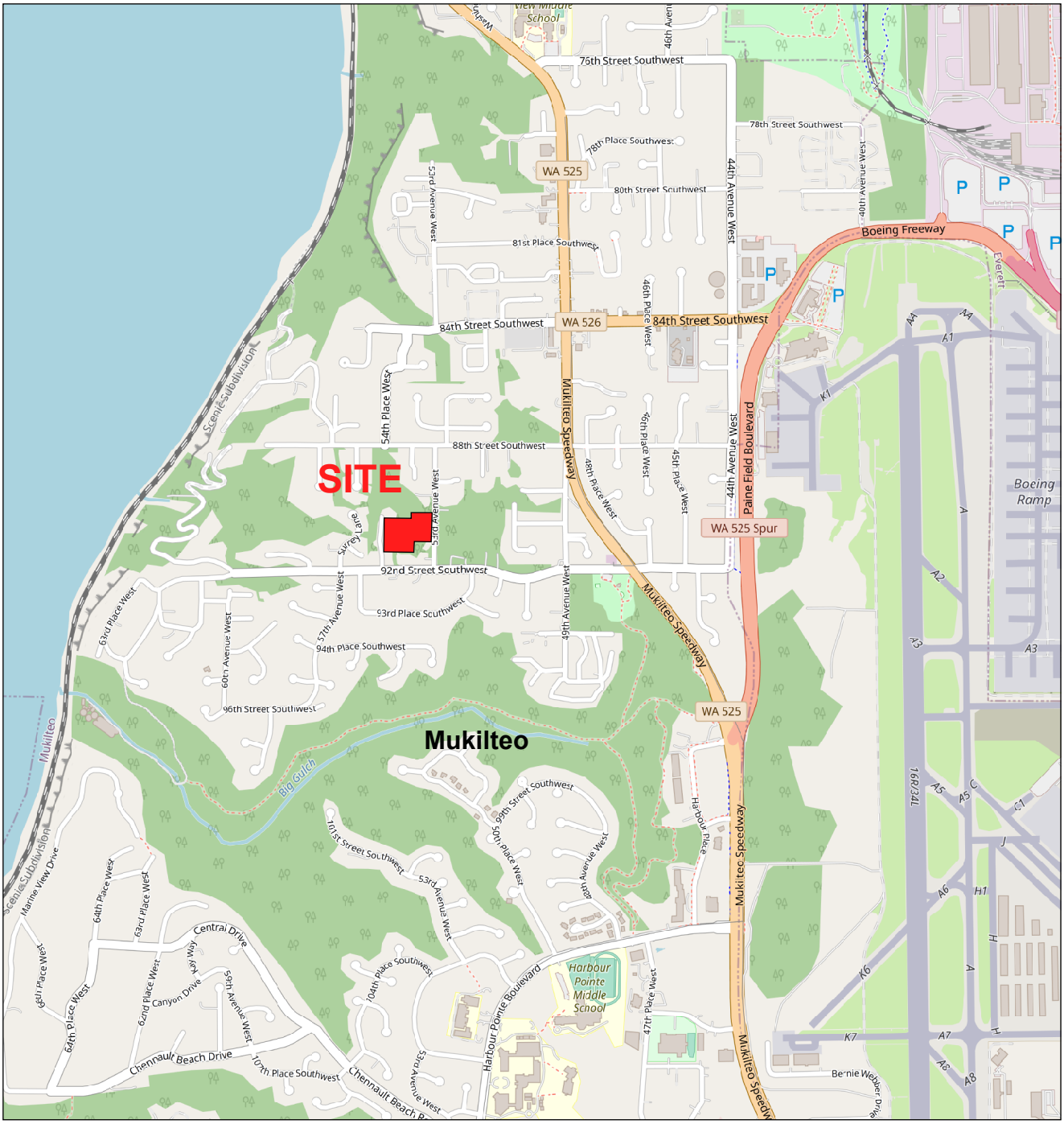
Liquefaction is a phenomenon where saturated or loose soil suddenly loses internal strength and behaves as a fluid. This behavior is in response to increased pore water pressures resulting from an earthquake or another intense ground shaking. In our opinion, site susceptibility to liquefaction may be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

LIMITATIONS

The recommendations and conclusions provided in this 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 neither expressed nor implied. Variations in the soil and groundwater conditions observed at the exploration locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided in this study if variations are encountered.

Additional Services

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



Reference:
Snohomish County, Washington
OpenStreetMap.org

NORTH

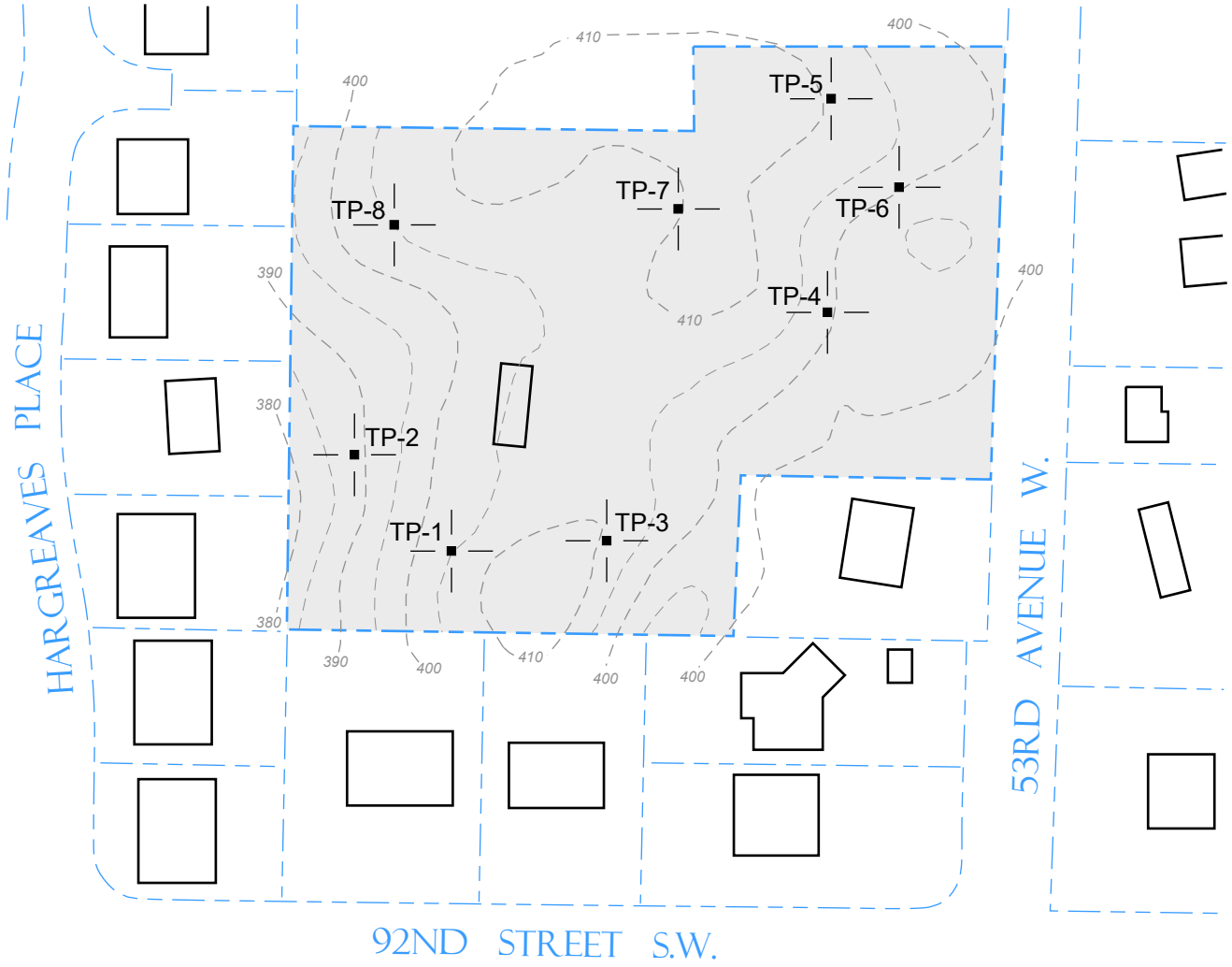
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Vicinity Map
Daffron Property
Mukilteo, Washington

Drwn. MRS	Date 07/15/2021	Proj. No. 7975
Checked BCS	Date July 2021	Plate 1



NORTH

1"=100'

0 50 100 200

Scale in Feet

LEGEND

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-7975, June 2021

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.

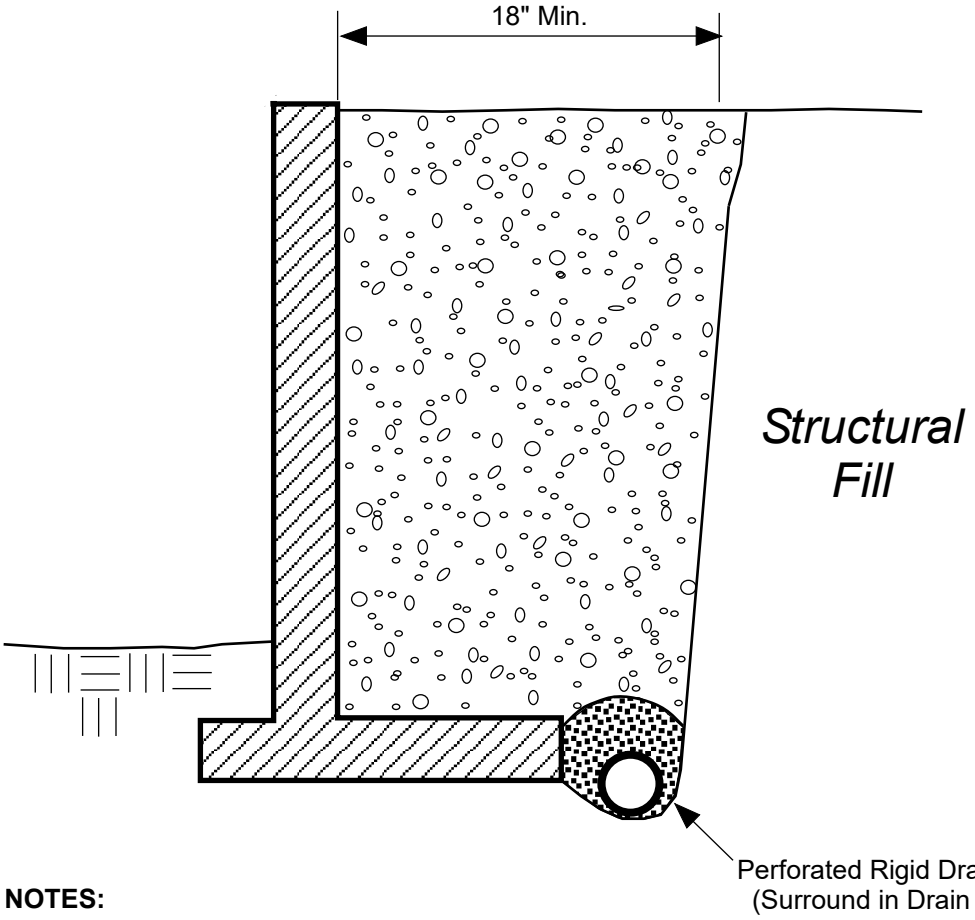
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Test Pit Location Plan
Daffron Property
Mukilteo, Washington

Drwn. MRS	Date 07/14/2021	Proj. No. 7975
Checked BCS	Date July 2021	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:

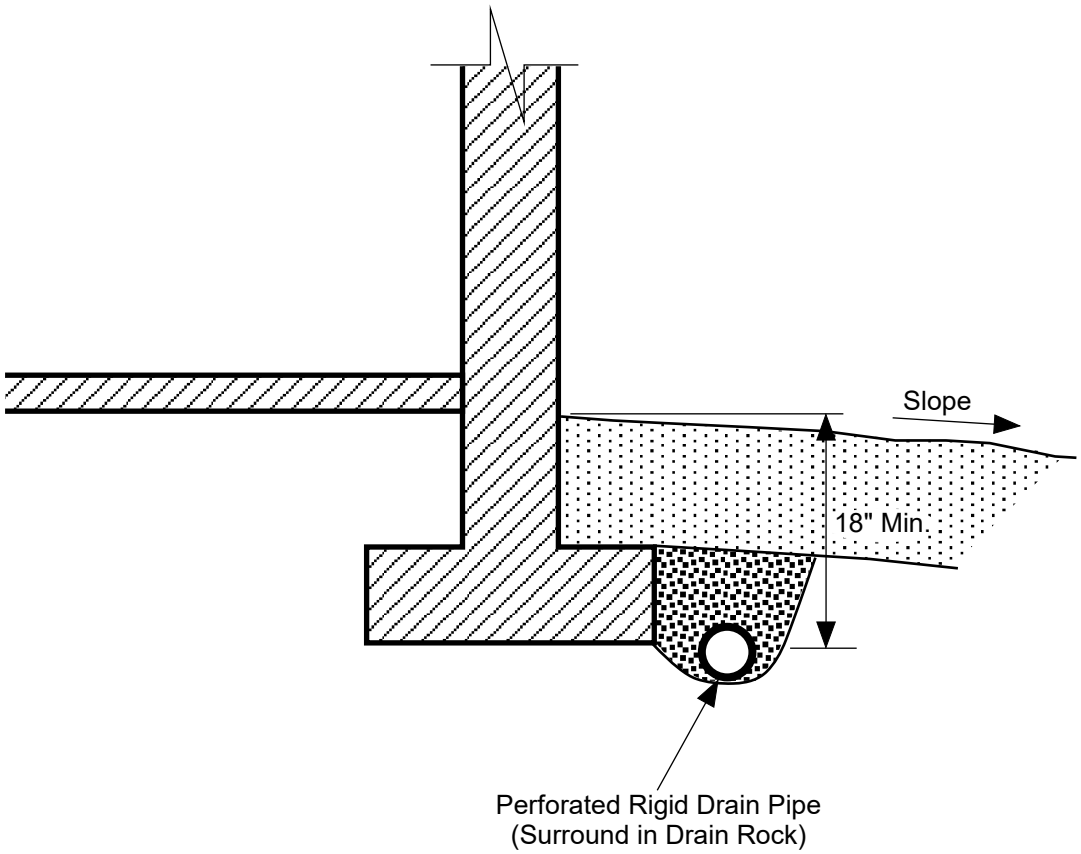
Free-draining Structural Backfill

1-inch Drain Rock

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

Retaining Wall Drainage Detail
Daffron Property
Mukilteo, Washington

Drwn. MRS	Date 07/15/2021	Proj. No. 7975
Checked BCS	Date July 2021	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.

LEGEND:

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

1-inch Drain Rock

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

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

Footing Drain Detail
Daffron Property
Mukilteo, Washington

Drwn. MRS	Date 07/15/2021	Proj. No. 7975
Checked BCS	Date July 2021	Plate 4

Appendix A

Subsurface Exploration
Test Pit Logs

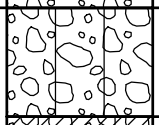
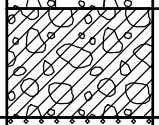
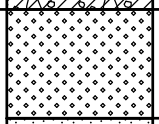
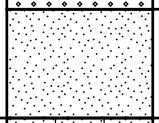
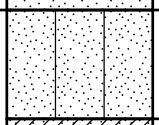
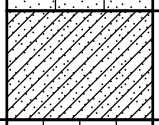
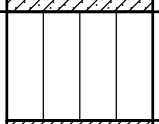
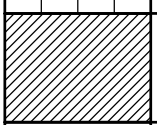
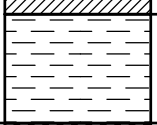
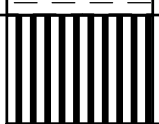
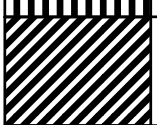
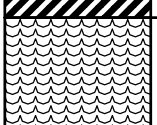
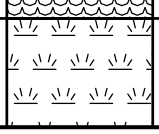
ES-7975

Subsurface conditions on site were explored on June 21, 2021 by excavating eight test pits using a machine and operator retained by our firm. The approximate locations of the test pits are illustrated on Plate 2 of this study. The subsurface exploration logs are provided in this Appendix. The test pits were advanced to a maximum depth of about 13 feet bgs.

The final logs represent the interpretations of the field logs and the results of laboratory analyses. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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
	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

TEST PIT NUMBER TP-1

PROJECT NUMBER ES-7975 **PROJECT NAME** Daffron Property

DATE STARTED 6/21/21 **COMPLETED** 6/21/21 **GROUND ELEVATION** _____ **TEST PIT SIZE** _____

EXCAVATION CONTRACTOR NW Excavating **LATITUDE** 47.91570 **LONGITUDE** -122.30695

EXCAVATION METHOD _____ **GROUND WATER LEVELS:**

LOGGED BY BCS **CHECKED BY** HTW **AT TIME OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 6": brush

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, minor root intrusions
				0.5	Brown silty SAND, dense, damp to moist
					-becomes gray, weakly cemented
		MC = 7.0%	SM		
					-becomes very dense, light iron oxide staining
		MC = 11.8%		4.0	-sparse gravel
					Test pit terminated at 4.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

Earth Solutions NW, LLC
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Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-2

PROJECT NUMBER ES-7975 **PROJECT NAME** Daffron Property
DATE STARTED 6/21/21 **COMPLETED** 6/21/21 **GROUND ELEVATION** _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR NW Excavating **LATITUDE** 47.91585 **LONGITUDE** -122.30717
EXCAVATION METHOD _____ **GROUND WATER LEVELS:**
LOGGED BY BCS **CHECKED BY** HTW **AT TIME OF EXCAVATION** ---
NOTES Depth of Topsoil & Sod 24": brush

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL intermixed with 5/8" crushed rock (Fill)
		MC = 14.1%			2.0 Brown silty SAND, loose to medium dense, moist
		MC = 9.8%			-light iron oxide staining -becomes gray, dense
5					-sparse gravel
			SM		-becomes very dense, weakly cemented
		MC = 12.5%			-decreasing fines content
					-increasing gravel content
		MC = 8.7%			9.0

Test pit terminated at 9.0 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

TEST PIT NUMBER TP-3

PROJECT NUMBER ES-7975 **PROJECT NAME** Daffron Property

DATE STARTED 6/21/21 **COMPLETED** 6/21/21 **GROUND ELEVATION** _____ **TEST PIT SIZE** _____

EXCAVATION CONTRACTOR NW Excavating **LATITUDE** 47.91573 **LONGITUDE** -122.30661

EXCAVATION METHOD _____ **GROUND WATER LEVELS:**

LOGGED BY BCS **CHECKED BY** HTW **AT TIME OF EXCAVATION** ---

NOTES Surface Conditions: brush/ferns

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, minor root intrusions
				1.0	Brown silty SAND, medium dense to dense, damp
		MC = 3.2%			
					-becomes gray, dense
			SM		
		MC = 8.7%			-becomes very dense, moist (unweathered till), weakly cemented
5					
					-light iron oxide staining
		MC = 9.2%		6.0	
					Test pit terminated at 6.0 feet below existing grade due to refusal in very dense till. 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

TEST PIT NUMBER TP-4

PROJECT NUMBER ES-7975 **PROJECT NAME** Daffron Property

DATE STARTED 6/21/21 **COMPLETED** 6/21/21 **GROUND ELEVATION** _____ **TEST PIT SIZE** _____

EXCAVATION CONTRACTOR NW Excavating **LATITUDE** 47.91615 **LONGITUDE** -122.30609

EXCAVATION METHOD _____ **GROUND WATER LEVELS:**

LOGGED BY BCS **CHECKED BY** HTW **AT TIME OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 8": ferns/forest floor

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, minor root intrusions
				0.6	Brown silty SAND, loose to medium dense, damp to moist
		MC = 10.3%			
					-becomes gray, medium dense to dense
					-weakly cemented
		MC = 9.1%			
					-becomes very dense
5			SM		
					-trace iron oxide staining
		MC = 7.3%		9.0	
					Test pit terminated at 9.0 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
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TEST PIT NUMBER TP-5

PROJECT NUMBER ES-7975 **PROJECT NAME** Daffron Property
DATE STARTED 6/21/21 **COMPLETED** 6/21/21 **GROUND ELEVATION** _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR NW Excavating **LATITUDE** 47.91639 **LONGITUDE** -122.30612
EXCAVATION METHOD _____ **GROUND WATER LEVELS:**
LOGGED BY BCS **CHECKED BY** HTW **AT TIME OF EXCAVATION** ---
NOTES Depth of Topsoil & Sod 8": brush

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, minor root intrusions
				0.6	Brown silty SAND, loose, damp
		MC = 5.7%			
					-becomes gray, dense, moist
		MC = 8.8% Fines = 27.6%			-weakly cemented, light iron oxide staining [USDA Classification: slightly gravelly sandy LOAM]
			SM		-trace gravel
5					-becomes very dense
		MC = 5.8%			-increasing gravel content, decreasing fines content
		MC = 7.6% Fines = 19.9%		8.0	[USDA Classification: gravelly sandy LOAM]
					Test pit terminated at 8.0 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

TEST PIT NUMBER TP-6

PROJECT NUMBER ES-7975 **PROJECT NAME** Daffron Property
DATE STARTED 6/21/21 **COMPLETED** 6/21/21 **GROUND ELEVATION** _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR NW Excavating **LATITUDE** 47.91620 **LONGITUDE** -122.30598
EXCAVATION METHOD _____ **GROUND WATER LEVELS:**
LOGGED BY BCS **CHECKED BY** HTW **AT TIME OF EXCAVATION** ---
NOTES Depth of Topsoil & Sod 10": brush

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, minor root intrusions to 0.8'
			SM		Tan silty SAND with gravel, loose to medium dense, damp
		MC = 5.7%			3.0
			GW-GM		Tan well-graded gravel with silt and sand, dense, damp
5		MC = 2.6% Fines = 7.3%			[USDA Classification: extremely gravelly sandy LOAM]
10		MC = 8.8% Fines = 9.2%	GP-GM		10.0 Tan poorly graded GRAVEL with silt and sand, medium dense, damp [USDA Classification: very gravelly sandy LOAM] -light iron oxide staining
		MC = 17.9%			-increasing moisture, silt lenses 13.0 Test pit terminated at 13.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

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TEST PIT NUMBER TP-7

PROJECT NUMBER ES-7975
PROJECT NAME Daffron Property
DATE STARTED 6/21/21 **COMPLETED** 6/21/21
GROUND ELEVATION **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 47.91619 **LONGITUDE** -122.30649
EXCAVATION METHOD
GROUND WATER LEVELS:
LOGGED BY BCS **CHECKED BY** HTW
AT TIME OF EXCAVATION ---
NOTES Depth of Topsoil & 10": grass

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, minor root intrusions
					0.8
					Brown silty SAND, medium dense, damp
					-becomes gray
					-light iron oxide staining
		MC = 9.6%			-becomes dense, moist
			SM		-becomes very dense, weakly cemented
5		MC = 11.6%			
		MC = 9.7%			
					7.5
					Test pit terminated at 7.5 feet below existing grade. No groundwater encountered during excavation. No caving observed.

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TEST PIT NUMBER TP-8

PROJECT NUMBER ES-7975 **PROJECT NAME** Daffron Property
DATE STARTED 6/21/21 **COMPLETED** 6/21/21 **GROUND ELEVATION** _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR NW Excavating **LATITUDE** 47.91620 **LONGITUDE** -122.30710
EXCAVATION METHOD _____ **GROUND WATER LEVELS:**
LOGGED BY BCS **CHECKED BY** HTW **AT TIME OF EXCAVATION** ---
NOTES Depth of Topsoil & 10": brush/ferns

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, minor root intrusions
				0.8	Gray silty SAND, loose to medium dense, damp
		MC = 6.5%			-light iron oxide staining
					-becomes dense
					-becomes very dense, weakly cemented
			SM		
5		MC = 7.6%			
					-heavy oxide staining
					-becomes moist
		MC = 10.7%		7.0	

Test pit terminated at 7.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

Appendix B

Laboratory Test Results

ES-7975

Earth Solutions NW, LLC
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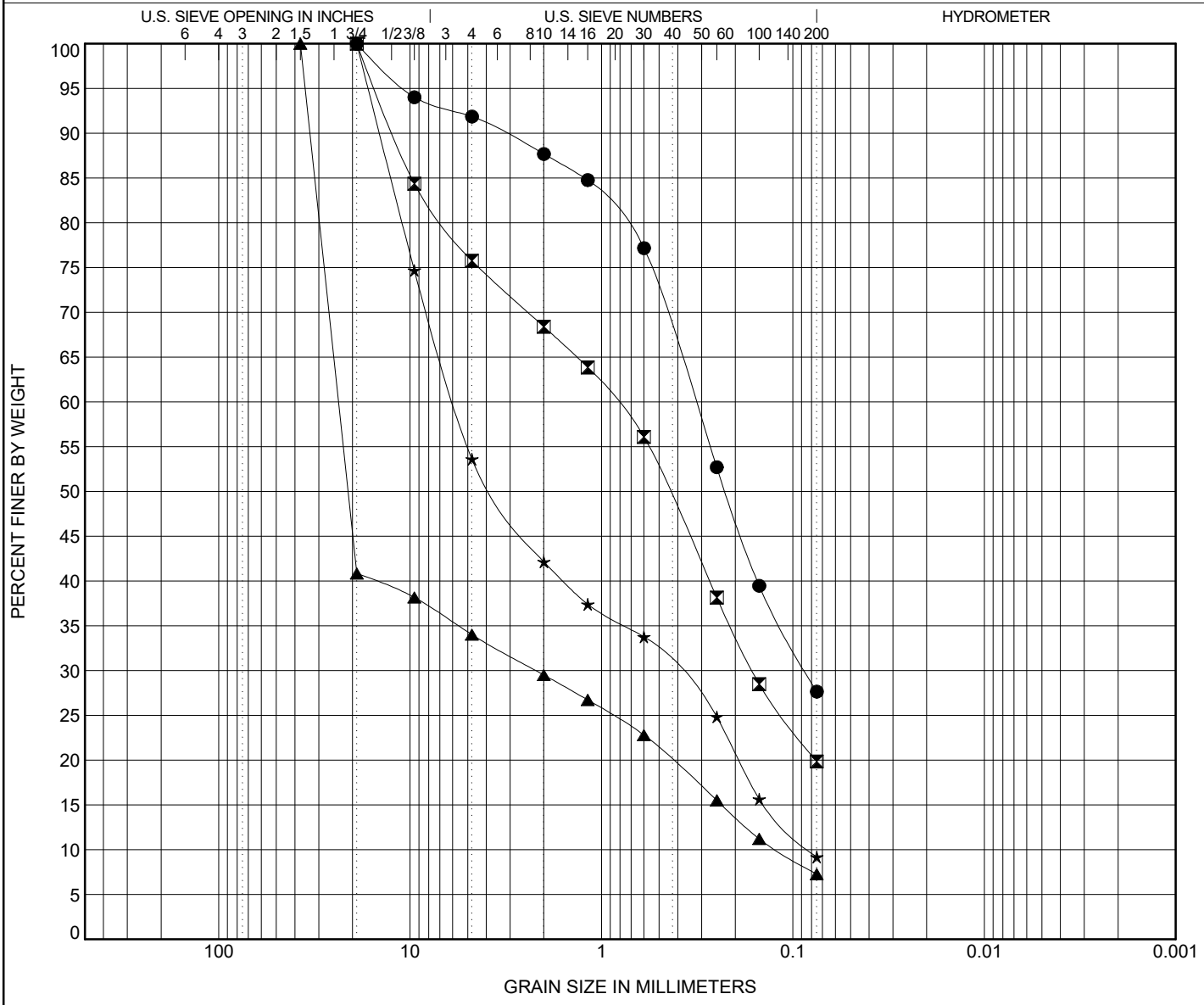
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-7975 **PROJECT NAME** Daffron Property



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	Cc	Cu
●	TP-05	3.50ft.	USDA: Gray Slightly Gravelly Sandy Loam. USCS: SM.		
⊠	TP-05	8.00ft.	USDA: Gray Gravelly Sandy Loam. USCS: SM with Gravel.		
▲	TP-06	6.00ft.	USDA: Tan Extremely Gravelly Sandy Loam. USCS: GW-GM with Sand.	1.68	195.19
★	TP-06	10.00ft.	USDA: Tan Very Gravelly Sandy Loam. USCS: GP-GM with Sand.	0.36	71.58

	Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	TP-05	3.5ft.	19	0.324	0.086					27.6	
⊠	TP-05	8.0ft.	19	0.843	0.163					19.9	
▲	TP-06	6.0ft.	37.5	23.681	2.199	0.121				7.3	
★	TP-06	10.0ft.	19	5.861	0.415	0.082				9.2	

GRAIN SIZE USDA ES-7975 DAFFRON PROPERTY.GPJ GINT US LAB.GDT 7/6/21

Report Distribution

ES-7975

EMAIL ONLY

Sea Pac Homes
120 Southwest Everett Mall Way, Suite 100
Everett, Washington 98204

Attention: Mr. Glen Belew

EMAIL ONLY

Perkl Properties, LLC
P.O. Pox 558
Lake Stevens, Washington 98258

Attention: Mr. Nate Perkl