Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services

UPDATED GEOTECHNICAL ENGINEERING STUDY
PROPOSED NORMANDY HEIGHTS
2007 SHAW ROAD
PUYALLUP, WASHINGTON

ES-0593

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PREPARED FOR

RM HOMES, LLC

November 9, 2006
Updated May 3, 2022

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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

November 9, 2006
Updated May 3, 2022
ES-0593

RM Homes, LLC
2913 – 5th Avenue Northeast, Suite 201
Puyallup, Washington 98372

Attention: Mr. James Kerby

Greetings, Mr. Kerby:

Earth Solutions NW, LLC (ESNW) is pleased to present this updated geotechnical engineering report in support of the proposed residential development. We understand the project is pursuing construction of a residential plat and associated infrastructure improvements. This updated report provides additional subsurface exploration and an updated site layout plan. From a geotechnical standpoint, development as currently proposed is feasible. Based on the conditions encountered during our subsurface exploration, the site is underlain medium dense to dense sand and silt deposits with variable fines contents.

In our opinion, the proposed residential structures can be constructed on conventional continuous and spread foundations bearing on competent native soil, recompacted native soil, or new structural fill placed directly on competent native soils. Native soils considered capable for support of the proposed residences are anticipated to be encountered beginning at depths of about two to four feet below existing grades. Where loose or otherwise unsuitable soil conditions are encountered at foundation subgrades, additional compaction efforts or overexcavation and restoration with structural fill will likely be necessary.

We understand the site is will pursue conventional detention designs as means of stormwater management. From a geotechnical standpoint, the use of infiltration on this site is not recommended given the variable soil conditions and existing slope features across the site.

We appreciate the opportunity to be of service to you on this project. If you have any questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Chase G. Halsen, L.G.
Senior Project Geologist

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INTRODUCTION

General

This geotechnical engineering study was updated for the proposed residential short plat to be constructed at 2007 Shaw Road East, in Puyallup, Washington. The purpose of this study was to provide geotechnical recommendations for the proposed development and included the following geotechnical services:

- Test pits to characterize site soil and groundwater conditions.
- Laboratory testing of representative soil samples collected at the test pit locations.
- Engineering analyses.
- Preparation of this geotechnical engineering study.

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

- Concept Site Plan II, undated.
- Puyallup Municipal Code, Chapter 21.06.
- PublicGIS application, maintained by Pierce County, Washington.
- Hazard Map GIS application, maintained by the City of Puyallup, Washington.
- Geologic Information Portal, maintained by Washington State Department of Natural Resources.
- Geologic Map of the Tacoma Quadrangle, prepared by J. Eric Schuster et al., November 2015.
- Surficial Geologic Map and Section of the Lake Tapps Quadrangle (Tapps), Washington, Crandell, 1963.
- Online Web Soil Survey (WSS) resource, maintained by the Natural Resources Conservation Service under the United States Department of Agriculture (USDA).

Project Description

We understand the project is pursuing construction of a residential plat consisting of 20 home building sites and associated infrastructure improvements. At the time of report submission, specific grading plans and building load plans were not available for review. Based on our experience with similar developments, the proposed residential structures will likely be two to three stories each and constructed using relatively lightly loaded wood framing supported on conventional foundations. Perimeter footing loads will likely be about 2 to 3 kips per lineal foot. Slab-on-grade loading is anticipated to be approximately 150 pounds per square foot (psf). We anticipate a combination of grade modifications (cuts or fills) of about 5 to 10 feet will likely be required to establish building pad and roadway elevations. Deeper excavations will likely be necessary to install utilities and construct the stormwater pond.

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

SITE CONDITIONS

Surface

The subject site is located at the northeast corner of the intersection between Shaw Road East and Crystal Ridge Drive, in Puyallup, Washington. The approximate site location is depicted on Plate 1 (Vicinity Map). The site area consists of Pierce County parcel number 042035-4039 totaling about 8.20 acres. Topography descends to the northwest with about 90 feet of elevation change occurring within the confines of the property. In general, site topography descends from the roadways and includes a vague bench area before descending to the east toward a natural drainage ravine and stream. The site is developed with a single-family residence and associated improvements within the northwestern site area and a gravel pad in the southwestern site area. Remaining portions of the site are surfaced with forested growth and/or brush and brambles.

Subsurface

An ESNW representative observed, logged, and sampled the excavation of eight test pits on October 23, 2006 and three borings near the proposed stormwater facility on February 8, 2022. Both explorations were completed with machinery and operators retained by our firm. The borings were installed to monitor groundwater conditions near the proposed stormwater facility under a separate project phase (ES-593.03). The approximate locations of the explorations are depicted on Plate 2 (Subsurface Exploration Plan). Representative soil samples collected at the test pit and boring locations were analyzed in general accordance with Unified Soil Classification System (USCS) and USDA methods and procedures.

The following sections provide a generalized characterization of the encountered subsurface conditions. Please refer to the test pit logs provided in Appendix A for a more detailed description of subsurface conditions.

Topsoil and Fill

Topsoil was encountered in the upper approximate 7 to 12 inches of existing grades at the test pit locations. The topsoil was characterized by a dark brown color, trace organic matter, and root inclusions. Fill was not encountered at the test pit locations but may be present in proximity existing site structures.

Native Soil

Underlying topsoil, native soils were characterized primarily as poorly graded sand with variable gravel and fines contents and poorly graded gravel with variable fines contents (USCS: SP, SP-SM, GP, and GP-GM) throughout out the majority of the site. At the boring locations completed near the proposed stormwater facility, silty sand (USCS: SM) and silt dominated soils (USCS: ML) were encountered. Native soils were encountered in a loose to medium dense and moist condition, extending to the terminus of each test pit location, and conditions ranged from loose to dense at the boring locations, which were advanced to a maximum depth of 21.5 feet below the ground surface (bgs).

Geologic Setting

The referenced geologic map identifies ice-contact deposits (Qgo$_i$) as underlying the site and surrounding areas. The outwash deposits described in the referenced geologic map are characterized as sand, gravel, silt and clay in a loose and well sorted condition. The referenced Tapps geologic map resource further refines this geologic setting as Lacustrine sand (Qil) and describes the Lacustrine sand as a somewhat chaotic or random assemblage of lacustrine sand and silt with abundant large boulders that do not correlate well with present topography. The referenced WSS resource identifies Indianola loamy sand (Map Unit Symbol: 18C) as underlying the site and surrounding areas. This soil series is associated with terrace, kames, and esker landforms and formed in sandy glacial outwash. Based on our field exploration, encountered native soils correlate with local geologic mapping designations of ice-contact deposits.

Groundwater

Groundwater was not encountered at the test pit locations during the October 2006 exploration. 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 elevations and flow rates are higher during the winter, spring, and early summer months.

To assist with stormwater management designs, targeted groundwater monitoring was performed from February 2022 through the end of April 2022. The monitoring was focused in the proposed stormwater tract and targeted to the proposed design elevation of the facility. Groundwater was not observed at any of the well locations over the course of the monitoring period. While there is a seasonal stream located at the base of the adjacent natural ravine slope, it does not appear that to be fed by a local groundwater regime associated with the site.

Critical Areas Review

Based on review of readily available topographic data, most of the site contains slopes with gradients less than 40 percent. However, isolated and discontinuous slopes of 40 percent or greater may be present. Further topographic evaluation and delineation of slopes is currently underway. Once the final topographic data is made available to ESNW, further discussion and evaluations of potential critical areas and mitigation recommendations will be provided.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our investigation, construction of the proposed residential plat is feasible from a geotechnical standpoint. The primary geotechnical considerations for the proposal are in reference to structural fill placement and compaction, foundation design, and stormwater management.

Site Preparation and Earthwork

Initial site preparation activities will consist of installing temporary erosion control measures, establishing grading limits, and site demolition and clearing activities. Subsequent earthwork activities will involve mass excavation, foundation subgrade preparation activities, and related infrastructure installations.

Temporary Erosion Control

The following temporary erosion and sediment control (TESC) Best Management Practices (BMPs) should be considered:

- Silt fencing should be placed around the site perimeter, where appropriate.

- Temporary construction entrances and drive lanes should be constructed with at least six inches of quarry spalls to minimize off-site soil tracking and provide a stable access entrance surface. A woven geotextile fabric may be placed underneath the quarry spalls to provide greater stability, if needed.

- When not in use, soil stockpiles should be covered or otherwise protected. Soil stockpiles should never be placed near the top of a slope.

- 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.

Additional TESC BMPs, as specified by the project design team and indicated on the plans, should be incorporated into construction activities. TESC measures must be actively monitored and modified during construction as site conditions require, as approved by the site erosion control Lead to ensure proper performance is maintained.

Excavations and Slopes

Based on the soil conditions observed at the test locations, the following allowable temporary slope inclinations, as a function of horizontal to vertical (H:V) inclination, may be used. The applicable Federal Occupation Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) soil classifications are also provided:

• Loose to medium dense soil	1.5H:1V (Type C)
• Areas exposing groundwater	1.5H:1V (Type C)
• Dense native soil	1H:1V (Type B)

Steeper temporary slope inclinations within undisturbed, very dense native soil may be feasible based on the soil and groundwater conditions exposed within the excavations. If pursued, ESNW can evaluate the feasibility of utilizing steeper temporary slopes on a case-by-case basis at the time of construction. In any case, an ESNW representative should observe temporary slopes to confirm inclinations are suitable for the exposed soil conditions and to provide additional excavation and slope stability recommendations, as necessary. If the recommended temporary slope inclinations cannot be achieved, temporary shoring may be necessary to support excavations. Permanent slopes should be graded to 2H:1V (or flatter) and planted with vegetation to enhance stability and minimize erosion potential. Permanent slopes should be observed by ESNW prior to vegetating and landscaping.

In-situ and Imported Soil

Based on the conditions observed during our subsurface exploration, site soils will exhibit a high sensitivity to moisture and are not suitable for use as structural fill unless the moisture content is at or slightly above optimum (determined using modified Proctor ASTM D-1557) prior to placement and compaction. Successful use of on-site soil as structural fill will largely be dictated by the moisture content at the time of placement and compaction. Depending on the time of year construction occurs, remedial measures (such as soil aeration) may be necessary as part of site grading and earthwork activities. If the on-site soil cannot be successfully compacted, the use of an imported soil may be necessary.

In our opinion, a contingency should be provided in the project budget for export of soil that cannot be successfully compacted as structural fill, particularly if grading activities take place during periods of extended rainfall activity. In general, soils with fines contents greater than 5 percent typically degrade rapidly when exposed to periods of rainfall.

Imported structural fill soil should consist of a well-graded, granular soil that can achieve a suitable working moisture content. 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).

Structural Fill

Structural fill is defined as compacted soil placed in slab-on-grade, roadway, permanent slope, retaining wall, and utility trench backfill areas. The following recommendations are provided for soils intended for use as structural fill:

• Moisture content	At or slightly above optimum
• Relative compaction (minimum)	95 percent (Modified Proctor)
• Loose lift thickness (maximum)	12 inches

The on-site soil may not be suitable for use as structural fill unless a suitable moisture content is achieved at the time of placement and compaction. If the on-site soil cannot achieve the above specifications, use of an imported structural fill material will likely be necessary. With respect to underground utility installations and backfill, local jurisdictions will likely dictate soil type(s) and compaction requirements.

Slope Fill

Structural fill within unregulated sloping areas on this site should be placed on a level bench as depicted on Plate 3 (Slope Fill Detail). Benches must be “keyed” into the slope, and subsequently filled and compacted with suitable structural fill before continuing to the next bench. Sloping finish grades should be “overbuilt” using a bench-style fill and cut to the design gradient to ensure a compacted slope face is maintained. ESNW should review the final grading plans to confirm the recommendations in this report have been incorporated. ESNW should observe structural fill placement to confirm subgrade conditions and provide additional drainage recommendations, as necessary.

Subgrade Preparation

Foundation and slab subgrade surfaces should consist of competent, undisturbed native soil or structural fill placed and compacted directly on a competent native soil subgrade. ESNW should observe subgrade areas prior to placing formwork. Supplementary recommendations for subgrade improvement may be provided at the time of construction; such recommendations would likely include further mechanical compaction effort or overexcavation and replacement with suitable structural fill. It is imperative that all foundation elements associated within previous site structures be removed and any resulting voids be filled in accordance with the *Structural Fill* section of this report.

Wet Season Grading

Earthwork activities that occur during wet weather conditions may require additional measures to protect structural subgrades and soils 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 elevations, covering working surfaces with crushed rock, protecting structural fill soils from adverse moisture conditions, and additional TESC recommendations. ESNW can also assist in obtaining a wet season grading permit or extension, where appropriate, if required by the presiding jurisdiction.

Foundations

Based on the conditions encountered during our fieldwork, in our opinion, the proposed residences can be constructed on conventional continuous and spread foundations bearing on competent native soil, recompacted native soil, or new structural fill placed directly on competent native soils. Native soils considered capable for support of the proposed residences are anticipated to be first encountered at depths of about two to four feet bgs. Where loose or otherwise unsuitable soil conditions are encountered at foundation subgrades, additional compaction efforts or overexcavation and restoration with structural fill will likely be necessary.

Provided the foundations will be supported as recommended, the following parameters may be used for foundation design:

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

* *Assumes sides of the foundation will be backfilled with compacted structural fill.*

A one-third increase in the allowable soil bearing capacity may 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. Most settlement should occur during construction when dead loads are applied.

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 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)	1.249
Mapped 1-second period spectral response acceleration, S_1 (g)	0.430
Short period site coefficient, F_a	1.001
Long period site coefficient, F_v	1.870†
Adjusted short period spectral response acceleration, S_{MS} (g)	1.249
Adjusted 1-second period spectral response acceleration, S_{M1} (g)	0.804†
Design short period spectral response acceleration, S_{DS} (g)	0.833
Design 1-second period spectral response acceleration, S_{D1} (g)	0.539†

* *Assumes dense native soil conditions, encountered to a maximum depth of 21.5 feet bgs during the February 2022 field exploration, remain at least medium dense to at least 100 feet bgs.*

† *Values assume F_v may be determined using linear interpolation per Table 11.4-2 in ASCE 7-16.*

As indicated in the table footnote, several of the seismic design values provided above are dependent on the assumption that site-specific ground motion analysis (per Section 11.4.8 of ASCE 7-16) will not be required for the subject project. ESNW recommends the validity of this assumption be confirmed at the earliest available opportunity during the planning and early design stages of the project. Further discussion between the project structural engineer, the project owner, 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 low. The depth of the regional groundwater table and the relatively medium dense characteristics of the native soil were the primary bases for this opinion.

Slab-on-Grade Floors

Slab-on-grade floors for the proposed structures should be supported on competent, well-compacted, firm, and unyielding subgrades. Unstable or yielding subgrade areas should be recompacted or overexcavated and replaced with suitable structural fill prior to slab construction.

A capillary break consisting of at least four inches of free-draining crushed rock or gravel should be placed below each slab. The free-draining material should have 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). In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. The vapor barrier should be a material specifically designed for use as a vapor barrier and should be installed in accordance with the specifications of the manufacturer.

Retaining Walls

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

• Active earth pressure (unrestrained condition)	35 pcf (equivalent fluid)
• At-rest earth pressure (restrained condition)	55 pcf
• Traffic surcharge* (passenger vehicles)	70 psf (rectangular distribution)
• Passive earth pressure	300 pcf (equivalent fluid)
• Allowable soil bearing capacity	2,500 psf
• Coefficient of friction	0.40
• Seismic surcharge	8H psf**

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

Additional surcharge loading from foundations, sloped backfill, or other loading should be included in the retaining wall design, as appropriate. 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, as appropriate. ESNW should review retaining wall designs to verify that appropriate earth pressure values have been incorporated into the design and to provide additional recommendations, as necessary.

Retaining walls should be backfilled with free-draining material that extends along the height of the wall and a distance of at least 12 inches behind the wall. The upper one foot of the wall backfill may consist of a less permeable (surface seal) soil, if desired. In lieu of free-draining backfill, use of an approved sheet drain material may also be considered, based on the observed subsurface and groundwater conditions. ESNW should review conditions at the time of construction and provide recommendations for sheet drain material, as appropriate. A perforated drainpipe should be placed along the base of the wall and connected to an appropriate discharge location. A typical retaining wall drainage detail is illustrated on Plate 4.

Drainage

Surface grades must be designed to direct water away from the buildings to the extent practical. The grade adjacent to the buildings should be sloped away at a gradient of at least 2 percent for a horizontal distance of at least 10 feet (or as building and property setbacks allow). In no instance should water be allowed to collect, pond, or flow uncontrolled above and over sloping areas.

Groundwater seepage zones may be encountered during construction, depending on the time of year grading operations take place. Temporary measures to control surface water runoff and groundwater seepage during construction would likely involve interceptor trenches and sumps. ESNW should be consulted during preliminary grading and excavation activities to identify areas of seepage and to provide recommendations to reduce the potential for seepage-related instability. In our opinion, foundation drains should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 5.

Preliminary Stormwater Management Considerations

We understand the project will utilize detention (stormwater pond or stormwater vault) within the north central site area. Preliminary designs suggest a bottom of facility elevation at about 290 feet. As such, minimal to no excavations would be required within the easternmost area of the facility footprint while excavations up to about 20 feet may be required within the central and western half of the facility footprint. From a geotechnical standpoint, construction of a pond or vault in the area is feasible. ESNW should have the opportunity to review grading plans and the site topographic survey once they become available to provide additional recommendations relating to stormwater facility designs.

Given the exposed in-situ conditions, the project must be prepared to install a liner if a stormwater pond will be constructed. The pond liner should consist of a placed and compacted till or clay liner, or geomembrane, in accordance with the governing jurisdictional requirements. ESNW can assist in further evaluating appropriate liner material and construction methods, as requested. Pond berm walls must be placed and compacted to the specifications provided in the *Structural Fill* section of this report. It is possible that onsite soils will not meet the gradation and permeability requirements to use as berm fill. As such, a contingency should be added to the project budge in the case imported material is required for such use. Given the current positioning of the proposed stormwater facility in relation to existing site slope, global slope stability analysis should be considered once grading plans and the site topographic survey has been completed.

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 proofrolling 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 subgrade areas may still exist after base grading activities. Areas containing unsuitable or yielding subgrade conditions will require remedial measures, such as overexcavation and replacement with crushed rock or structural fill, prior to pavement. If roadway areas will be designed with an inverted crown, additional drainage measures may be recommended at the time of construction to help maintain subgrade stability and pavement performance.

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).

- 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 areas may be considered:

- Three inches of HMA placed over six inches of CRB.

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

The HMA, ATB, and CRB materials should conform to the specifications of the governing jurisdiction. All soil base material should be compacted to at least 95 percent of the maximum dry density. Final pavement design recommendations can be provided once final traffic loading has been determined. Governing jurisdictional standards may supersede the recommendations provided in this report.

Utility Support and Trench Backfill

In our opinion, native soils will generally be competent for support of utilities. In general, native soils may be suitable for use as structural backfill throughout utility trench excavations, provided the soils are at (or slightly above) the optimum moisture content at the time of placement and compaction. Structural trench backfill should not be placed dry of the optimum moisture content. Each section of the site utility lines must be adequately supported in appropriate bedding material. Utility trench backfill should be placed and compacted to the specifications of structural fill (as previously detailed in this report) or to the applicable specifications of the presiding jurisdiction.

LIMITATIONS

This study has been prepared for the exclusive use of RM Homes, LLC and its representatives. No warranty, express or implied, is made. 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. Variations in the soil and groundwater conditions observed at the test pit locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided 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:
Pierce 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.

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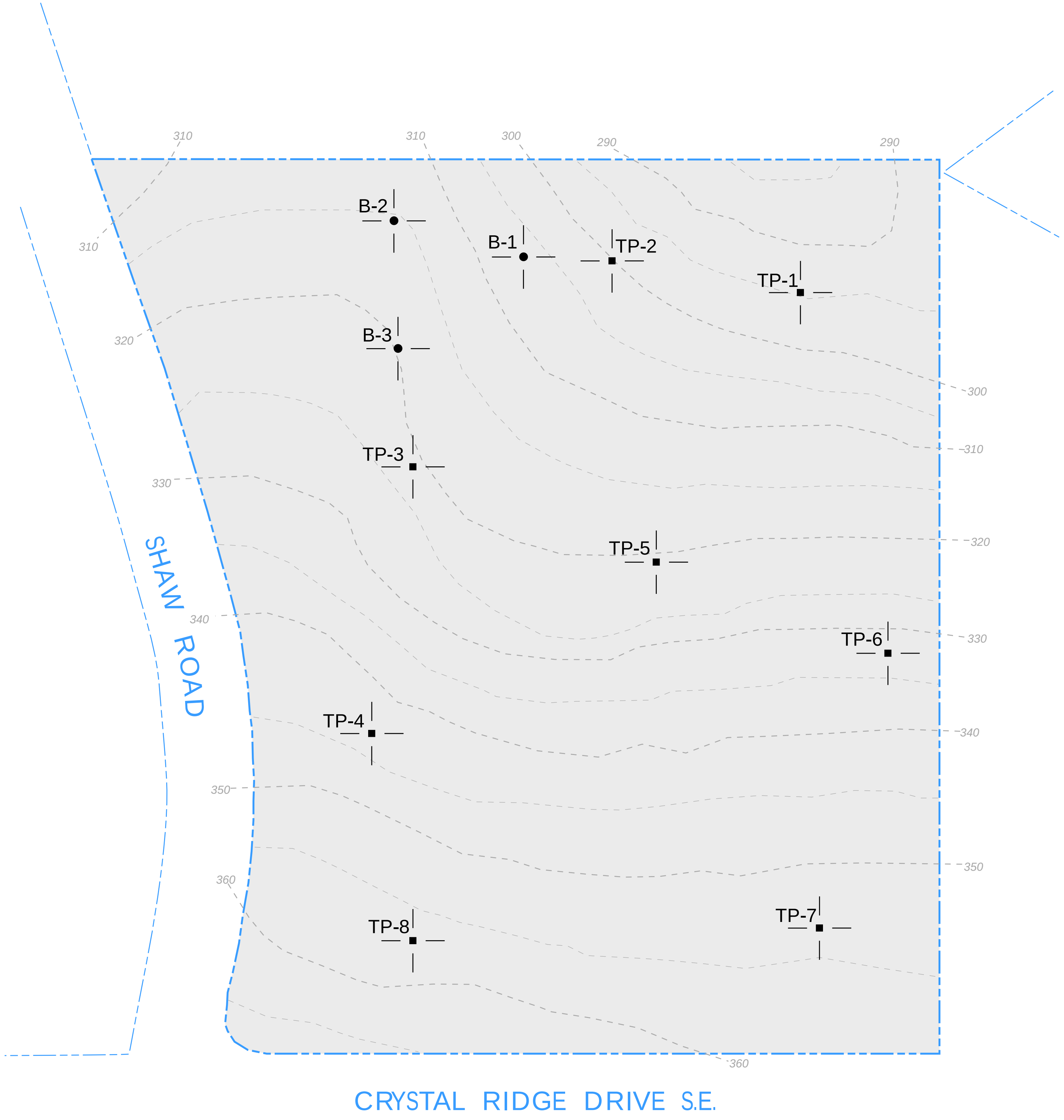
Earth Solutions NWLLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

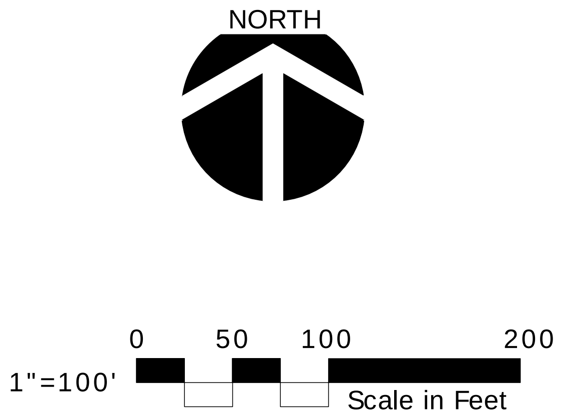
Vicinity Map
Normandy Heights
Puyallup, Washington

Drwn. MRS	Date 05/02/2022	Proj. No. 0593
Checked CGH	Date May 2022	Plate 1



LEGEND

B-1 ●	Approximate Location of ESNW Boring, Proj. No. ES-0593.03, Feb. 2022
TP-1 ■	Approximate Location of ESNW Test Pit, Proj. No. ES-0593, Oct. 2006
▨	Subject Site



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.

Subsurface Exploration Plan
Normandy Heights
Puyallup, Washington

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

Drwn. By
MRS

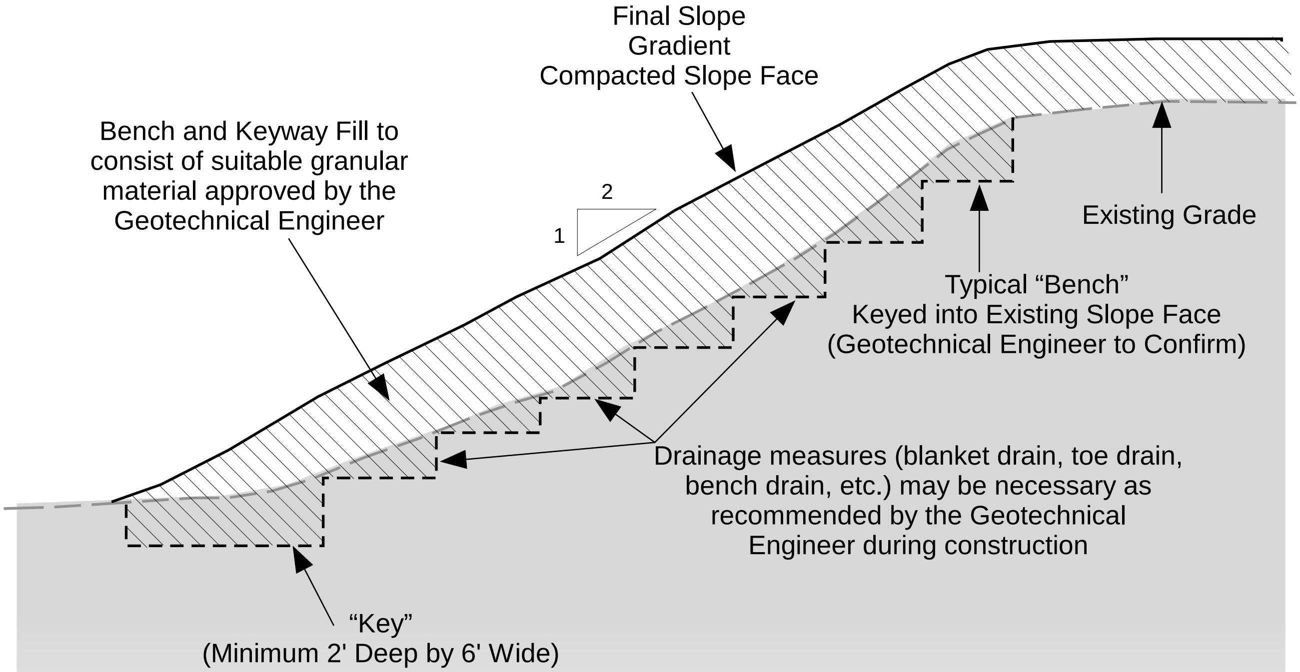
Checked By
CGH

Date
05/02/2022

Proj. No.
0593

Plate
2

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING



NOTES:

- Slope should be stripped of topsoil and unsuitable materials prior to excavating Keyway or benches.
- Benches will typically be equal to a bulldozer blade width of approximately 8 feet but shall be at least 4 feet.
- Final slope gradient should be 2H : 1V.
- Final slope face should be densified by over-building with compacted fill and trimming back to shape or by compaction with a bulldozer or vibratory drum roller.
- Planting or hydroseeding slope face with a rapid growth deep-rooted vegetative mat will reduce erosion potential of slope area.
- Use of pegged-in-place jute matting or geotechnical fabric will help maintain the seed and mulch in place until the root system has an opportunity to germinate.
- Structural fill should be placed in thin loose lifts not exceeding 12 inches in thickness. Each lift should be compacted to no less than the degree specified in the “Site Preparation and Earthwork” section of this report. No additional lift should be placed until compaction is achieved.

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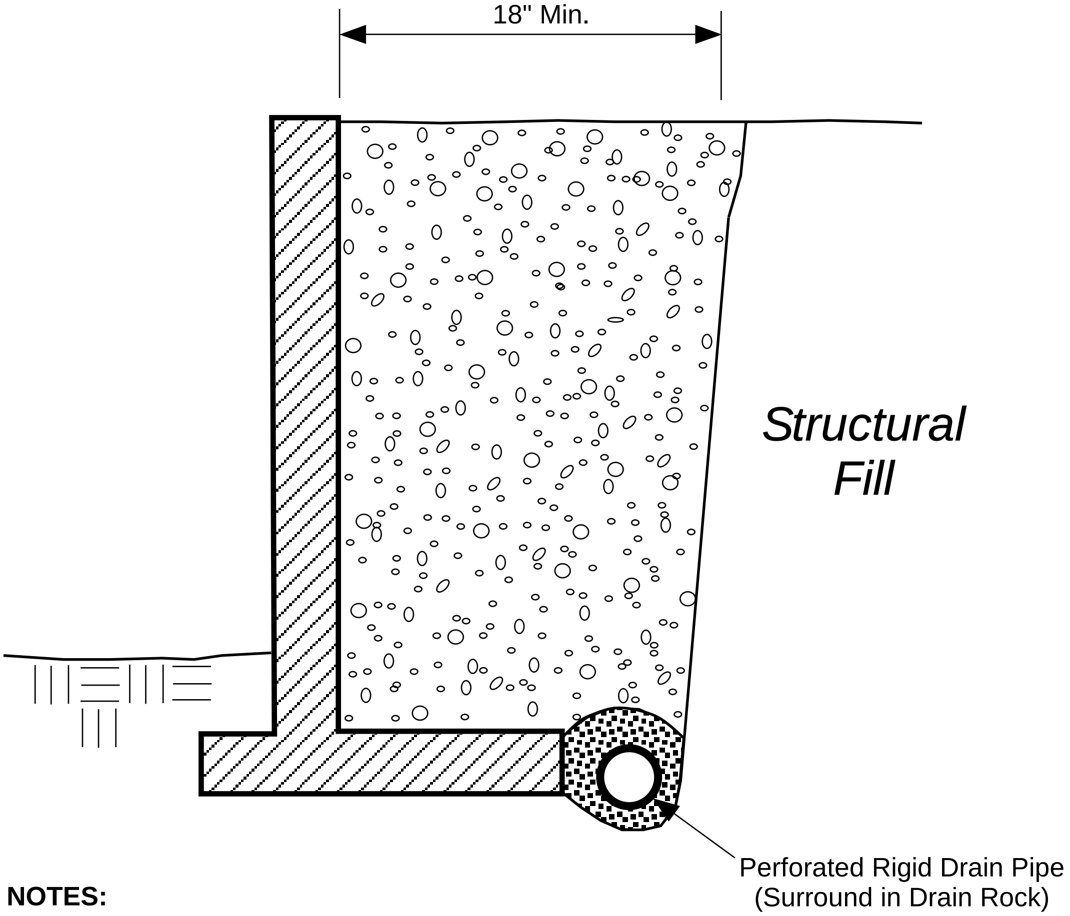
Slope Fill Detail
Normandy Heights
Puyallup, Washington

Drwn. MRS	Date 05/02/2022	Proj. No. 0593
Checked SSR	Date May 2022	Plate 3



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

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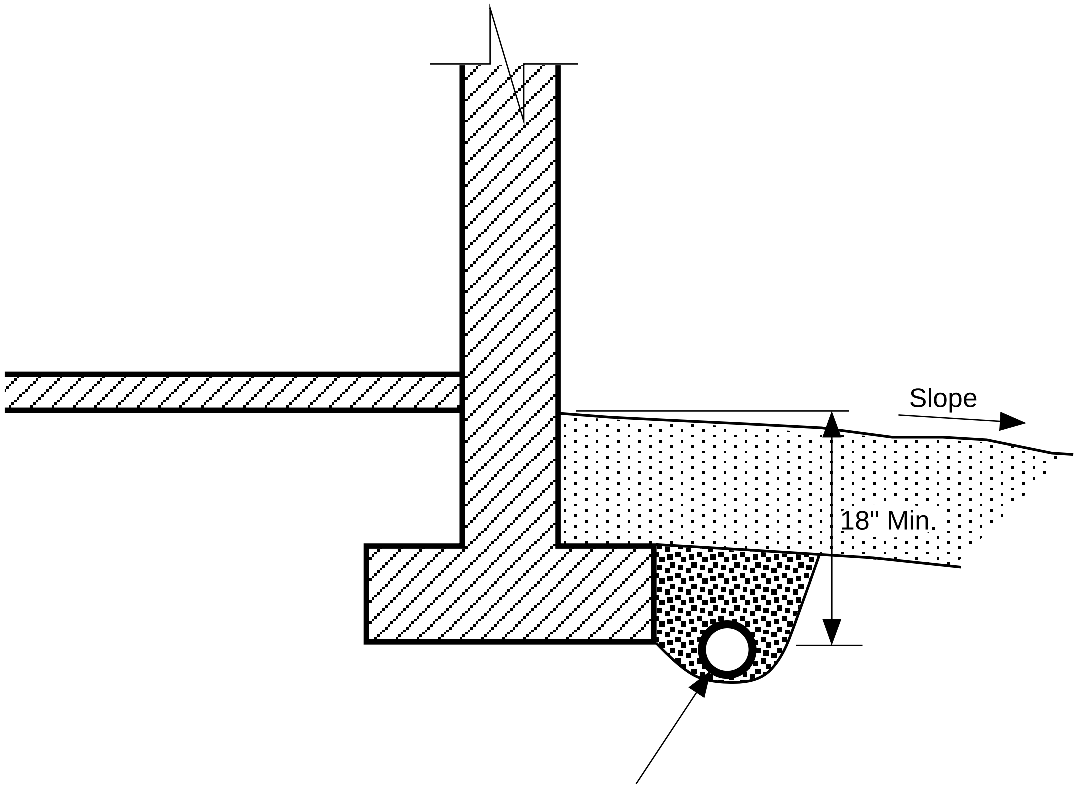
Retaining Wall Drainage Detail
Normandy Heights
Puyallup, Washington

Drwn. MRS	Date 05/02/2022	Proj. No. 0593
Checked SSR	Date May 2022	Plate 4



Perforated Rigid Drain Pipe
(Surround in Drain Rock)

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

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Footing Drain Detail
Normandy Heights
Puyallup, Washington

Drwn. MRS	Date 05/02/2022	Proj. No. 0593
Checked SSR	Date May 2022	Plate 5

Appendix A

Subsurface Exploration
Boring and Test Pit Logs

ES-0593

An ESNW representative observed, logged, and sampled eight test pits on October 23, 2006 and three borings on February 8, 2022. The explorations were completed in accessible site areas using exploratory equipment and operators retained by our firm. The test pits were excavated to a maximum exploration depth of about 17 feet bgs and the borings were advanced to a maximum depth of about 21.5 feet bgs. The approximate locations of the test pits and borings are depicted on Plate 2 (Subsurface Exploration Plan). The test pit and boring logs are provided in this Appendix.

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.

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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.

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BORING NUMBER B-1

PROJECT NUMBER ES-0593.03
PROJECT NAME Normandy Heights
DATE STARTED 2/8/22 **COMPLETED** 2/8/22
GROUND ELEVATION
DRILLING CONTRACTOR Boretec1, Inc.
LATITUDE 47.17139 **LONGITUDE** -122.25172
DRILLING METHOD HSA
GROUND WATER LEVEL:
LOGGED BY CGH **CHECKED BY** SSR
∇ **AT TIME OF DRILLING**
NOTES Surface Conditions: drill-pad

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					SM	▩	Brown silty SAND, loose, moist (Drill Pad Fill)
2.5	SS	67	1-3-5 (8)	MC = 30.5%		▩	
3.5					ML	‖	Brown SILT, loose, moist
5.0	SS	67	2-4-5 (9)	MC = 30.7% Fines = 85.5%		‖	-trace iron oxide staining [USDA Classification: LOAM]
7.5	SS	100	5-6-7 (13)	MC = 30.0%		‖	-becomes medium dense, wet -~3" sand lens
10.0	SS	67	6-8-11 (19)	MC = 12.0%	SP-SM	⁘	Gray poorly graded SAND with silt, medium dense, moist
12.5						⁘	
15.0							

(Continued Next Page)

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BORING NUMBER B-1

PROJECT NUMBER ES-0593.03

PROJECT NAME Normandy Heights

DATE STARTED 2/8/22 **COMPLETED** 2/8/22

GROUND ELEVATION

DRILLING CONTRACTOR Boretec1, Inc.

LATITUDE 47.17139 **LONGITUDE** -122.25172

DRILLING METHOD HSA

GROUND WATER LEVEL:

▽ **AT TIME OF DRILLING**

LOGGED BY CGH **CHECKED BY** SSR

NOTES Surface Conditions: drill-pad

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
15.0							
	☒ SS	67	8-8-12 (20)	MC = 21.8% Fines = 51.7%	ML		Gray sandy SILT, medium dense, moist [USDA Classification: LOAM]
16.5							Boring terminated at 16.5 feet below existing grade. No groundwater encountered during drilling. 2" PVC standpipe installed to bottom of boring. Lower 10.0 feet slotted. Well ID: B95510. Boring backfilled with sand/bentonite.

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BORING NUMBER B-2

PAGE 1 OF 2

PROJECT NUMBER ES-0593.03

PROJECT NAME Normandy Heights

DATE STARTED 2/8/22 **COMPLETED** 2/8/22

GROUND ELEVATION

DRILLING CONTRACTOR Boretec1, Inc.

LATITUDE 47.17148 **LONGITUDE** -122.25214

DRILLING METHOD HSA

GROUND WATER LEVEL:

LOGGED BY CGH **CHECKED BY** SSR

∇ **AT TIME OF DRILLING**

NOTES Surface Conditions: cleared brush

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0							Brown SILT, loose, moist
2.5							
5.0	☒ SS	100	1-3-4 (7)	MC = 28.5%			-becomes moist to wet
7.5					ML		
10.0	☒ SS	100	1-3-4 (7)	MC = 33.4% Fines = 90.6%			-very minor perched groundwater seepage -zones of heavy iron oxide staining [USDA Classification: slightly gravelly LOAM]
12.5							
15.0							

(Continued Next Page)

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BORING NUMBER B-2

PROJECT NUMBER ES-0593.03

PROJECT NAME Normandy Heights

DATE STARTED 2/8/22 **COMPLETED** 2/8/22

GROUND ELEVATION

DRILLING CONTRACTOR Boretec1, Inc.

LATITUDE 47.17148 **LONGITUDE** -122.25214

DRILLING METHOD HSA

GROUND WATER LEVEL:

LOGGED BY CGH **CHECKED BY** SSR

∇ **AT TIME OF DRILLING**

NOTES Surface Conditions: cleared brush

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
15.0	SS	100	3-5-7 (12)	MC = 29.5%	ML		Brown SILT, loose, moist *(continued)* -becomes medium dense, wet -minor perched groundwater seepage
17.5							
20.0	SS	67	8-12-15 (27)	MC = 3.7% Fines = 5.4%	SP-SM	20.0	Gray poorly graded SAND, medium dense, moist [USDA Classification: slightly gravelly SAND]
						21.5	Boring terminated at 21.5 feet below existing grade. Groundwater seepage encountered at 10.0 and 15.0 feet during drilling. 2" PVC standpipe installed to bottom of boring. Lower 10.0 feet slotted. Well ID: BM5511. Boring backfilled with sand/bentonite.

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BORING NUMBER B-3

PAGE 1 OF 2

PROJECT NUMBER ES-0593.03

PROJECT NAME Normandy Heights

DATE STARTED 2/8/22 **COMPLETED** 2/8/22

GROUND ELEVATION

DRILLING CONTRACTOR Boretec1, Inc.

LATITUDE 47.17121 **LONGITUDE** -122.25216

DRILLING METHOD HSA

GROUND WATER LEVEL:

LOGGED BY CGH **CHECKED BY** SSR

∇ **AT TIME OF DRILLING**

NOTES Surface Conditions: brush

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0							Brown silty SAND, loose, moist
2.5					SM		
5.0							5.0
	SS	100	4-5-6 (11)	MC = 5.0%			Gray poorly graded SAND, medium dense, moist
7.5					SP		
10.0							10.0
	SS	100	4-6-8 (14)	MC = 11.1% Fines = 15.4%			Gray silty SAND, medium dense, moist [USDA Classification: loamy fine SAND]
12.5					SM		
15.0							15.0

(Continued Next Page)

BORING NUMBER B-3

PAGE 2 OF 2

PROJECT NUMBER ES-0593.03

PROJECT NAME Normandy Heights

DATE STARTED 2/8/22 **COMPLETED** 2/8/22

GROUND ELEVATION

DRILLING CONTRACTOR Boretec1, Inc.

LATITUDE 47.17121 **LONGITUDE** -122.25216

DRILLING METHOD HSA

GROUND WATER LEVEL:

LOGGED BY CGH **CHECKED BY** SSR

∇ **AT TIME OF DRILLING**

NOTES Surface Conditions: brush

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
15.0	SS	67	6-9-10 (19)	MC = 12.0%	SP-SM		Gray poorly graded SAND with silt and gravel, medium dense, moist
17.5							
20.0	SS	67	18-30-11 (41)	MC = 4.1%			-becomes dense
						21.5	

Boring terminated at 21.5 feet below existing grade. No groundwater encountered during drilling. 2" PVC standpipe installed to bottom of boring. Lower 10.0 feet slotted. Well ID: BM5512. Boring backfilled with sand/bentonite.

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TEST PIT NUMBER TP-1

PAGE 1 OF 2

PROJECT NUMBER 0593
PROJECT NAME Normandy Heights
DATE STARTED 10/23/06 **COMPLETED** 10/23/06
GROUND ELEVATION 295 ft
EXCAVATION CONTRACTOR Aikins Excavating
LATITUDE **LONGITUDE**
EXCAVATION METHOD
GROUND WATER LEVEL:
LOGGED BY WLR **CHECKED BY** WLR
∇ **AT TIME OF EXCAVATION**
NOTES Depth of Topsoil & Sod 12": forest duff

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0		MC = 2.5% MC = 2.0%	GP-GM		Light brown to brown poorly graded GRAVEL with sand, loose to medium dense, moist
9.0		MC = 3.9% Fines = 1.5%	SP		286.0 Brown poorly graded SAND with gravel;, medium dense, moist
14.0			GP		281.0 Brown poorly graded GRAVEL with sand, medium dense, moist

Depth scale: 0.0, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0

(Continued Next Page)

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TEST PIT NUMBER TP-1

PROJECT NUMBER 0593

PROJECT NAME Normandy Heights

DATE STARTED 10/23/06 **COMPLETED** 10/23/06

GROUND ELEVATION 295 ft

EXCAVATION CONTRACTOR Aikins Excavating

LATITUDE **LONGITUDE**

EXCAVATION METHOD

GROUND WATER LEVEL:

LOGGED BY WLR **CHECKED BY** WLR

▽ **AT TIME OF EXCAVATION**

NOTES Depth of Topsoil & Sod 12": forest duff

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
15.0		MC = 2.6%	GP		Brown poorly graded GRAVEL with sand, medium dense, moist *(continued)*
		MC = 2.9% Fines = 1.3%		17.0	278.0

Test pit terminated at 17.0 feet below existing grade. No groundwater encountered during excavation.

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TEST PIT NUMBER TP-2

PAGE 1 OF 1

PROJECT NUMBER 0593
PROJECT NAME Normandy Heights
DATE STARTED 10/23/06 **COMPLETED** 10/23/06
GROUND ELEVATION 300 ft
EXCAVATION CONTRACTOR Aikins Excavating
LATITUDE **LONGITUDE**
EXCAVATION METHOD
GROUND WATER LEVEL:
LOGGED BY WLR **CHECKED BY** WLR
▽ **AT TIME OF EXCAVATION**
NOTES Depth of Topsoil & Sod 8": forest duff

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					Light brown silty SAND, medium dense, moist
			SM		
		MC = 6.9%			
2.5					
					3.0 297.0
					Brown poorly graded SAND with silt, medium dense, moist
		MC = 4.8%			
5.0					
			SP-SM		
7.5					
		MC = 4.8% Fines = 6.1%			
10.0					
		MC = 2.8% Fines = 2.2%			11.0 289.0
					Gray poorly graded GRAVEL with sand, medium dense, moist
			GP		
12.5					
					13.0 287.0
					Gray silty SAND, medium dense, moist
			SM		
15.0		MC = 9.3% Fines = 34.8%			15.0 285.0

Test pit terminated at 15.0 feet below existing grade. No groundwater encountered during excavation.

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TEST PIT NUMBER TP-3

PAGE 1 OF 1

PROJECT NUMBER 0593
PROJECT NAME Normandy Heights
DATE STARTED 10/23/06 **COMPLETED** 10/23/06
GROUND ELEVATION 320 ft
EXCAVATION CONTRACTOR Aikins Excavating
LATITUDE **LONGITUDE**
EXCAVATION METHOD
GROUND WATER LEVEL:
LOGGED BY WLR **CHECKED BY** WLR
∇ **AT TIME OF EXCAVATION**
NOTES Depth of Topsoil & Sod 7"

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					Light brown to gray poorly graded SAND, medium dense, moist
2.5					
		MC = 2.7% Fines = 2.2%			
5.0			SP		
		MC = 4.8%			
7.5					
10.0		MC = 6.3%			10.0 310.0
					Test pit terminated at 10.0 feet below existing grade. No groundwater encountered during excavation.

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TEST PIT NUMBER TP-4

PAGE 1 OF 1

PROJECT NUMBER 0593

PROJECT NAME Normandy Heights

DATE STARTED 10/23/06 **COMPLETED** 10/23/06

GROUND ELEVATION 345 ft

EXCAVATION CONTRACTOR Aikins Excavating

LATITUDE **LONGITUDE**

EXCAVATION METHOD

GROUND WATER LEVEL:

LOGGED BY WLR **CHECKED BY** WLR

∇ **AT TIME OF EXCAVATION**

NOTES Depth of Topsoil & Sod 8"

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					Gray poorly graded SAND with gravel, medium dense, moist
		MC = 2.4%			
2.5					
		MC = 2.9% Fines = 1.6%			
5.0			SP		
7.5					
		MC = 2.5%			
10.0		MC = 3.7%			10.0 335.0
					Test pit terminated at 10.0 feet below existing grade. No groundwater encountered during excavation.

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TEST PIT NUMBER TP-5

PAGE 1 OF 1

PROJECT NUMBER 0593

PROJECT NAME Normandy Heights

DATE STARTED 10/23/06 **COMPLETED** 10/23/06

GROUND ELEVATION 320 ft

EXCAVATION CONTRACTOR Aikins Excavating

LATITUDE **LONGITUDE**

EXCAVATION METHOD

GROUND WATER LEVEL:

LOGGED BY WLR **CHECKED BY** WLR

∇ **AT TIME OF EXCAVATION**

NOTES Depth of Topsoil & Sod 10"

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0			SP		Light brown poorly graded SAND with silt, loose to medium dense, moist
		MC = 4.6%			
2.5					
		MC = 4.7%			
5.0					
6.0			GP		314.0
					Gray poorly graded GRAVEL with sand, medium dense, moist
		MC = 3.0%			
7.5					
10.0		MC = 6.0%			310.0
					Test pit terminated at 10.0 feet below existing grade. No groundwater encountered during excavation.

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TEST PIT NUMBER TP-6

PAGE 1 OF 1

PROJECT NUMBER 0593

PROJECT NAME Normandy Heights

DATE STARTED 10/23/06 **COMPLETED** 10/23/06

GROUND ELEVATION 335 ft

EXCAVATION CONTRACTOR Aikins Excavating

LATITUDE ______ **LONGITUDE** ______

EXCAVATION METHOD ______

GROUND WATER LEVEL:

LOGGED BY WLR **CHECKED BY** WLR

∇ **AT TIME OF EXCAVATION** ______

NOTES Depth of Topsoil & Sod 12"

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0		MC = 1.7%	GP		Gray poorly graded GRAVEL with sand, medium dense, moist
2.0					333.0
2.5		MC = 3.1% Fines = 0.8%	SP		Brown poorly graded SAND with gravel, medium dense, moist
5.0					
7.5		MC = 2.4%			
10.0		MC = 2.3%			325.0
					Test pit terminated at 10.0 feet below existing grade. No groundwater encountered during excavation.

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TEST PIT NUMBER TP-7

PAGE 1 OF 1

PROJECT NUMBER 0593
PROJECT NAME Normandy Heights
DATE STARTED 10/23/06 **COMPLETED** 10/23/06
GROUND ELEVATION 350 ft
EXCAVATION CONTRACTOR Aikins Excavating
LATITUDE ______ **LONGITUDE** ______
EXCAVATION METHOD ______
GROUND WATER LEVEL:
LOGGED BY WLR **CHECKED BY** WLR
∇ **AT TIME OF EXCAVATION** ______
NOTES Depth of Topsoil & Sod 6"

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		
0.0 2.5		MC = 2.0%	GP		Light brown to gray poorly graded GRAVEL with sand, loose to medium dense, moist	3.0	347.0
		MC = 3.6% Fines = 1.0%	SP		Gray poorly graded SAND, medium dense, moist	5.0	345.0
5.0		MC = 2.9%	GP		Gray poorly graded GRAVEL with sand, medium dense, moist	7.0	343.0
7.5		MC = 6.2%	SP		Gray poorly graded SAND with gravel, medium dense, moist	8.0	342.0

Test pit terminated at 8.0 feet below existing grade. No groundwater encountered during excavation.

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TEST PIT NUMBER TP-8

PAGE 1 OF 1

PROJECT NUMBER 0593
PROJECT NAME Normandy Heights
DATE STARTED 10/23/06 **COMPLETED** 10/23/06
GROUND ELEVATION 355 ft
EXCAVATION CONTRACTOR Aikins Excavating
LATITUDE **LONGITUDE**
EXCAVATION METHOD
GROUND WATER LEVEL:
LOGGED BY WLR **CHECKED BY** WLR
▽ **AT TIME OF EXCAVATION**
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0		MC = 8.1% MC = 6.1%	SP-SM		Light brown to gray poorly graded SAND with silt, medium dense, moist	
4.0		MC = 5.1% Fines = 1.6%	SP		Gray poorly graded SAND, medium dense, moist	351.0
12.0		MC = 4.7%			Test pit terminated at 12.0 feet below existing grade. No groundwater encountered during excavation.	343.0

Depth scale: 0.0, 2.5, 5.0, 7.5, 10.0

Appendix B

Laboratory Test Results

ES-0593

Earth Solutions NW, LLC
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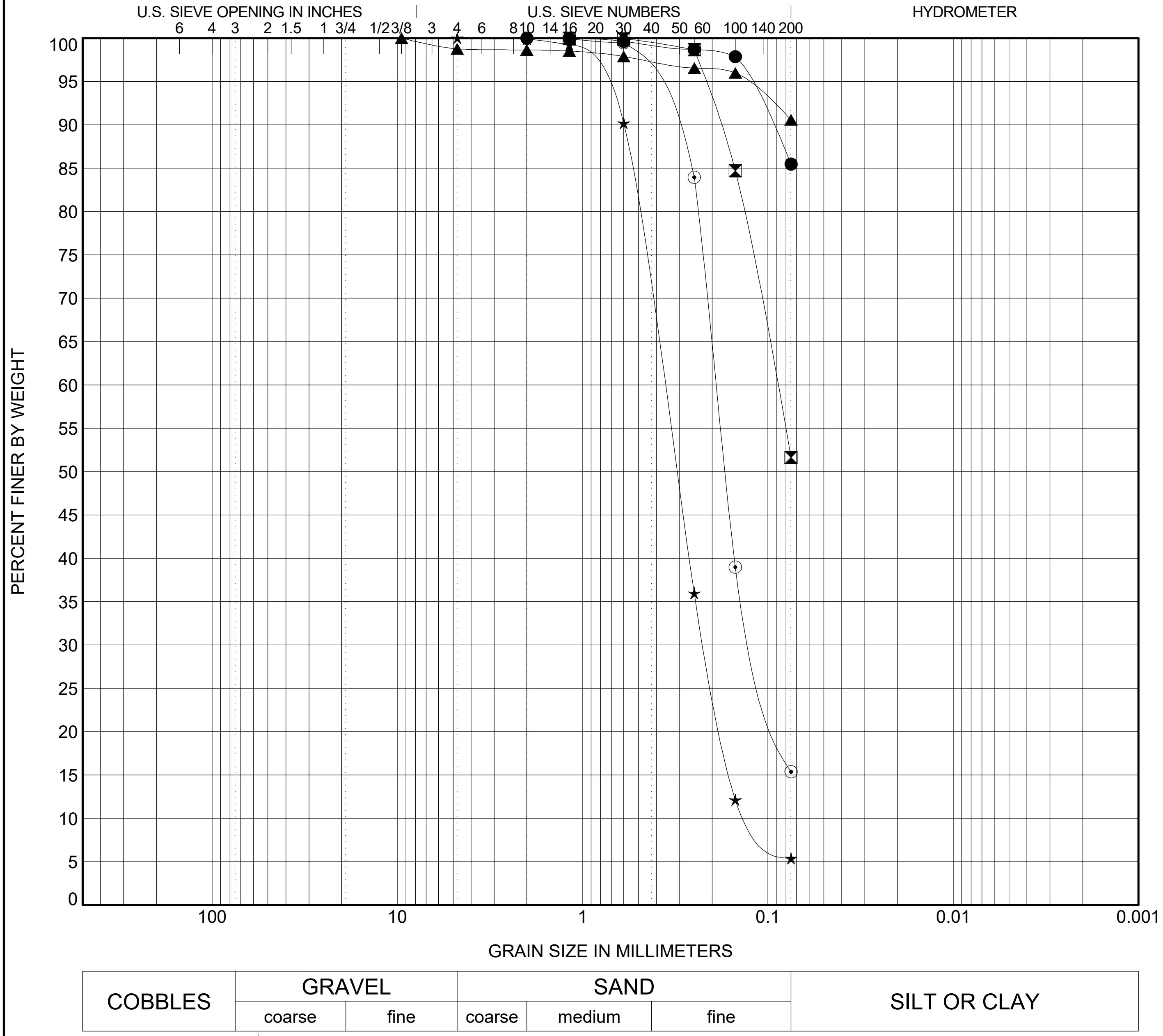
GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-0593.03 **PROJECT NAME** Normandy Heights



Specimen Identification			Classification	Cc	Cu
●	B-01	5.00ft.	USDA: Brown Loam. USCS: ML.		
⧗	B-01	15.00ft.	USDA: Gray Loam. USCS: Sandy ML.		
▲	B-02	10.00ft.	USDA: Brown Slightly Gravelly Loam. USCS: ML.		
★	B-02	20.00ft.	USDA: Gray Slightly Gravelly Sand. USCS: SP-SM.	1.09	3.06
☉	B-03	10.00ft.	USDA: Gray Loamy Fine Sand. USCS: SM.		

Specimen Identification			D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	B-01	5.0ft.	2							85.5	
⧗	B-01	15.0ft.	1.18	0.089						51.7	
▲	B-02	10.0ft.	9.5							90.6	
★	B-02	20.0ft.	4.75	0.368	0.22	0.12				5.4	
☉	B-03	10.0ft.	2	0.19	0.115					15.4	

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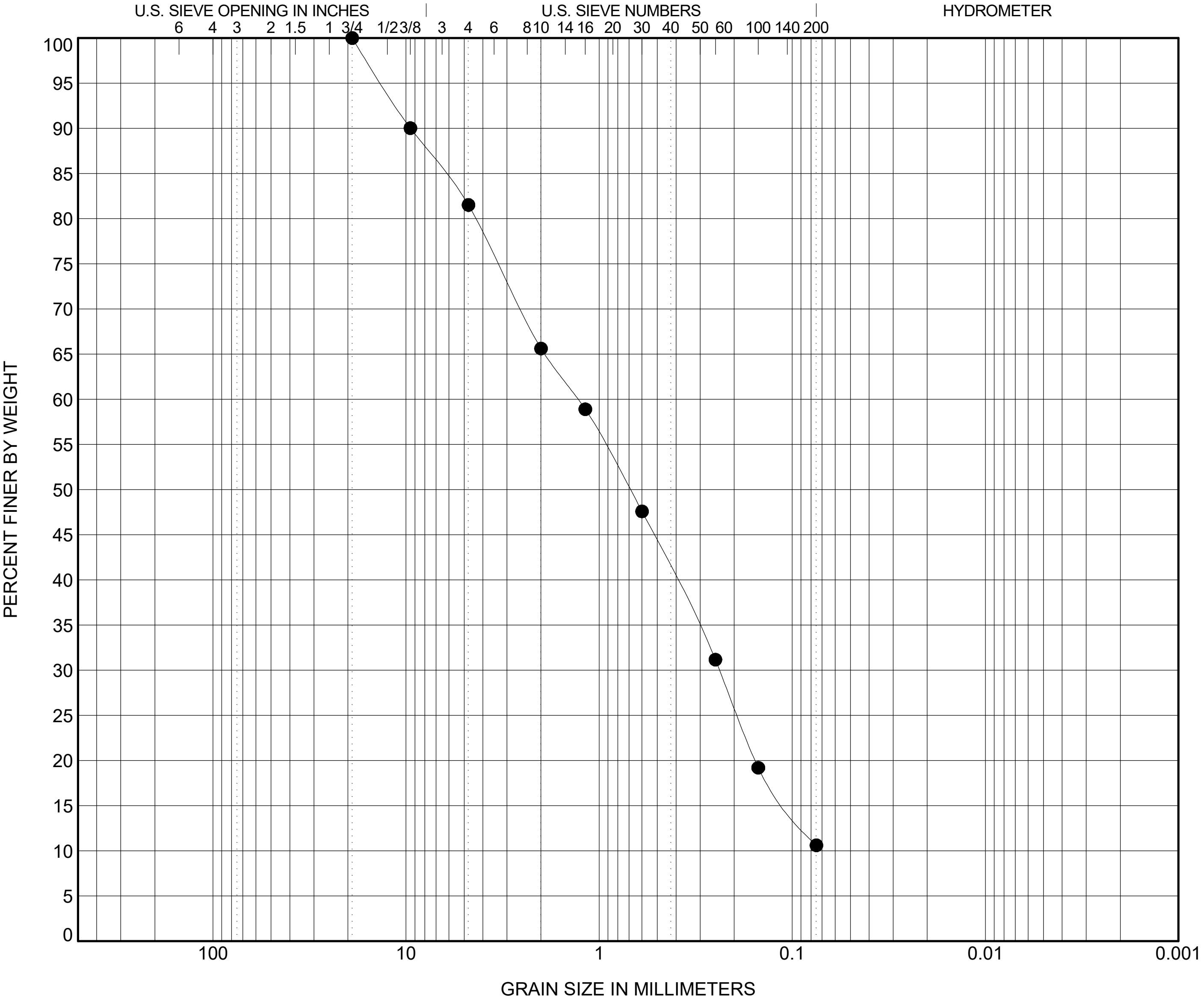
GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-0593.03 **PROJECT NAME** Normandy Heights



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	Cc	Cu
●	B-03	20.00ft.	USDA: Gray Gravelly Loamy Coarse Sand. USCS: SP-SM with Gravel.	0.62	18.02

Specimen Identification			D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	B-03	20.0ft.	19	1.286	0.238					10.6	

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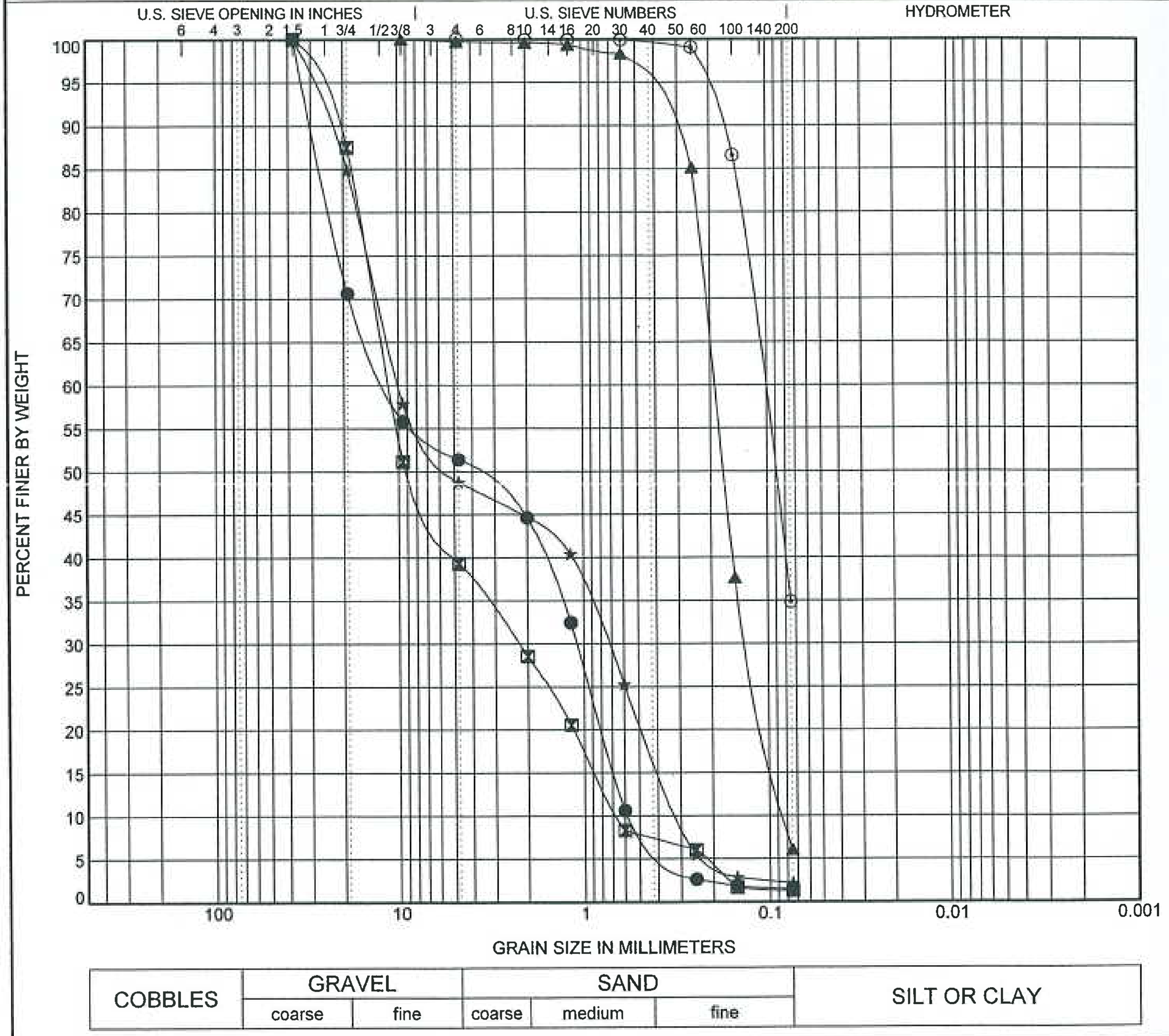
GRAIN SIZE DISTRIBUTION

CLIENT Trinity Land Development

PROJECT NAME Normandy Heights

PROJECT NUMBER ES-593

PROJECT LOCATION Puyallup



	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	TP-01	10.0ft.	USDA: Brown very gravelly coarse sand, USCS: SP				0.18	20.63
☒	TP-01	17.0ft.	USDA: Light brown extremely gravelly coarse sand, USCS: GP				0.68	17.06
▲	TP-02	8.0ft.	USDA: Light brown fine sand, USCS: SP-SM				1.03	2.33
★	TP-02	11.0ft.	USDA: Gray very gravelly coarse sand, USCS: GP				0.18	32.81
⊙	TP-02	15.0ft.	USDA: Gray fine sandy loam, USCS: SM					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-01	10.0ft.	37.5	11.554	1.093	0.56	48.6	49.9	1.5	
☒	TP-01	17.0ft.	37.5	11.246	2.248	0.659	60.7	38.1	1.3	
▲	TP-02	8.0ft.	9.5	0.191	0.127	0.082	0.3	93.7	6.1	
★	TP-02	11.0ft.	37.5	10.02	0.741	0.305	51.2	46.6	2.2	
⊙	TP-02	15.0ft.	4.75	0.105			0.0	65.2	34.8	

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GRAIN SIZE DISTRIBUTION

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PROJECT NAME Normandy Heights

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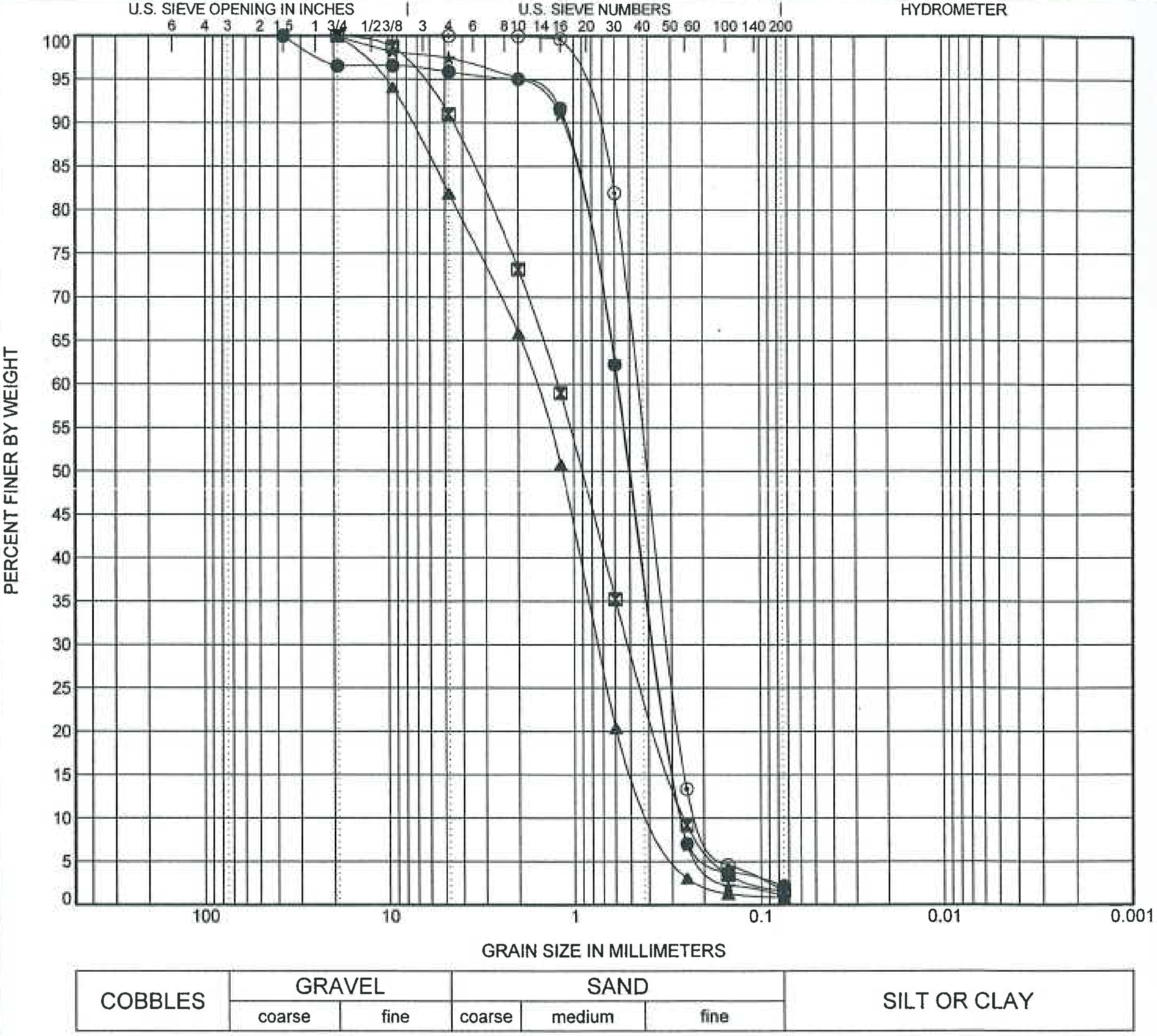
PROJECT LOCATION Puyallup



Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	**TP-03**	**3.0ft.**	**USDA: Light brown sand, USCS: SP**				**0.85**	**2.21**
☒	**TP-04**	**4.0ft.**	**USDA: Brown gravelly coarse sand, USCS: SP**				**0.80**	**4.77**
▲	**TP-06**	**4.0ft.**	**USDA: Light brown gravelly coarse sand, USCS: SP**				**0.95**	**4.59**
★	**TP-07**	**4.0ft.**	**USDA: Brown sand, USCS: SP**				**0.85**	**2.19**
⊙	**TP-08**	**8.0ft.**	**USDA: Gray sand, USCS: SP**				**1.03**	**2.21**

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP-03**	**3.0ft.**	**37.5**	**0.579**	**0.36**	**0.262**	**4.1**	**93.7**	**2.2**	
☒	**TP-04**	**4.0ft.**	**19**	**1.226**	**0.503**	**0.257**	**9.0**	**89.4**	**1.6**	
▲	**TP-06**	**4.0ft.**	**19**	**1.631**	**0.743**	**0.355**	**18.1**	**81.1**	**0.8**	
★	**TP-07**	**4.0ft.**	**19**	**0.575**	**0.359**	**0.263**	**2.6**	**96.4**	**1.0**	
⊙	**TP-08**	**8.0ft.**	**4.75**	**0.453**	**0.309**	**0.205**	**0.0**	**98.4**	**1.6**	

Report Distribution

ES-0593

<u>EMAIL ONLY</u>

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