**PREPARED FOR**

**PDC SEATTLE LPIV BB/TH, LLC**

**June 3, 2022**



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# GEOTECHNICAL ENGINEERING STUDY
# PORT 17
# 273 MAURIN ROAD
# LEWIS COUNTY (CHEHALIS), WASHINGTON

**ES-8489**

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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

June 3, 2022
ES-8489

PDC Seattle LPIV BB/TH, LLC
1821 Dock Street, Suite 100
Tacoma, Washington 98042

Attention: Mr. Darren Peugh

Greetings, Mr. Peugh:

Earth Solutions NW, LLC (ESNW) is pleased to present this geotechnical report to support the proposed project. Based on the results of our investigation, the construction of the proposed industrial structure is feasible from a geotechnical standpoint. Our study indicates the site is underlain by shallow fill that overlies native silty sand and silt with variable fines percentages. Localized variations with respect to soil gradation (such as increased gravel and clay percentages) were observed; however, silty sand and silt are considered the primary underlying native soils. Groundwater seepage was observed at each exploration location, ranging in exposure depths from near surface to about nine-and-one-half feet below the ground surface. Seepage rates were field characterized as being minor to heavy.

Based on our findings, the proposed industrial structure may be constructed on conventional continuous and spread footing foundations bearing upon competent native soil, recompacted native soil, or new structural fill placed directly on competent native soil. Native soil conditions considered suitable for support of the proposed structures will likely be encountered beginning at a depth of about three to five feet below existing grades. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soil to the specifications of structural fill or overexcavation and replacement with suitable structural fill will be necessary.

The existing site fill encountered to depths of about two-and-one-half to three feet is not considered suitable for direct foundation support and should be removed from these areas before foundation preparation activities. However, utilization of these soils as general fill within roadway and dock-high fill areas may be feasible, provided it can meet the specifications outlined for such use in this report. ESNW should observe and evaluate these soils before such use during site grading activities.

From a geotechnical standpoint, infiltration is considered infeasible given the fine-grained nature of the predominant underlying soil types. Furthermore, the exposure of various groundwater seepage zones throughout the test pit locations indicates that the native site soils are hydraulically restrictive. In our opinion, other means of stormwater management should be pursued for this project.

Pertinent geotechnical recommendations are provided in this study. 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 (study) was prepared for the proposed industrial facility development to be constructed at 273 Maurin Road, in the Chehalis area of unincorporated Lewis County, Washington. This study was prepared to provide geotechnical recommendations for currently proposed development plans and included the following geotechnical services:

- Test pits and cone penetration tests to characterize soil and groundwater conditions.
- Laboratory testing of representative soil samples collected at the test pit locations.
- Geotechnical engineering analyses.

The following documents and maps were reviewed as part of our study preparation:

- Proposed Site Plan – Option 2, prepared by Synthesis, PLLC, dated February 8, 2022.
- Online Web Soil Survey (WSS) resource, maintained by the Natural Resources Conservation Service under the United States Department of Agriculture (USDA).
- Geologic Map of the Centralia Quadrangle, Lewis County, Washington, prepared by Andrew J Sadowski, et al., November 2018.
- GIS Map, maintained by Lewis County, Washington.

## Project Description

Currently referred to as Port 17, the subject project is proposing the construction of an industrial facility (single structure totaling about 427,100 square feet) and associated site improvements. We anticipate the structure will have a clear height of 32 feet and be of concrete tilt-up construction. Site ingress and egress will be provided from Maurin Road. We presume stormwater management will be provided either through the existing pond located in the northwest site area or through a new facility that utilizes conventional detention/retention designs.

At the time of report submission, specific building load plans were not available for review; however, we expect perimeter footing loads to be about 5 to 7 kips per lineal foot with column loads of about 80 to 120 kips. Slab-on-grade loading is anticipated to be approximately 350 pounds per square foot (psf). Following removal activities of surface gravels and existing fill soil, we anticipate grade cuts and fills of about five feet or less will be necessary to achieve design elevations.

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 the final designs to confirm that appropriate geotechnical recommendations have been incorporated into the plans.

## SITE CONDITIONS

### Surface

The subject site is located along the north side of Maurin Road, about 250 feet east of the intersection with McBride Court, in the Chehalis area of unincorporated Lewis County, Washington. The approximate site location is depicted on Plate 1 (Vicinity Map). The irregular-shaped property consists of adjoining Lewis County parcel nos. 017744004001, 017746004003, and 017746004002. Although the total property area encompasses a larger amount of land, only about 17 acres are being pursued for development. Site topography appears to be relatively level with about five feet of elevation change occurring across the development envelope. A review of historical aerial photography suggests the site was previously developed with a single-family residence which was located near the northern property line. The remaining site areas appear to have consisted of grass pasture lands. Between 2016 and 2019, the residence was demolished, the stormwater management pond was constructed, and gravel was placed across the majority of the proposed building area.

### Subsurface

An ESNW representative observed, logged, and sampled the excavation of seven test pits within readily accessible areas of the proposed development envelope, on April 21, 2022. The test pits ranged in depths from about 10 to 11 feet below the existing ground surface (bgs) and were excavated using a trackhoe and operator retained by our firm. The approximate locations of the test pits are depicted on Plate 2 (Subsurface Exploration Plan). In addition to the test pit exploration, one Cone Penetration Test (CPT) was advanced to a depth of about 10.5 feet, below the ground surface (bgs) where refusal was encountered. Please refer to the test pit logs and CPT charts provided in Appendix A for a more detailed description of the encountered subsurface conditions. Representative soil samples collected at the test pit locations were analyzed following both the Unified Soil Classification System (USCS) and USDA methods and procedures.

**Topsoil and Fill**

Topsoil was not encountered at the test pit locations during the April 2022 exploration. Fill was observed at each test pit location and is characterized as the following:

- Imported Rock: The upper approximate one-half to one foot of existing grades generally consisted of clean washed rock. Based on a review of readily available aerial photography, the rock was placed between 2016 and 2019.

- Mineralogical Soil Fill: Underlying the rock, silty sand and silt of varying fines percentages was observed at each test pit location, extending to depths of about two-and-one-half to three feet bgs. The fill was observed in a loose to medium dense and moist condition. The encountered mineralogical soil was characterized as fill due to the observed color variations and presence of localized organics.

**Native Soil and Geologic Setting**

Underlying fill, native soils were primarily encountered as silty sand and silt with varying fines percentages (USCS: SM and ML, respectively) and are considered representative of older alluvial deposits (Qoa) which have been mapped in the area. Localized variations, such as increased gravel percentages (USCS: GM) and clay percentages (USCS: CH) were also observed; however, silty sand and silt-dominated soils should be considered the primary underlying soil unit type. The referenced WSS resource indicates the site is underlain by Lacamas silt loam and Reed silty clay (Map Unit Symbols: 118 and 172, respectively). Both the Lacamas and Reed soil series are associated with floodplain and terrace landforms.

**Groundwater**

Perched groundwater seepage was encountered at each test pit location during the April 2022 exploration, generally at an exposure depth between about one-half to nine-and-one-half feet bgs. The exposed groundwater flows were characterized as minor to heavy. Groundwater elevations can fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater elevations are higher during the winter, spring, and early summer months.

**<u>Review of Potential Geologically Hazards Areas</u>**

A review of applicable codes indicates that Lewis County recognizes hazards relating to erosion, steep slope/landslides, seismic activity, volcanic activity, mine activity, channel migration, and alluvial fans as potential geologically hazardous areas. Based on our review of the Lewis County Code, the referenced GIS map application, and the observed field/soil conditions, it is our opinion that the site does not contain any of the aforementioned geologically hazardous areas recognized by Lewis County.

## DISCUSSION AND RECOMMENDATIONS

### General

Based on the results of our investigation, the construction of the proposed industrial structures is feasible from a geotechnical standpoint. The primary geotechnical considerations for the proposed development are in reference to structural fill placement and compaction, foundation design, and site earthwork operations.

### Site Preparation and Earthwork

Initial site preparation activities will consist of installing temporary erosion control measures, establishing grading limits, and site clearing and removal activities. Subsequent earthwork activities will involve mass site grading and installation of infrastructure and stormwater management improvements.

#### Temporary Erosion Control

The following temporary erosion and sediment control Best Management Practices (TESC BMPs) are offered:

- Temporary construction entrances and drive lanes should be constructed with at least six inches of quarry spalls to both minimize off-site soil tracking and provide a stable access entrance surface. A woven geotextile fabric can be placed beneath the quarry spalls to provide greater stability if needed.
- Silt fencing should be placed around the site perimeter.
- When not in use, soil stockpiles should be covered or otherwise protected.
- Temporary measures for controlling surface water runoff, such as interceptor trenches, sumps, or interceptor swales, should be installed before beginning earthwork activities.
- Dry soils disturbed during construction should be wetted to reduce dust.
- When appropriate, permanent planting or hydroseeding will help to stabilize site soils.

Additional TESC BMPs, as specified by the project civil engineer on the plans, should be incorporated into construction activities. TESC measures will require upkeep and potential modification during construction to ensure proper function; such upkeep should be coordinated with the site erosion control lead, where applicable.

#### Stripping

Topsoil was not encountered at the test pit explorations. Where encountered, organic-rich topsoil should be stripped and segregated into a stockpile for later use on site or to be exported.

**Excavations and Slopes**

Based on the soil conditions observed at the test pit 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 seepage 1.5H:1V (Type C)

In our opinion, the majority of the site area is considered to be underlying by Type C soils given the prevailing presence of groundwater seepage. Steeper temporary slope inclinations within undisturbed, very dense native soil may be feasible based on the soil and groundwater conditions exposed within the excavations. ESNW should evaluate the feasibility of utilizing steeper temporary slopes 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 before vegetation and landscaping.

**In-situ and Imported Soil**

Successful use of the on-site soil as structural fill will largely be dictated by the moisture content at the time of placement and compaction. Based on the conditions observed during the subsurface exploration, the native soils are considered to possess an extreme moisture sensitivity. 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 imported soil may be necessary. In our opinion, a contingency should be provided in the project budget for the 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 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).

**Wet Weather Grading**

In our opinion, native site soils will degrade very rapidly, become unsuitable for use as structural fill, and/or loose in-situ competency when exposed to rainfall. If grading will take place during the wet season, the use of imported structural fill must be expected for fill operations. Means of protecting design subgrades will also be crucial in maintaining soil stability and competency. If areas are left unprotected, overexcavation and restoration may be required.

**Subgrade Preparation**

Foundation and slab subgrade surfaces should consist of competent, undisturbed native soil or structural fill placed and compacted atop competent native soil. ESNW should observe subgrade areas before 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.

**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. 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 (per ASTM D1557)
- Loose lift thickness (maximum) — 12 inches

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

Native site soils are considered to possess an extreme moisture sensitivity and may require conditioning (aeration or addition of water) if pursued for use as structural fill. The use of a sheep-foot roller may also be prudent in achieving adequate compaction of these soils during grading operations given the high fines percentages of the native soils.

## Foundations

In our opinion, the proposed industrial structure may be constructed on conventional continuous and spread footing foundations bearing upon competent native soil, recompacted native soil, or new structural fill placed directly on competent native soil. Competent native soil suitable for support of foundations will likely be encountered beginning at a depth of about three to five feet bgs. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soil to the specifications of structural fill or overexcavation and replacement with suitable structural. The existing site fill encountered to depths of about two-and-one-half to three feet is not considered suitable for direct foundation support and should be removed from these areas before foundation preparation activities.

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

- Allowable soil bearing capacity — 3,000 psf
- Passive earth pressure — 300 pcf (equivalent fluid)
- Coefficient of friction — 0.40

The above passive pressure and friction values include a factor-of-safety (FOS) of 1.5. A one-third increase in the allowable soil bearing capacity may be assumed for short-term wind and seismic loading conditions. With structural loading as expected, total settlement in the range of one inch and differential settlement of about one-half inch is anticipated over one typical column spacing, about 50 feet. Most settlements should occur during construction when dead loads are applied.

A review of the referenced GIS map application indicates the site is within an area considered to possess a very low susceptibility to liquefaction. Based on the observed soil and groundwater conditions, it is our opinion that liquefaction susceptibility may be considered low. However, given the depositional setting of the site, there is the potential for some settlement to occur from a large seismic event. In our opinion, total settlement of about two inches and a differential settlement of about one inch over a typical column spacing may be experienced during a large seismic event.

Given the site areas and size of the structures, there may be some variation with respect to exposed native soils across the building pad areas (before placement of dock-high fill). As such, ESNW should be present during mass grading operations to evaluate the exposed native soil surface and provide additional recommendations for maintaining soil stability.

**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*) | 1.148 |
| Mapped 1-second period spectral response acceleration, $S_1$ (*g*) | 0.473 |
| Short period site coefficient, $F_a$ | 1.041 |
| Long-period site coefficient, $F_v$ | 1.827† |
| Adjusted short-period spectral response acceleration, $S_{MS}$ (*g*) | 1.195 |
| Adjusted 1-second period spectral response acceleration, $S_{M1}$ (*g*) | 0.864† |
| Design short-period spectral response acceleration, $S_{DS}$ (*g*) | 0.797 |
| Design 1-second period spectral response acceleration, $S_{D1}$ (*g*) | 0.576† |

* *Assumes dense native soil conditions, encountered to a maximum depth of 11 feet bgs during the April 2022 field exploration, remain 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 on 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. However, minor resulting settlements from a seismic event may occur. In our opinion, such total settlements of about two inches and differential settlements of about one inch could be experienced during a seismic event.

**Slab-on-Grade Floors**

Slab-on-grade floors for the proposed residential structures should be supported by competent, firm, and unyielding subgrades. Unstable or yielding subgrade areas should be recompacted or overexcavated and replaced with suitable structural fill before 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. Vapor barriers should be made from material specifically designed for use as a vapor barrier and should be installed by the manufacturer's recommendations.

**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)
- Coefficient of friction — 0.40
- Seismic surcharge — 8H psf**

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

The above passive pressure and friction values include a FOS of 1.5 and are based on a level backfill condition and level grade at the wall toe. Revised design values will be necessary if sloping grades are to be used above or below retaining walls. Additional surcharge loading from adjacent foundations, sloped backfill, or other relevant loads should be included in the retaining wall design.

Retaining walls should be backfilled with free-draining material that extends along with 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 less permeable soil if desired. A sheet drain may be considered instead of free-draining backfill. 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. If drainage is not provided, hydrostatic pressures should be included in the wall design.

## Drainage

Zones of perched groundwater seepage could develop in site excavations depending on the time of year grading operations take place, particularly within deeper excavations for utilities and stormwater facilities. 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 both 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, foundation drains should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4.

### Infiltration Feasibility

From a geotechnical standpoint, infiltration is considered infeasible for the project. The site is predominately underling by silty sand and silt-dominated soils which possess relatively high fines percentages. Furthermore, the prevalence of perched groundwater across the site at various elevations indicates the native soils are hydraulically restrictive. On this basis, other means of stormwater management should be pursued.

## 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 detailed in the *Site Preparation and Earthwork* section of this report. Soft, wet, or otherwise unsuitable subgrade areas may still exist after base grading activities. Areas of unsuitable or yielding subgrade conditions may require remedial measures, such as overexcavation and replacement with structural fill or thicker crushed rock sections, before paving.

For relatively high volume, heavily loaded pavements subjected to moderate to high, loaded truck traffic, the following sections can be considered for preliminary design:

- Four inches of asphalt concrete (AC) placed over six inches of crushed rock base (CRB), or;
- Four inches of AC placed over four and one-half inches of asphalt-treated base (ATB).

For relatively high volume, heavily loaded pavements subjected to occasional truck traffic, the following sections can be considered for preliminary design:

- Three inches of AC placed over six inches of crushed rock base CRB, or;
- Three inches of AC placed over four and one-half inches of ATB.

For relatively lightly loaded pavements subjected mainly to automobiles, the following sections can be considered for preliminary design:

- Two inches of AC placed over four inches of CRB, or;
- Two inches of AC placed over three inches of ATB.

The AC, CRB, and ATB materials should conform to WSDOT specifications.

Concrete aprons and pavements areas can use a six-inch fiber-reinforced section supported on at least six inches of gravel base.

An ESNW representative should be requested to observe subgrade conditions before placement of CRB or ATB. As necessary, supplemental recommendations for achieving subgrade stability and drainage can be provided. If the 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 where fine-grained soils are exposed at pavement subgrade elevations.

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.

**Utility Support and Trench Backfill**

In our opinion, the native soil will generally be suitable for support of utilities. Remedial measures may be necessary for some areas to provide support for utilities, such as overexcavation and replacement with structural fill and/or placement of geotextile fabric. Groundwater seepage will likely be encountered within utility excavations, and caving of trench walls may occur where groundwater is encountered. Depending on the time of year and conditions encountered, dewatering or temporary trench shoring may be necessary during utility excavation and installation.

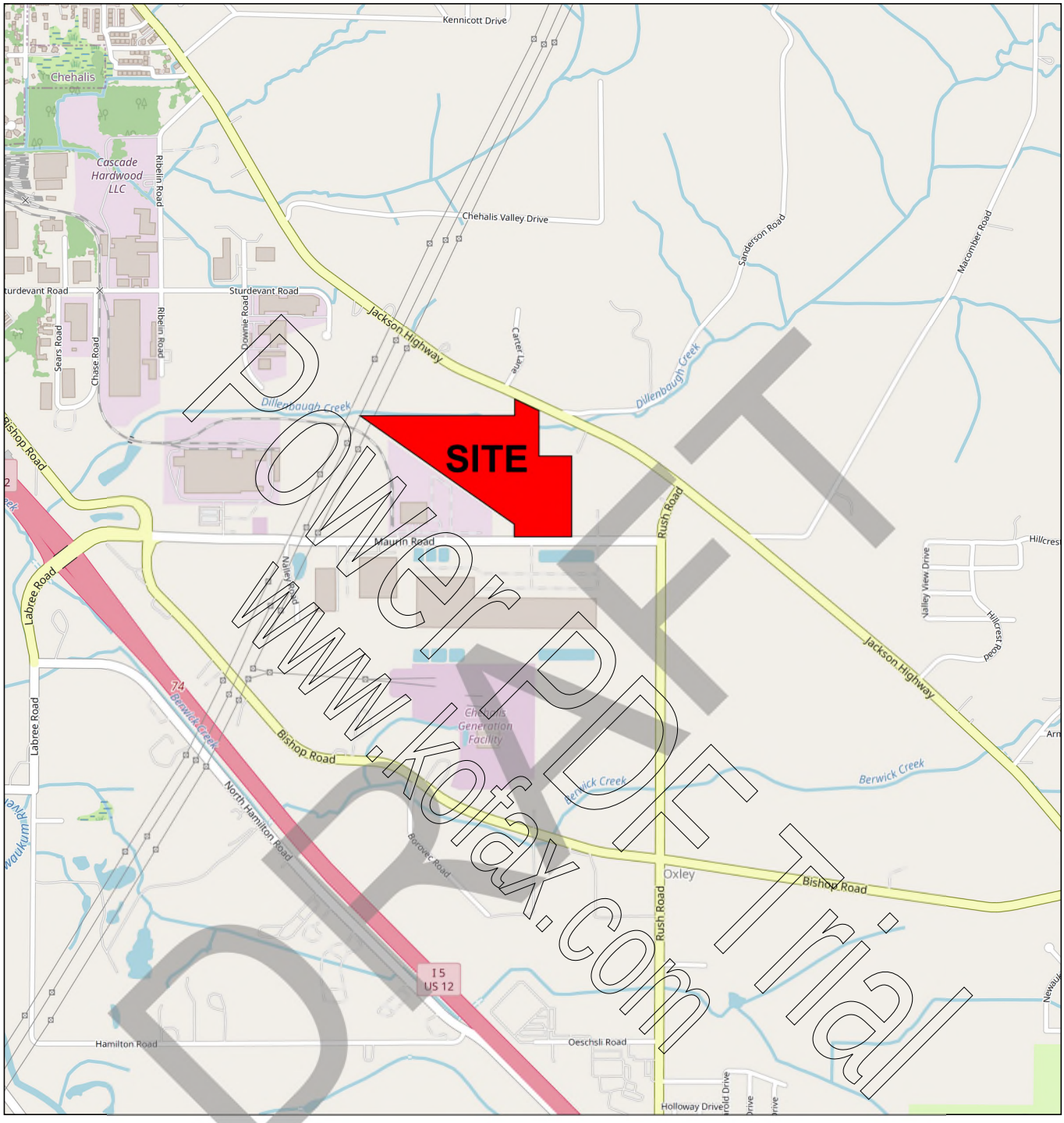
The on-site soil is not considered suitable for use as structural backfill throughout the utility trench excavations unless the soil is at (or slightly above) the optimum moisture content at the time of placement and compaction. Moisture conditioning of the soil may be necessary at some locations before use as structural fill. Each section of the utility lines must be adequately supported by the bedding material. Utility trench backfill should be placed and compacted to the structural fill specifications 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 PDC Seattle LPIV BB/TH, LLC, and its representatives. 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. No warranty, express or implied, is made. Variations in the soil and groundwater conditions observed at the test locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided in this study if variations are encountered.

### Additional Services

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






Reference:
Lewis 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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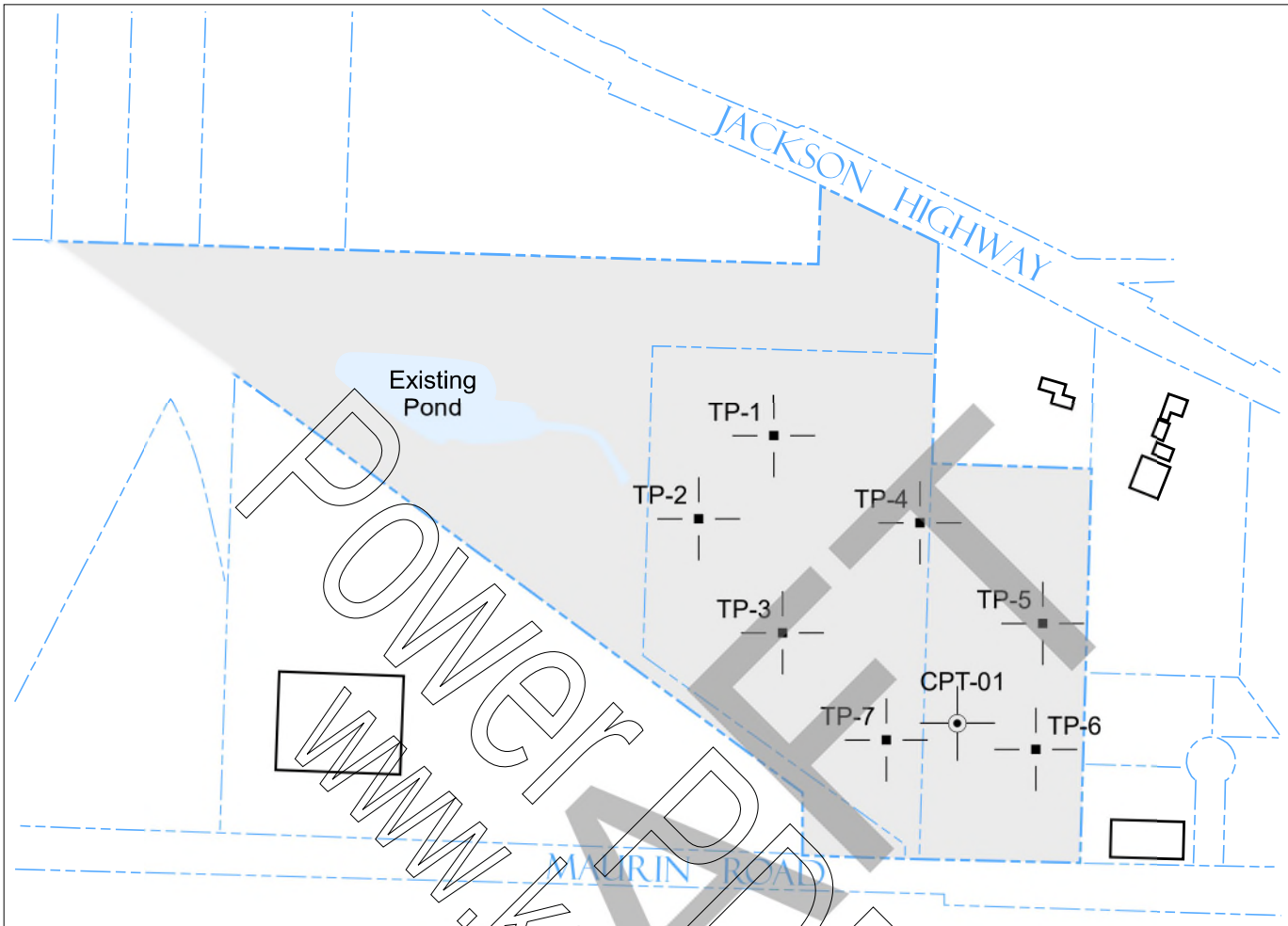
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

# Vicinity Map
# Port 17
# Lewis County (Chehalis), Washington

| | | |
|---|---|---|
| Drwn. CAM | Date 06/02/2022 | Proj. No. 8489 |
| Checked CGH | Date June 2022 | Plate 1 |






**LEGEND**

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-8489, April 2022

CPT-01 — Approximate Location of ConeTec CPT, Proj. No. 22-59-24033, April 2022

Subject Site

Existing Building

NORTH

NOT - TO - SCALE

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.

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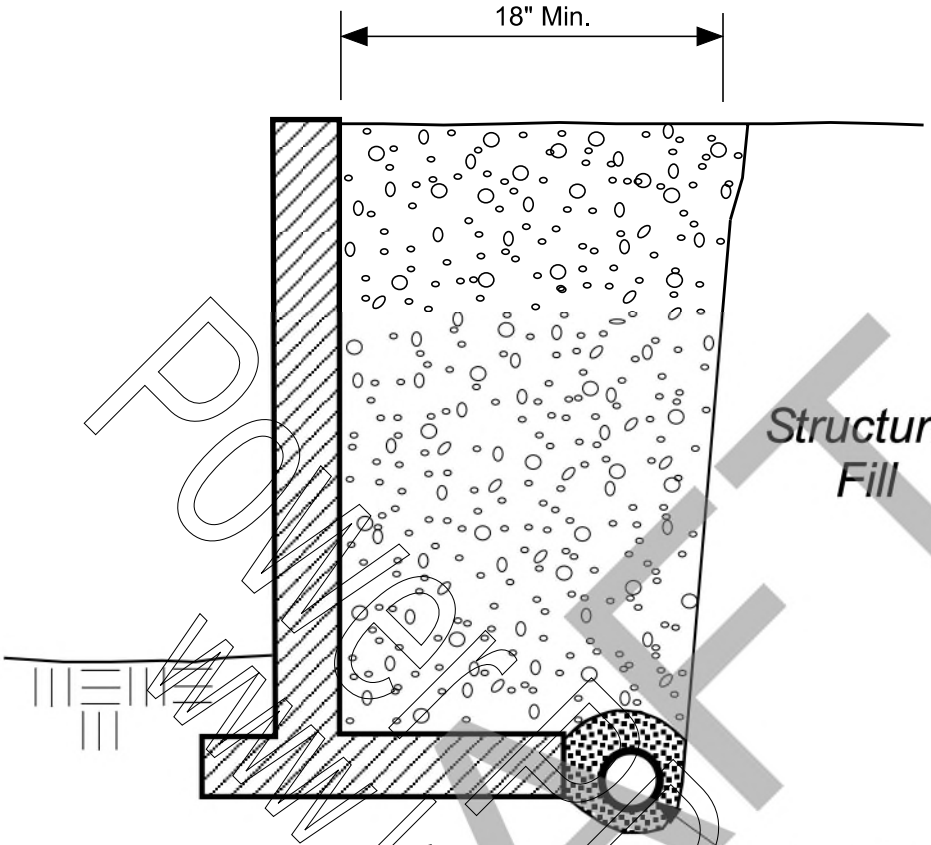
# Subsurface Exploration Plan
# Port 17
# Lewis County (Chehalis), Washington

| | | |
|---|---|---|
| Drwn. CAM | Date 06/02/2022 | Proj. No. 8489 |
| Checked CGH | Date June 2022 | Plate 2 |






**NOTES:**

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

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

**LEGEND:**

Free-draining Structural Backfill

1-inch Drain Rock

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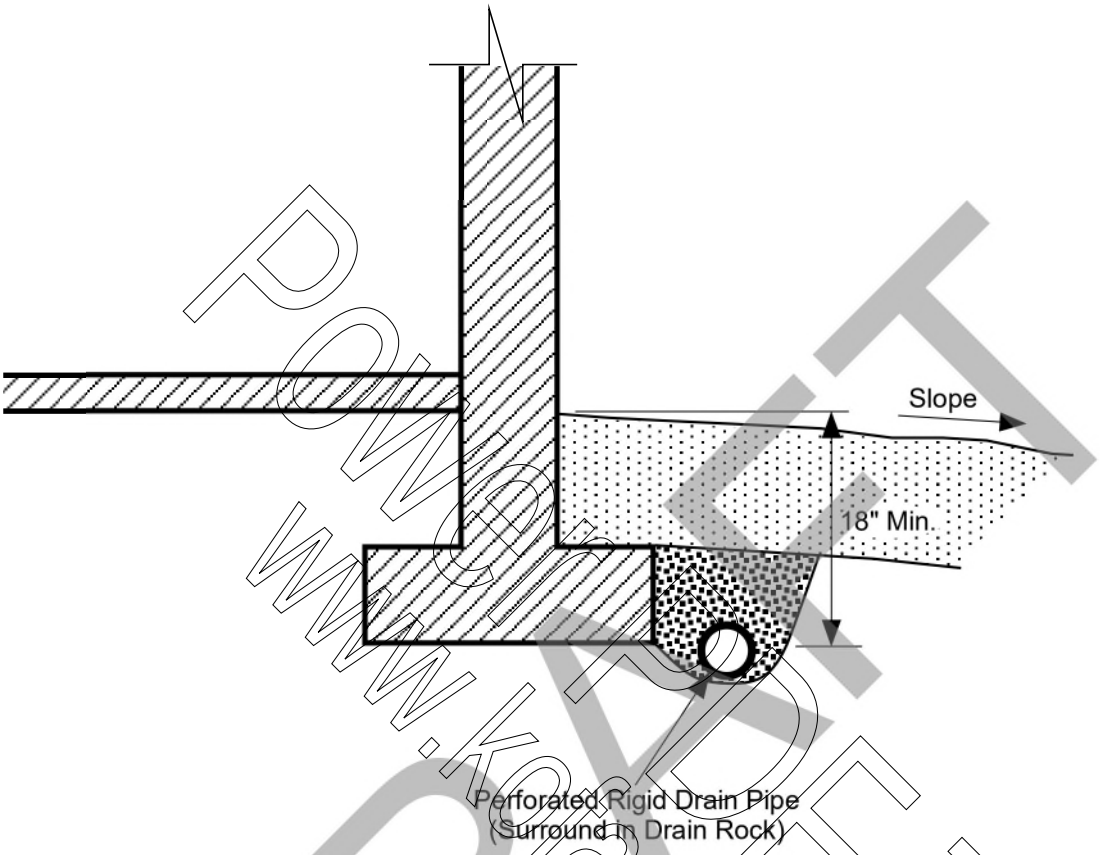
# Retaining Wall Drainage Detail
# Port 17
# Lewis County (Chehalis), Washington

| | | |
|---|---|---|
| Drwn. CAM | Date 06/02/2022 | Proj. No. 8489 |
| Checked CGH | Date June 2022 | Plate 3 |






**NOTES:**

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

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

**LEGEND:**

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

1-inch Drain Rock

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# Footing Drain Detail
# Port 17
# Lewis County (Chehalis), Washington

| | | |
|---|---|---|
| Drwn. CAM | Date 06/02/2022 | Proj. No. 8489 |
| Checked CGH | Date June 2022 | Plate 4 |

## Appendix A

## Subsurface Exploration
## Test Pit Logs
## CPT Charts

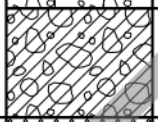
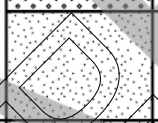
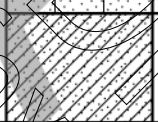
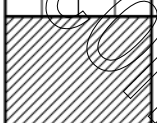
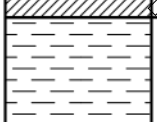
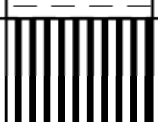
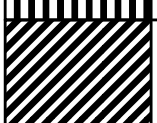
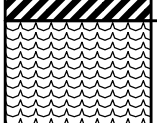
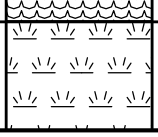
### ES-8489

Subsurface conditions at the subject site were explored on April 26, 2022. Seven test pits were excavated using a trackhoe and operator retained by our firm and one CPT was advanced. The approximate locations of the exploration locations are illustrated on Plate 2 of this study. The test pit logs and CPT Charts are provided in this Appendix. The test pits were advanced to a maximum depth of approximately 11 feet bgs while the CPT was advanced to a maximum depth of about 10.5 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: GRAPH | SYMBOLS: LETTER | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS | GRAVEL AND GRAVELLY SOILS | CLEAN GRAVELS |  | GW | WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | (LITTLE OR NO FINES) |  | GP | POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | GRAVELS WITH FINES |  | GM | SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES |
| | | (APPRECIABLE AMOUNT OF FINES) |  | GC | CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES |
| MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | SAND AND SANDY SOILS | CLEAN SANDS |  | SW | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | (LITTLE OR NO FINES) |  | SP | POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES |
| | MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE | SANDS WITH FINES |  | SM | SILTY SANDS, SAND - SILT MIXTURES |
| | | (APPRECIABLE AMOUNT OF FINES) |  | SC | CLAYEY SANDS, SAND - CLAY MIXTURES |
| FINE GRAINED SOILS | SILTS AND CLAYS | LIQUID LIMIT LESS THAN 50 |  | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | |  | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | |  | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE | SILTS AND CLAYS | LIQUID LIMIT GREATER THAN 50 |  | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS |
| | | |  | CH | INORGANIC CLAYS OF HIGH PLASTICITY |
| | | |  | OH | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS |
| HIGHLY ORGANIC SOILS | | |  | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |

DUAL SYMBOLS are used to indicate borderline soil classifications.

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

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# TEST PIT NUMBER TP-1



**PROJECT NUMBER** ES-8489 **PROJECT NAME** Port 17
**DATE STARTED** 4/26/22 **COMPLETED** 4/26/22 **GROUND ELEVATION**
**EXCAVATION CONTRACTOR** NW Excavating **LATITUDE** 46.6295 **LONGITUDE** -122.91482
**EXCAVATION METHOD** **GROUND WATER LEVEL:**
**LOGGED BY** CGH **CHECKED BY** KRC ▽ **AT TIME OF EXCAVATION**
**NOTES** Surface Conditions: gravel

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0.0 | | | FILL | Clean washed rock 6-12" (Fill) |
| | | | | 1.0 |
| | | | ML | Brown SILT with sand, loose to medium dense, wet (Fill)<br>-trace organics, minor perched groundwater seepage at 1' |
| | | MC = 35.6%<br>Fines = 73.1% | | -becomes dark gray, odor<br>[USDA Classification: slightly gravelly LOAM] |
| 2.5 | | | | 3.0 |
| | | MC = 29.1% | ML | Gray sandy SILT, medium dense, wet<br>-heavy iron oxide staining |
| | | | | -heavy perched groundwater seepage |
| 5.0 | | MC = 17.7% | | 5.0 |
| | | | GM | Gray silty GRAVEL with sand, medium dense, wet<br>-heavy iron oxide staining |
| 7.5 | | | | 7.5 |
| | | | SM | Gray silty SAND, medium dense, wet |
| | | MC = 38.3% | | -heavy iron oxide staining |
| 10.0 | | | | |
| | | MC = 28.0% | | 11.0 |

Test pit terminated at 11.0 feet below existing grade. Groundwater seepage encountered at 1.0 and 4.5 feet during excavation. No caving observed.

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Fax: 425-449-4711

# TEST PIT NUMBER TP-2



**PROJECT NUMBER** ES-8489 **PROJECT NAME** Port 17
**DATE STARTED** 4/26/22 **COMPLETED** 4/26/22 **GROUND ELEVATION**
**EXCAVATION CONTRACTOR** NW Excavating **LATITUDE** 46.62892 **LONGITUDE** -122.91525
**EXCAVATION METHOD** **GROUND WATER LEVEL:**
**LOGGED BY** CGH **CHECKED BY** KRC ▽ **AT TIME OF EXCAVATION**
**NOTES** Surface Conditions: gravel

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | FILL | | Clean washed rock 6" (Fill) |
| | | | | 0.5 | Gray SILT with sand, loose to medium dense, wet (Fill) |
| | | | | | -heavy perched groundwater seepage |
| | | | ML | | |
| 2.5 | | MC = 29.4% | | 3.0 | Gray sandy SILT, medium dense, wet |
| | | | | | -heavy iron oxide staining |
| | | MC = 24.2% | | | |
| 5.0 | | | | | -heavy perched groundwater seepage |
| | | | ML | | |
| 7.5 | | | | 8.0 | Reddish brown silty GRAVEL with sand, medium dense to dense, moist |
| | | | | | -heavy iron oxide staining |
| | | | GM | | |
| 10.0 | | | | | |
| | | MC = 13.6% | | 11.0 | |

Test pit terminated at 11.0 feet below existing grade. Groundwater seepage encountered at 1.0 and 5.0 feet during excavation. No caving observed.

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# TEST PIT NUMBER TP-3



**PROJECT NUMBER** ES-8489 **PROJECT NAME** Port 17
**DATE STARTED** 4/26/22 **COMPLETED** 4/26/22 **GROUND ELEVATION**
**EXCAVATION CONTRACTOR** NW Excavating **LATITUDE** 46.62833 **LONGITUDE** -122.91476
**EXCAVATION METHOD** **GROUND WATER LEVEL:**
**LOGGED BY** CGH **CHECKED BY** KRC ▽ **AT TIME OF EXCAVATION**
**NOTES** Surface Conditions: gravel

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | FILL | | Clean washed rock ~6" (Fill) |
| | | | | 0.5 | Brown silty SAND, loose, wet (Fill) |
| | | | | | -moderate perched groundwater seepage |
| | | | SM | | |
| 2.5 | | MC = 33.3% | | | -becomes gray |
| | | Fines = 89.3% | | 2.5 | Gray SILT, medium dense, moist to wet |
| | | | | | [USDA Classification: slightly gravelly LOAM] |
| | | | | | -heavy iron oxide staining |
| | | | ML | | |
| 5.0 | | | | 5.0 | Gray silty SAND with gravel, medium dense, moist to wet |
| | | | | | -heavy iron oxide staining, minor perched groundwater seepage from 5' to 7' |
| | | MC = 18.8% | | | |
| 7.5 | | | SM | | |
| 10.0 | | MC = 22.3% | | 10.0 | |

Test pit terminated at 10.0 feet below existing grade. Groundwater seepage encountered at 1.0 and 5.0 to 7.0 feet during excavation. No caving observed.

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# TEST PIT NUMBER TP-4



**PROJECT NUMBER** ES-8489 **PROJECT NAME** Port 17
**DATE STARTED** 4/26/22 **COMPLETED** 4/26/22 **GROUND ELEVATION**
**EXCAVATION CONTRACTOR** NW Excavating **LATITUDE** 46.62888 **LONGITUDE** -122.91349
**EXCAVATION METHOD** **GROUND WATER LEVEL:**
**LOGGED BY** CGH **CHECKED BY** KRC ▽ **AT TIME OF EXCAVATION**
**NOTES** Surface Conditions: gravel

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | FILL | | Clean washed rock 6" (Fill) |
| | | | | 0.5 | |
| | | | SM | | Brown silty SAND, loose, moist (Fill)<br>-minor perched groundwater seepage at 6" |
| | | | | | -becomes gray |
| 2.5 | | MC = 36.2%<br>LL = 88<br>PL = 35<br>Fines = 93.3%<br>PI = 53 | | 2.5 | |
| | | | CH | | Gray fat CLAY, medium dense, moist<br>-heavy iron oxide staining |
| | | | | | -minor perched groundwater seepage |
| 5.0 | | | | 5.5 | |
| | | | | | Gray silty SAND with gravel, medium dense to dense, moist |
| | | MC = 12.4% | | | |
| 7.5 | | | SM | | |
| 10.0 | | | | | |
| | | MC = 17.2% | | 11.0 | |

Test pit terminated at 11.0 feet below existing grade. Groundwater seepage encountered at 0.5 and 4.5 feet during excavation. No caving observed.

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# TEST PIT NUMBER TP-5



**PROJECT NUMBER** ES-8489 **PROJECT NAME** Port 17
**DATE STARTED** 4/26/22 **COMPLETED** 4/26/22 **GROUND ELEVATION**
**EXCAVATION CONTRACTOR** NW Excavating **LATITUDE** 46.62847 **LONGITUDE** -122.91257
**EXCAVATION METHOD** **GROUND WATER LEVEL:**
**LOGGED BY** CGH **CHECKED BY** KRC ▽ **AT TIME OF EXCAVATION**
**NOTES** Surface Conditions: gravel

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | | | Clean washed rock ~12" (Fill) |
| | | | FILL | | |
| | | | | 1.0 | Brown silty SAND, loose, moist (Fill) |
| | | | SM | | |
| 2.5 | | | | 2.5 | -becomes gray |
| | | MC = 21.0% | | | Gray sandy SILT, medium dense, moist to wet<br>-slight caving at 2.5'<br>-heavy iron oxide staining |
| | | | ML | | |
| | | | | | -moderate perched groundwater seepage to 6.5' |
| 5.0 | | | | 5.0 | Reddish brown silty SAND, medium dense, moist to wet |
| | | MC = 20.5% | | | -heavy iron oxide staining |
| | | | | | |
| 7.5 | | | SM | | |
| | | | | | -moderate perched groundwater seepage |
| 10.0 | | | | | |
| | | MC = 31.0% | | 11.0 | |

Test pit terminated at 11.0 feet below existing grade. Groundwater seepage encountered from 4.5 to 6.5 and at 9.5 feet during excavation. Caving observed at 2.5 feet.

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# TEST PIT NUMBER TP-6



**PROJECT NUMBER** ES-8489 **PROJECT NAME** Port 17
**DATE STARTED** 4/26/22 **COMPLETED** 4/26/22 **GROUND ELEVATION**
**EXCAVATION CONTRACTOR** NW Excavating **LATITUDE** 46.62764 **LONGITUDE** -122.91265
**EXCAVATION METHOD** **GROUND WATER LEVEL:**
**LOGGED BY** CGH **CHECKED BY** KRC ▽ **AT TIME OF EXCAVATION**
**NOTES** Surface Conditions: gravel

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | | | Clean washed rock 6-12" (Fill) |
| | | | FILL | | |
| | | | | 1.0 | Brown silty SAND, loose, moist (Fill) |
| | | | | | -moderate perched groundwater seepage at 1' |
| | | | SM | | |
| 2.5 | | | | 2.5 | Gray silty SAND, medium dense, moist to wet |
| | | MC = 25.3% | | | -moderate iron oxide staining |
| 5.0 | | MC = 19.0%<br>Fines = 35.7% | | | -heavy iron oxide staining<br>[USDA Classification: slightly gravelly sandy LOAM] |
| | | | SM | | -minor perched groundwater seepage |
| 7.5 | | | | | |
| | | | | | -moderate cobbles, extreme iron oxide staining |
| 10.0 | | MC = 26.1% | | 10.0 | |

Test pit terminated at 10.0 feet below existing grade. Groundwater seepage encountered at 1.0 and 6.0 feet during excavation. No caving observed.

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# TEST PIT NUMBER TP-7



**PROJECT NUMBER** ES-8489 **PROJECT NAME** Port 17

**DATE STARTED** 4/26/22 **COMPLETED** 4/26/22 **GROUND ELEVATION**

**EXCAVATION CONTRACTOR** NW Excavating **LATITUDE** 46.62767 **LONGITUDE** -122.9136

**EXCAVATION METHOD** **GROUND WATER LEVEL:**

**LOGGED BY** CGH **CHECKED BY** KRC ▽ **AT TIME OF EXCAVATION**

**NOTES** Surface Conditions: gravel

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | FILL | | Clean washed rock 6" (Fill) |
| | | | | 0.5 | Brown to gray silty SAND, loose, moist |
| | | | | | -minor perched groundwater seepage |
| | | | SM | | |
| 2.5 | | | | 2.5 | Gray SILT with sand, loose to medium dense, wet |
| | | MC = 27.8% Fines = 70.4% | ML | | [USDA Classification: slightly gravelly LOAM] |
| 5.0 | | | | 5.0 | Gray silty SAND with gravel, medium dense, moist |
| | | | | | -heavy iron oxide staining |
| | | MC = 18.0% | | | -trace small boulders |
| 7.5 | | | SM | | |
| 10.0 | | | | | |
| | | MC = 21.6% | | 11.0 | |

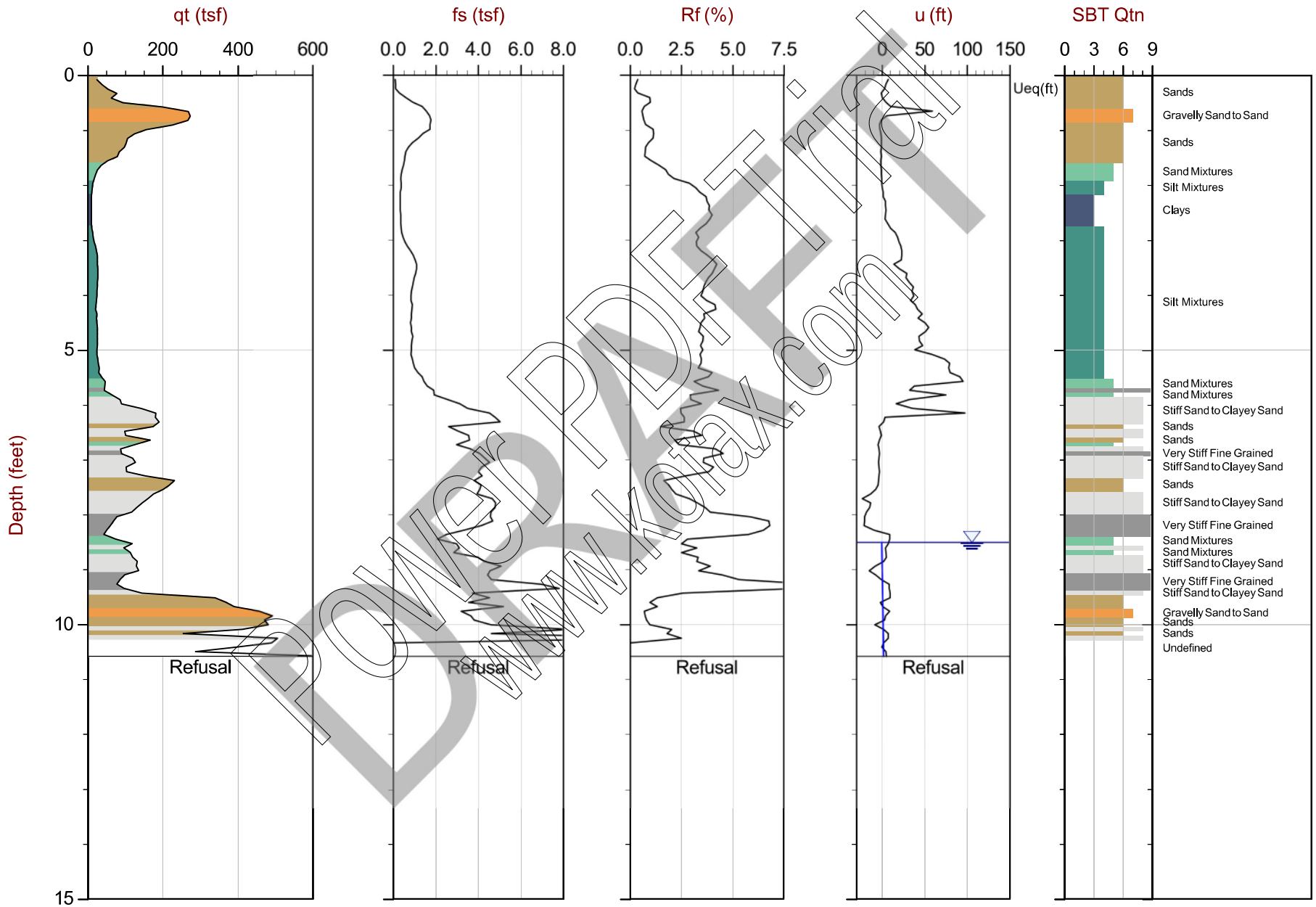
Test pit terminated at 11.0 feet below existing grade. Groundwater seepage encountered at 1.0 foot during excavation. No caving observed.

CONETEC

# Earth Solutions

Job No: 22-59-24033
Date: 2022-04-21 11:38
Site: Chehalis CPT

Sounding: CPT-01
Cone: 781:T1500F15U35






Max Depth: 3.225 m / 10.58 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-59-24033_SP01.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 46.62783 Long: -122.91340

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

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Date: 2022-04-21 11:38
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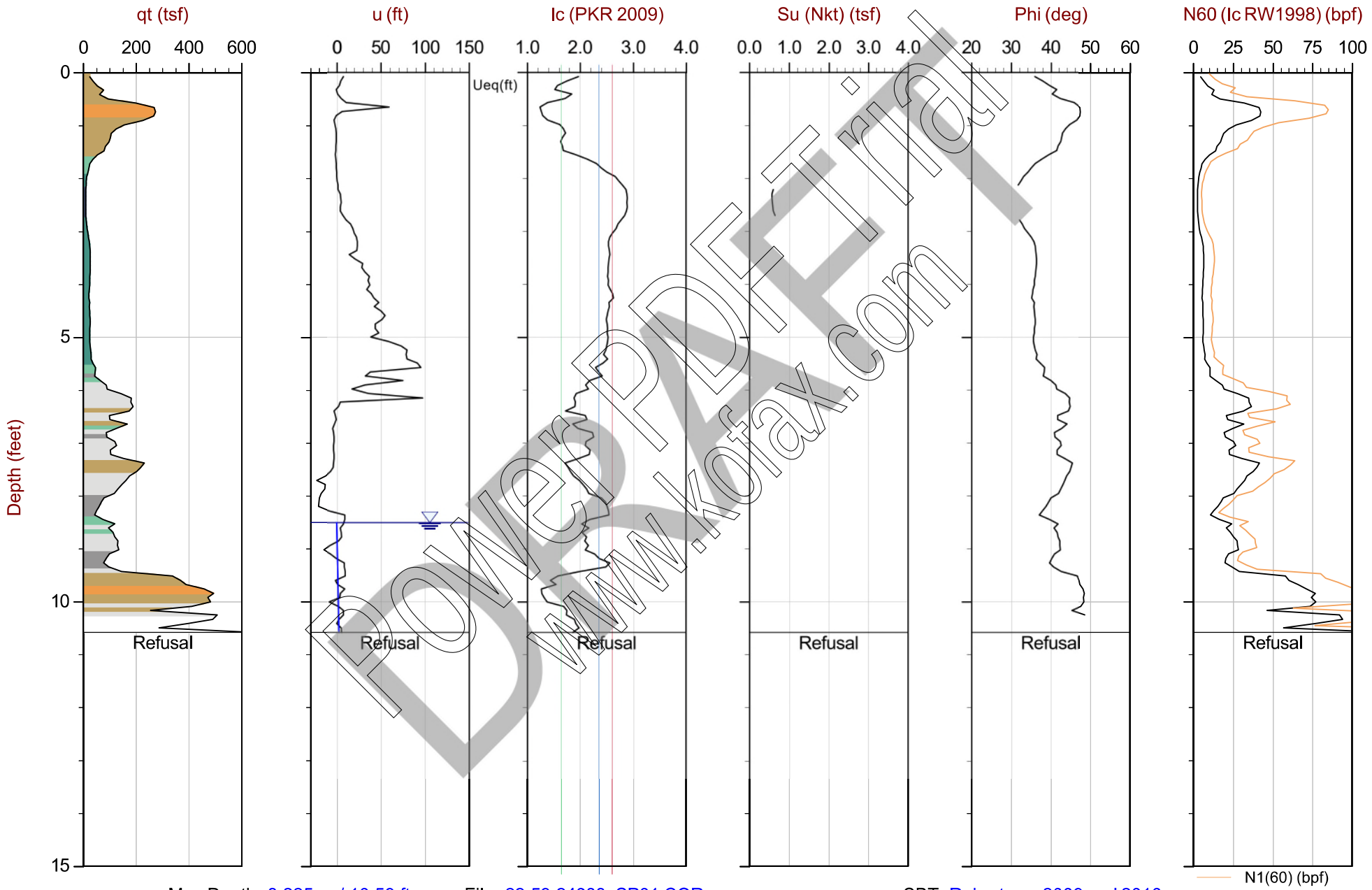





Max Depth: 3.225 m / 10.58 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-59-24033_SP01.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 46.62783 Long: -122.91340

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

## Appendix B

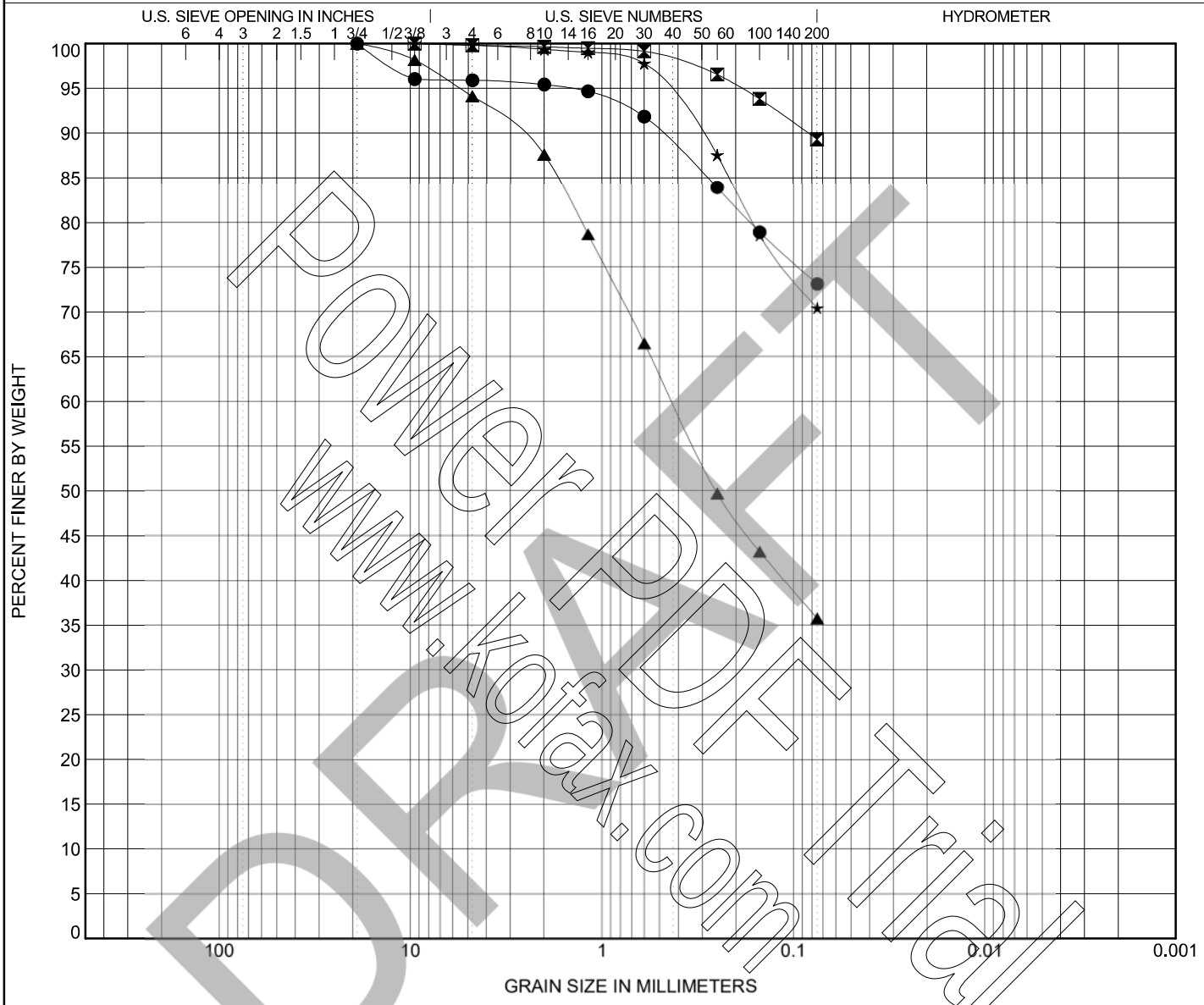
## Laboratory Test Results

## ES-8489

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

# GRAIN SIZE DISTRIBUTION

**PROJECT NUMBER** ES-8489 **PROJECT NAME** Port 17






| Specimen Identification | | | Classification | Cc | Cu |
|---|---|---|---|---|---|
| ● | TP-01 | 2.00ft. | USDA: Gray Slightly Gravelly Loam. USCS: ML with Sand. | | |
| ⊠ | TP-03 | 2.50ft. | USDA: Gray Slightly Gravelly Loam. USCS: ML. | | |
| ▲ | TP-06 | 5.00ft. | USDA: Gray Slightly Gravelly Sandy Loam. USCS: SM. | | |
| ★ | TP-07 | 4.00ft. | USDA: Gray Slightly Gravelly Loam. USCS: ML with Sand. | | |

| Specimen Identification | | | D100 | D60 | D30 | D10 | LL | PL | PI | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | TP-01 | 2.0ft. | 19 | | | | | | | 73.1 | |
| ⊠ | TP-03 | 2.5ft. | 9.5 | | | | | | | 89.3 | |
| ▲ | TP-06 | 5.0ft. | 19 | 0.428 | | | | | | 35.7 | |
| ★ | TP-07 | 4.0ft. | 9.5 | | | | | | | 70.4 | |

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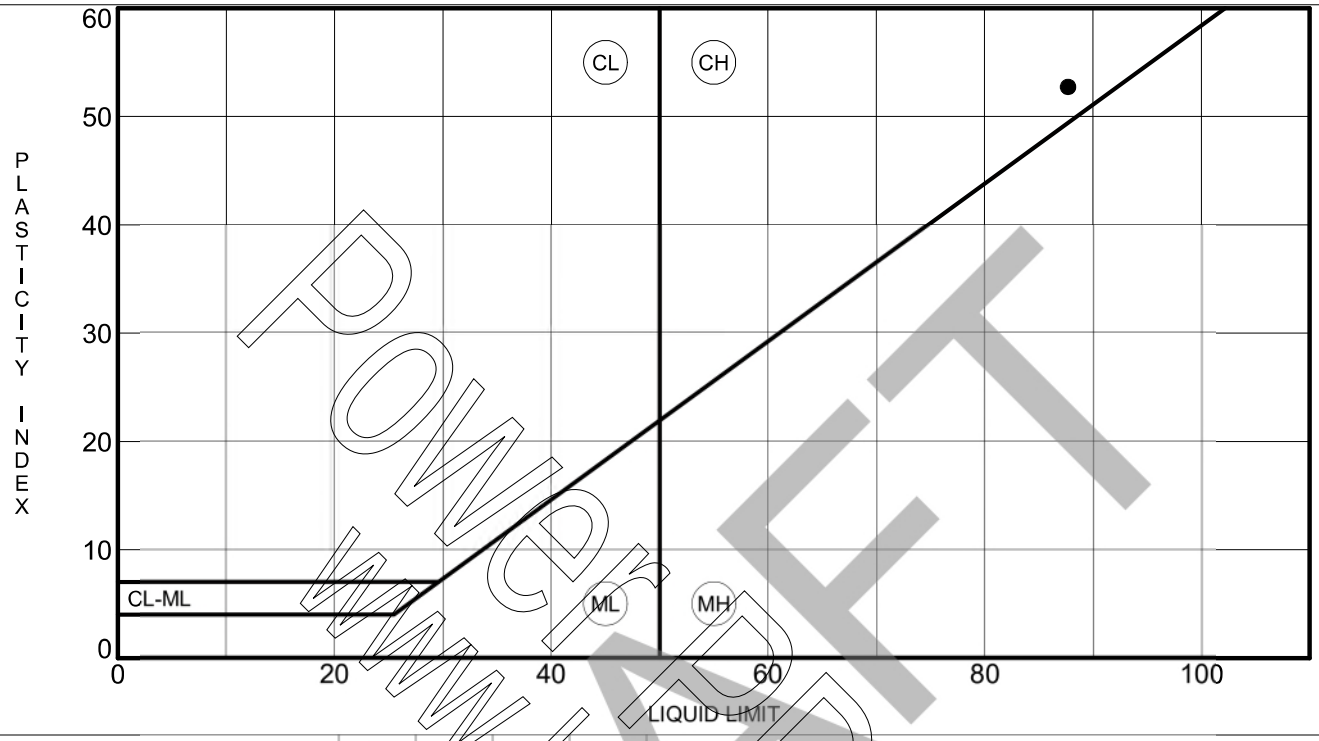
# ATTERBERG LIMITS' RESULTS

**PROJECT NUMBER** ES-8489 **PROJECT NAME** Port 17




| | Specimen Identification | | LL | PL | PI | Fines | Classification |
|---|---|---|---|---|---|---|---|
| ● | **TP-04** | **3.0** | **88** | **35** | **53** | **93.3** | **Gray Fat CLAY, CH** |

**Report Distribution**

**ES-8489**

**EMAIL ONLY**

**PDC Seattle LPIV BB/TH, LLC**
**1821 Dock Street, Suite 100**
**Tacoma, Washington 98402**

**Attention: Mr. Darren Peugh**