



Geotechnical Engineering, Construction  
Observation/Testing and Environmental Services

**GEOTECHNICAL ENGINEERING STUDY  
SANDSTONE RIDGE  
LANGAUNET LANE NORTHEAST AND NOLL ROAD NORTHEAST  
POULSBO, WASHINGTON**

**ES-8360.03**

**15365 NE 90<sup>th</sup> Street, Suite 100 • Redmond, WA 98052 • (425) 449-4704  
3130 Varney Lane, Suite 105 • Pasco, WA 99301 • (509) 905-0275  
esnw.com**

PREPARED FOR  
JKM HOLDINGS, LLC

August 9, 2024



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08/09/2024

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**GEOTECHNICAL ENGINEERING STUDY  
SANDSTONE RIDGE  
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**Earth Solutions NW, LLC  
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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.**



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August 9, 2024  
ES-8360.03

## Earth Solutions NW LLC

Geotechnical Engineering, Construction  
Observation/Testing and Environmental Services

JKM Holdings, LLC  
PO Box 188  
Puyallup, Washington 98371

Attention: Craig Steepy

Dear Craig:

Earth Solutions NW, LLC (ESNW), is pleased to present this report to support the proposed project. Based on the results of our investigation, construction of a residential development is feasible from a geotechnical standpoint. Our study indicates the site is underlain primarily by native glacial till deposits.

Based on our findings, the proposed single-family residences may be constructed on conventional continuous and spread footing foundations that bear upon competent native soil, recompacted native soil, or new structural fill that is placed and compacted directly on competent native soil. Competent native soil considered suitable for support of the proposed structures will likely be encountered beginning at a depth of about two to three-and-one-half feet below the existing ground surface. 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.

From a geotechnical standpoint, large-scale or full-scale infiltration is considered infeasible for the project due to the widespread presence of consolidated glacial till soils. Conventional stormwater management techniques (i.e., detention) will likely prove most feasible for this project.

This report provides geotechnical analyses and recommendations for the proposed development. We appreciate the opportunity to be of service to you on this project. If you have any questions regarding the content of this study, please call.

Sincerely,

**EARTH SOLUTIONS NW, LLC**

Steven K. Hartwig, L.G.  
Senior Staff Geologist

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**GEOTECHNICAL ENGINEERING STUDY  
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POULSBO, WASHINGTON**

**ES-8360.03**

**INTRODUCTION**

**General**

This geotechnical engineering study (study) was prepared for the proposed residential development to be constructed at the northeast corner of the intersection between Langaunet Lane Northeast and Noll Road Northeast, in Poulsbo, Washington. To complete our scope, ESNW performed the following services:

- Subsurface exploration to characterize the soil and groundwater conditions.
- Laboratory testing of representative soil samples collected on site.
- Geotechnical engineering analyses.
- Preparation of this report.

**Project Description**

Currently referred to as Sandstone Ridge, we understand the project is pursuing the construction of 86 home building sites, associated infrastructure improvements, and various open-space tract areas. A stormwater detention vault (vault) is proposed within the southeastern property area. Both Langaunet Lane Northeast and Noll Road Northeast will provide site egress and ingress.

At the time of report submission, specific building loads were not available for review; however, we anticipate the proposed structures will consist of relatively lightly loaded wood framing supported on conventional foundations. Based on our experience with similar developments, we estimate wall loads of about 2 to 3 kips per linear foot and slab-on-grade loading of 150 pounds per square foot (psf) will be incorporated into the final design.

If the above design assumptions either change or are incorrect, ESNW should be contacted to review the recommendations provided in this report. ESNW should be afforded the opportunity to 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 Langaunet Lane Northeast and Noll Road Northeast, in Poulsbo, Washington. The approximate site location is depicted on Plate 1 (Vicinity Map). The rectangular site consists of Kitsap County parcel number 132601-4-008-2004, totaling about 18.14 acres. The site is bordered to the north by residential development, to the east and south by Noll Road Northeast, and to the west by Langaunet Lane Northeast.

The site is undeveloped and forested with mature trees and moderate brush coverage. Topography descends to the east with about 95 feet of elevation change occurring across the subject property.

### **Subsurface**

An ESNW representative observed, logged, and sampled the excavation of eight test pits on May 21, 2024. The test pits were excavated within accessible areas of the site using a trackhoe and operator retained by ESNW. The test pits were completed to evaluate, classify, and characterize soil and shallow (observable) groundwater conditions across the subject site. Test pit exploration depths generally ranged from about 7.5 to 10 feet below the existing ground surface (bgs). The approximate locations of the test pits are depicted on Plate 2 (Test Pit Location Plan). Please refer to the test pit logs provided in Appendix A for a more detailed description of subsurface conditions.

Representative soil samples collected at the test pit locations were analyzed for moisture content and grain size distribution in general accordance with both Unified Soil Classification System (USCS) and United States Department of Agriculture (USDA) methods and procedures. Results of laboratory analyses are provided in Appendix B.

### **Topsoil and Fill**

Topsoil was generally encountered in the upper 6 to 12 inches of existing grades at the test pit locations. The topsoil was characterized by a dark brown color, minor root intrusions, and trace organic matter.

Fill was not encountered at the test pits during the May 2024 subsurface exploration.

### **Native Soil**

Underlying topsoil, native soils consisting primarily of silty sands with and without gravel (USCS: SM) were identified. In-situ soil density was characterized as medium dense to dense within the upper approximately one-and-one-half to four feet of existing grades. Thereafter, native soils were encountered in a very dense condition at each test pit location. The moisture content of the soil at the time of exploration was characterized primarily as damp to moist.

## **Geologic Setting**

The referenced geologic map resource identifies glacial till deposits (Qvt) as the primary native soil unit underlying the site and immediate vicinity. Glacial till consists of unstratified and compact clay, silt, sand, and gravels that were glacially transported and deposited. The referenced WSS resource identifies Poulsbo gravelly sandy loam, 0 to 15 percent slopes, as the primary soil unit underlying the subject development area. This soil series is associated with terrace and moraine landforms and is derived from basal till. Based on our field observations, we interpret the native soil conditions encountered at the test pit locations to represent glacial till deposits, which is consistent with the geologic and soils mapping resources outlined in this section.

## **Groundwater**

Groundwater seepage was not observed in the test pits excavated during the May 2024 subsurface exploration. Nevertheless, zones of perched groundwater seepage are common within glacial till deposits, and in our opinion, seepage zones should be anticipated depending on the time of year earthwork activities occur. Groundwater seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the winter, spring, and early summer months.

## **Geologically Hazardous Areas**

ESNW reviewed Chapter 16.20 of the Poulsbo Municipal Code (PMC) and the Kitsap County Parcel Search application to evaluate if jurisdictionally recognized geologically hazardous areas (GHAs) or areas of geologic concern (AGCs) are present on site or in the immediate vicinity. A review of the referenced Geological Hazard Areas map indicates the site does not contain any jurisdictionally recognized GHAs or AGCs. However, based on our observations, local soil survey designations, and the development limitation designations presented in Table 10 of the referenced soil survey, the site is characterized as an AGC per PMC definitions.

Based on our exploration, the site is underlain by competent glacial till deposits which exhibit good overall stability characteristics. As such, the potential for mass soil movement (during and/or after construction) is very low. With respect to surface water management and potential erosion processes, it is our opinion that appropriate Best Management Practices (BMPs) implemented both during and post-construction can successfully mitigate the AGC. From a geotechnical standpoint, it is our opinion that the site can be successfully developed using appropriate BMPs and typical construction practices in association with the local standard of care without the need for buffers or setbacks. In the post-construction condition, we anticipate the development will no longer meet the criteria of an AGC.

## **DISCUSSION AND RECOMMENDATIONS**

### **General**

Based on the results of our investigation, construction of the proposed residential development is feasible from a geotechnical standpoint. The primary geotechnical considerations associated with the proposed project include earthwork, temporary excavations, subgrade preparation, foundation support, and drainage recommendations.

### **Site Preparation and Earthwork**

Site preparation activities will likely consist of installing temporary erosion control measures, establishing grading limits, and performing site stripping. 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 BMPs are recommended:

- Temporary construction entrances and drive lanes, consisting of at least six inches of quarry spalls, should be considered to both minimize off-site soil tracking and provide stable surfaces at site entrances. Placing geotextile fabric underneath the quarry spalls will provide greater stability, if needed.
- Silt fencing should be placed around the appropriate portions of the site perimeter to prevent off-site migration of sediment.
- When not in use, soil stockpiles should be covered or otherwise protected (as necessary) to reduce the potential for soil erosion, especially during periods of wet weather. Stockpiles should never be placed near the top of slopes.
- As necessary, temporary measures for controlling surface water runoff, such as interceptor trenches, sumps, or interceptor swales, should be installed prior to beginning earthwork activities.
- Dry soil disturbed during construction should be wetted to minimize dust and airborne soil erosion.

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

## **Stripping**

Topsoil was encountered generally within the upper 6 to 12 inches of existing grades at the test pit locations. For preliminary planning purposes, a topsoil stripping depth of about 12 inches should be considered. However, areas of shallower or deeper topsoil pockets may be exposed across the site area. Organic-rich topsoil should be stripped and segregated into a stockpile either for later use on site or to be exported. Topsoil and organic-rich soil are not suitable for use in structural areas.

The material remaining immediately below the topsoil may have some root zones and will likely be variable in composition, density, and/or moisture content. This material may not be suitable for direct structural support as is and may require in-situ compaction or overexcavation. Depending on the time of year stripping occurs, the soil exposed below the topsoil may be too wet to compact and may need to be aerated or treated. ESNW should be contacted to observe initial stripping activities to provide recommendations regarding stripping depths and material suitability.

The owner and contractor(s) should coordinate with ESNW, as necessary, to utilize on-site soil to the extent feasible. Over-stripping should be avoided, as it is unnecessary and may result in increased project development costs.

## **In-situ and Imported Soil**

Based on the conditions observed during the subsurface exploration, the on-site soil is highly moisture sensitive. 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. Remedial measures (likely aeration or cement treatment) 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 earthwork operations 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 soil intended for use as structural fill should consist of a well-graded, granular soil with a moisture content that is at (or slightly above) the optimum level. During wet weather conditions, imported soil intended for use as structural fill should consist of a well-graded, granular soil with a fines content of 5 percent or less (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 foundation, slab-on-grade, roadway, permanent slope, retaining wall, and utility trench backfill areas. Structural fill placed and compacted during site grading activities should meet the following specifications:

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

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

## 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 and Washington Industrial Safety and Health Act soil classifications are also provided:

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

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

## **Subgrade Preparation**

Foundations should be constructed on competent native soil or structural fill placed directly on competent native soil. Loose or unsuitable soil conditions encountered below areas of footing and slab elements should be recompacted or overexcavated and restored as recommended in this report and by ESNW during construction. Uniform compaction of the foundation and slab subgrade areas will establish a relatively consistent subgrade condition below the foundation and slab elements. ESNW should be contacted to observe the foundation and slab subgrade prior to placing formwork. Supplementary recommendations for subgrade improvement can be provided at the time of construction and would likely include further mechanical compaction effort and/or overexcavation and replacement with suitable structural fill.

## **Foundations**

Based on our findings, the proposed single-family residences may be constructed on conventional continuous and spread footing foundations that bear upon competent native soil, recompacted native soil, or new structural fill that is placed and compacted directly on competent native soil. Competent native soil considered suitable for support of the proposed structures will likely be encountered beginning at a depth of about two to three-and-one-half 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 fill will be necessary.

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

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

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

## **Retaining Walls**

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

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

\* Where applicable.

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

The passive earth pressure and coefficient of friction values include a safety factor of 1.5. Additional surcharge loading from adjacent foundations, sloped backfill, or other loads should be included in the retaining wall design. Retaining walls should be backfilled with free-draining material that extends along the height of the wall and a distance of at least 18 inches behind the wall. The upper 12 inches of the wall backfill may consist of a less permeable soil, if desired.

Drainage should be provided behind retaining walls such that hydrostatic pressures do not develop. If drainage is not provided, hydrostatic pressures should be included in the wall design. A perforated drainpipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3.

## **Seismic Design**

The 2021 International Building Code (2021 IBC) recognizes ASCE 7-16 (formally known as the Minimum Design Loads and Associated Criteria for Buildings and Other Structures manual) 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 2021 IBC.

<b>Parameter</b>	<b>Value</b>
Site Class	C*
Mapped short period spectral response acceleration, $S_s$ (g)	1.362
Mapped 1-second period spectral response acceleration, $S_1$ (g)	0.48
Short period site coefficient, $F_a$	1.2
Long period site coefficient, $F_v$	1.5
Adjusted short period spectral response acceleration, $S_{MS}$ (g)	1.634
Adjusted 1-second period spectral response acceleration, $S_{M1}$ (g)	0.721
Design short period spectral response acceleration, $S_{DS}$ (g)	1.09
Design 1-second period spectral response acceleration, $S_{D1}$ (g)	0.48

\* Assumes very dense soil conditions, encountered to a maximum depth of 10 feet bgs during the May 2024 field exploration, remain very dense to at least 100 feet bgs. Based on our experience with the project geologic setting (glacial till) across the Puget Sound region, soil conditions are likely consistent with this assumption.

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 very low to negligible. The absence of a uniformly established, shallow groundwater table and the relatively consistent density of the native soils were the primary bases for this opinion.

## **Slab-on-Grade Floors**

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

A capillary break consisting of a minimum of four inches of free-draining crushed rock or gravel should be placed below the slab. The free-draining material should have a fines content of 5 percent or less defined as the percent passing the number 200 sieve, based on the minus three-quarters-inch fraction. In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. If used, the vapor barrier should consist of a material specifically designed to function as a vapor barrier and should be installed in accordance with the manufacturer's specifications.

### **Utility Support and Trench Backfill**

In our opinion, the on-site soil will generally be suitable for support of utilities. Remedial measures may be necessary in some areas to provide support for utilities, such as overexcavation and replacement with structural fill or placement of geotextile fabric. Groundwater seepage may 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 may not be suitable for use as structural backfill throughout 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 prior to use as structural fill. Each section of the utility lines must be adequately supported in 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.

### **Preliminary Pavement Sections**

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

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

- A minimum of two inches of hot-mix asphalt (HMA) placed over four inches of crushed rock base (CRB).
- A minimum of two inches of HMA placed over three inches of asphalt-treated base (ATB).

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

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

### **Drainage**

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. For preliminary planning purposes, installation of a foundation drain should be considered for the building perimeter footings. A typical foundation drain detail is provided on Plate 4.

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

### **Infiltration Evaluation**

From a geotechnical standpoint, large-scale or full-scale infiltration is considered infeasible for the project due to the widespread presence of consolidated glacial till. In general, these soils exhibit a low to negligible infiltration potential and cannot reliably support the long-term performance criteria required of infiltration facilities.

### **Preliminary Vault Considerations**

From a geotechnical standpoint, construction of a vault within the southeastern site corner is considered feasible. Based on our nearby test pit explorations, dense to very dense native silty sand is likely to be encountered in the vault excavation. Although not encountered during the May 2024 field exploration, areas of perched groundwater may also be present within the vault excavation. The vault should be located away from property lines or other crucial features to the extent feasible so that acceptable temporary slope inclinations (as provided above) can be established. Where such space is not available, temporary shoring may be necessary. An ESNW representative, the contractor, and the client (or their representative) should observe the completion of a test pit within the proposed vault area prior to mass earthwork operations. The test pit will allow ESNW to evaluate soil and groundwater conditions at the time of construction and to provide recommendations for maintaining stability, if necessary.

### **LIMITATIONS**

This study has been prepared for the exclusive use of JKM Holdings, 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. A warranty is neither expressed nor implied. Variations in the soil and groundwater conditions observed at the exploration locations may exist and may not become evident until construction. ESNW should be contacted to reevaluate the conclusions provided in this study if variations are encountered.

### **Additional Services**

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

### **REFERENCES**

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

- Client-provided Marked-up Site Plan
- Geologic Map of the Suquamish 7.5' Quadrangle and Part of the Seattle North 7.5' x 15' Quadrangle, Kitsap County, Washington, prepared by Ralph A. Haugerud and Kathy G. Troost, 2011
- Geological Hazard Areas Map, prepared by the City of Poulsbo Planning Department, dated June 14, 2017
- Poulsbo Municipal Code (PMC) Chapter 16.20 – Critical Areas
- Web Soil Survey (WSS) online resource, maintained by the Natural Resources Conservation Service (NRCS) under the United States Department of Agriculture (USDA)



Reference:  
Kitsap County, Washington  
OpenStreetMap.org



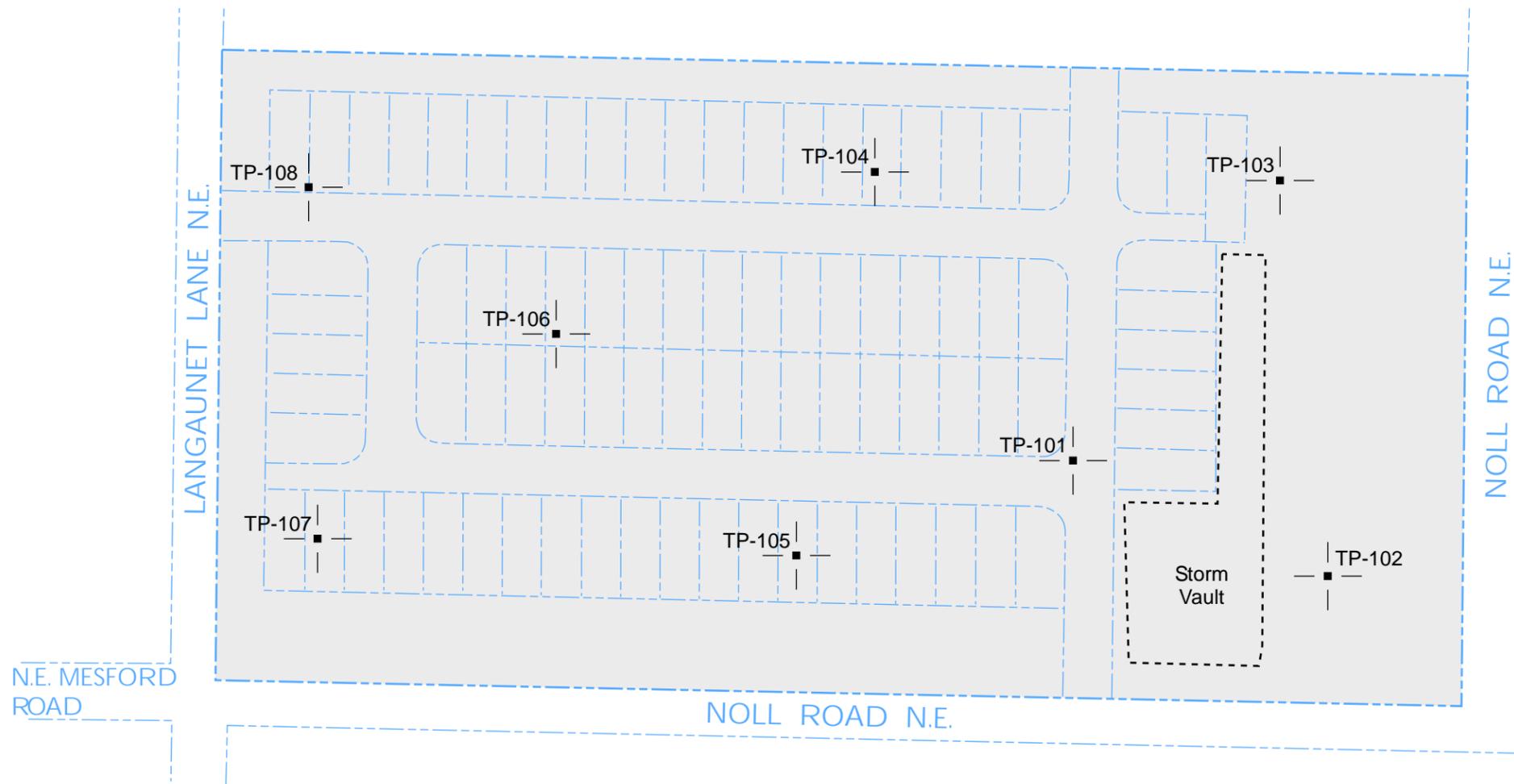
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.



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Geotechnical Engineering, Construction  
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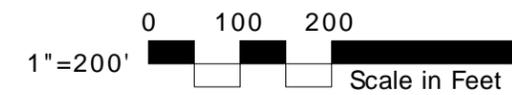
Vicinity Map  
Sandstone Ridge  
Poulsbo, Washington

Drawn MRS	Date 06/17/2024	Proj. No. 8360.03
Checked SKH	Date June 2024	Plate 1



**LEGEND**

- TP-101 | ■ | Approximate Location of ESNW Test Pit, Proj. No. ES-8360.03, May 2024
- ▭ | Subject Site

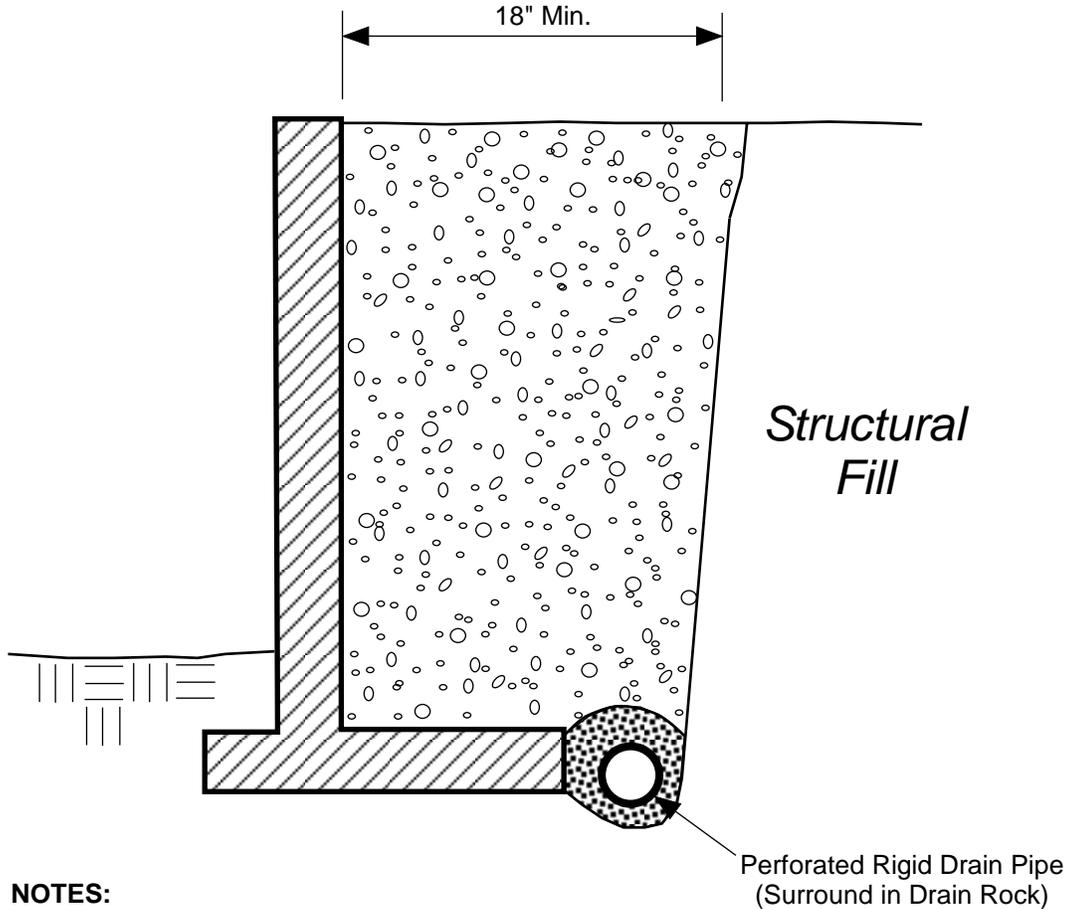


NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided 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.



Drawn MRS
Checked SKH
Date 06/17/2024
Proj. No. 8360.03
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:**

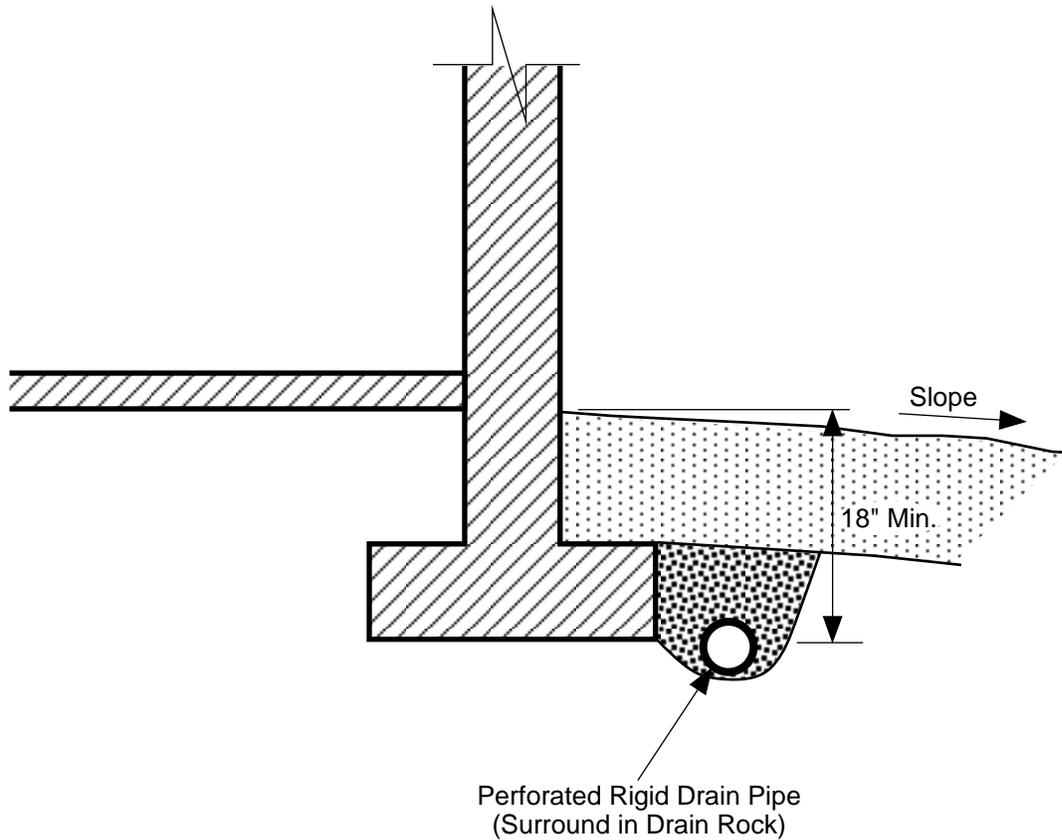


Free-draining Structural Backfill



1-inch Drain Rock

		<b>Earth Solutions NW<sub>LLC</sub></b> Geotechnical Engineering, Construction Observation/Testing and Environmental Services	
<b>Retaining Wall Drainage Detail</b> <b>Sandstone Ridge</b> <b>Poulsbo, Washington</b>			
Drawn	MRS	Date	06/17/2024
Proj. No.	8360.03		
Checked	SKH	Date	June 2024
Plate	3		



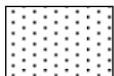
Perforated Rigid Drain Pipe  
(Surround in Drain Rock)

**NOTES:**

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

SCHMATIC ONLY - NOT TO SCALE  
NOT A CONSTRUCTION DRAWING

**LEGEND:**



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



1-inch Drain Rock

		<b>Earth Solutions NW<sub>LLC</sub></b> Geotechnical Engineering, Construction Observation/Testing and Environmental Services	
<b>Footing Drain Detail          Sandstone Ridge          Poulsbo, Washington</b>			
Drawn MRS	Date 06/17/2024	Proj. No.	8360.03
Checked SKH	Date June 2024	Plate	4

## **Appendix A**

### **Subsurface Exploration Logs**

#### **ES-8360.03**

ESNW explored on-site soil and groundwater conditions on May 21, 2024. Eight test pits were excavated using a trackhoe and operator retained by ESNW. The test pits were completed within accessible areas of the subject site. The approximate locations of the test pits are illustrated on Plate 2 of this study. The test pit logs are provided in this Appendix. The test pits were excavated to a maximum depth of approximately 10 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.

Coarse-Grained Soils - More Than 50% Retained on No. 200 Sieve		Moisture Content		Symbols	
Gravels - More Than 50% of Coarse Fraction Retained on No. 4 Sieve		<b>GW</b>	Well-graded gravel with or without sand, little to no fines	Dry - Absence of moisture, dusty, dry to the touch	
		<b>GP</b>	Poorly graded gravel with or without sand, little to no fines	Damp - Perceptible moisture, likely below optimum MC	
		<b>GM</b>	Silty gravel with or without sand	Moist - Damp but no visible water, likely at/near optimum MC	
		<b>GC</b>	Clayey gravel with or without sand	Wet - Water visible but not free draining, likely above optimum MC	
Sands - 50% or More of Coarse Fraction Passes No. 4 Sieve		<b>SW</b>	Well-graded sand with or without gravel, little to no fines	Saturated/Water Bearing - Visible free water, typically below groundwater table	
		<b>SP</b>	Poorly graded sand with or without gravel, little to no fines		
		<b>SM</b>	Silty sand with or without gravel		
		<b>SC</b>	Clayey sand with or without gravel		
Fine-Grained Soils - 50% or More Passes No. 200 Sieve		Terms Describing Relative Density and Consistency			
Silt and Clays Liquid Limit Less Than 50		<b>ML</b>	Silt with or without sand or gravel; sandy or gravelly silt	<b>Coarse-Grained Soils:</b> <u>Density</u> <u>SPT blows/foot</u> Very Loose                      < 4 Loose                              4 to 9 Medium Dense                    10 to 29 Dense                                30 to 49 Very Dense                        ≥ 50	
		<b>CL</b>	Clay of low to medium plasticity; lean clay with or without sand or gravel; sandy or gravelly lean clay	<b>Fine-Grained Soils:</b> <u>Consistency</u> <u>SPT blows/foot</u> Very Soft                         < 2 Soft                                  2 to 3 Medium Stiff                    4 to 7 Stiff                                 8 to 14 Very Stiff                        15 to 29 Hard                                ≥ 30	
		<b>OL</b>	Organic clay or silt of low plasticity	<b>Test Symbols &amp; Units</b> Fines = Fines Content (%) MC = Moisture Content (%) DD = Dry Density (pcf) Str = Shear Strength (tsf) PID = Photoionization Detector (ppm) OC = Organic Content (%) CEC = Cation Exchange Capacity (meq/100 g) LL = Liquid Limit (%) PL = Plastic Limit (%) PI = Plasticity Index (%)	
		<b>MH</b>	Elastic silt with or without sand or gravel; sandy or gravelly elastic silt		
Silt and Clays Liquid Limit 50 or More		<b>CH</b>	Clay of high plasticity; fat clay with or without sand or gravel; sandy or gravelly fat clay	<b>Component Definitions</b> <u>Descriptive Term</u> <u>Size Range and Sieve Number</u> Boulders                                  Larger than 12" Cobbles                                    3" to 12" Gravel Coarse Gravel                        3" to No. 4 (4.75 mm) Fine Gravel                            3/4" to No. 4 (4.75 mm) Sand Coarse Sand                         No. 4 (4.75 mm) to No. 10 (2.00 mm) Medium Sand                         No. 10 (2.00 mm) to No. 40 (0.425 mm) Fine Sand                              No. 40 (0.425 mm) to No. 200 (0.075 mm) Silt and Clay                            Smaller than No. 200 (0.075 mm)	
		<b>OH</b>	Organic clay or silt of medium to high plasticity		
Highly Organic Soils		<b>PT</b>	Peat, muck, and other highly organic soils	<b>Modifier Definitions</b> <u>Percentage by Weight (Approx.)</u> <u>Modifier</u> < 5    Trace (sand, silt, clay, gravel) 5 to 14    Slightly (sandy, silty, clayey, gravelly) 15 to 29    Sandy, silty, clayey, gravelly > 30     Very (sandy, silty, clayey, gravelly)	
Fill		<b>FILL</b>	Made Ground	Classifications of soils in this geotechnical report and as shown on the exploration logs are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates, and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D2487 and D2488 were used as an identification guide for the Unified Soil Classification System.	





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# TEST PIT NUMBER TP-101

PROJECT NUMBER ES-8360.03 PROJECT NAME Sandstone Ridge  
 DATE STARTED 5/21/24 COMPLETED 5/21/24 GROUND ELEVATION 531 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.73790 LONGITUDE -122.61356  
 LOGGED BY SKH CHECKED BY CGH GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_ ∇ AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Forest duff AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0						
			TPSL		Dark brown TOPSOIL, roots to 18"	530.5
					Brown silty SAND, medium dense to dense, damp	
	GB	MC = 7.6			-becomes gray, very dense, weakly cemented -probed 2"	
2.5						
			SM			
5.0						
					-becomes moderately cemented	
7.5						
	GB	MC = 11.4				522.0

Test pit terminated at 9.0 feet below existing grade due to refusal in very dense native soil. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.



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# TEST PIT NUMBER TP-102

PROJECT NUMBER ES-8360.03 PROJECT NAME Sandstone Ridge  
 DATE STARTED 5/21/24 COMPLETED 5/21/24 GROUND ELEVATION 509 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.73775 LONGITUDE -122.61264  
 LOGGED BY SKH CHECKED BY CGH GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_ ∇ AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Forest duff AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					
			TPSL		Dark brown TOPSOIL, roots to 24"
				1.0	508.0
					Brown silty SAND, medium dense to dense, damp
2.5	GB	MC = 10.4			-probed 4"
					-becomes gray, very dense, moderately cemented -probed 2"
5.0			SM		
7.5					
10.0	GB	MC = 10.6 Fines = 31.8		10.0	499.0

[USDA Classification: slightly gravelly sandy LOAM]

Test pit terminated at 10.0 feet below existing grade due to refusal in very dense native soil. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 8360-3.GPJ - GINT US.GDT - 8/9/24



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# TEST PIT NUMBER TP-103

PROJECT NUMBER ES-8360.03 PROJECT NAME Sandstone Ridge  
 DATE STARTED 5/21/24 COMPLETED 5/21/24 GROUND ELEVATION 519 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.73880 LONGITUDE -122.61277  
 LOGGED BY SKH CHECKED BY CGH GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_  $\nabla$  AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Forest duff AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0						
			TPSL		Dark brown TOPSOIL, roots to 12"	518.5
					Brown silty SAND, medium dense to dense, moist	
	GB	MC = 12.9			-probed 4"	
2.5						
					-becomes gray, very dense, moderately cemented	
			SM		-probed 2"	
5.0						
7.5						
	GB	MC = 12.5				511.0

Test pit terminated at 8.0 feet below existing grade due to refusal in very dense native soil. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.





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# TEST PIT NUMBER TP-105

PROJECT NUMBER ES-8360.03 PROJECT NAME Sandstone Ridge  
 DATE STARTED 5/21/24 COMPLETED 5/21/24 GROUND ELEVATION 548 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.73768 LONGITUDE -122.61483  
 LOGGED BY SKH CHECKED BY CGH GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_  $\nabla$  AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Forest duff AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					
			TPSL		Dark brown TOPSOIL, roots to 18"
				1.0	547.0
	GB	MC = 13.9			Brown silty SAND, medium dense, moist -probed 6"
2.5					
					-becomes gray, very dense
5.0			SM		
7.5					
	GB	MC = 12.6 Fines = 45.9		9.0	539.0
					[USDA Classification: slightly gravelly fine sandy LOAM]

Test pit terminated at 9.0 feet below existing grade due to refusal in very dense native soil. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.



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# TEST PIT NUMBER TP-106

PROJECT NUMBER ES-8360.03 PROJECT NAME Sandstone Ridge  
 DATE STARTED 5/21/24 COMPLETED 5/21/24 GROUND ELEVATION 588 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.73827 LONGITUDE -122.61584  
 LOGGED BY SKH CHECKED BY CGH GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_  $\nabla$  AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Forest duff AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					
			TPSL		Dark brown TOPSOIL, roots to 18"
				0.5	587.5
	GB	MC = 16.0			Brown silty SAND, medium dense, moist -probed 6"
2.5					
			SM		-becomes gray, very dense, weakly cemented -probed 1"
5.0					
7.5	GB	MC = 9.7 Fines = 39.8		7.5	580.5

[USDA Classification: slightly gravelly fine sandy LOAM]  
 Test pit terminated at 7.5 feet below existing grade due to refusal in very dense native soil. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.



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# TEST PIT NUMBER TP-107

PROJECT NUMBER ES-8360.03 PROJECT NAME Sandstone Ridge  
 DATE STARTED 5/21/24 COMPLETED 5/21/24 GROUND ELEVATION 593 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.73782 LONGITUDE -122.61682  
 LOGGED BY SKH CHECKED BY CGH GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_  $\nabla$  AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Forest duff AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					
			TPSL		Dark brown TOPSOIL, roots to 18"
				1.0	592.0
	GB	MC = 19.2			Brown silty SAND with gravel, medium dense, moist -probed 5"
2.5					-becomes gray, very dense
			SM		-probed 1"
5.0					
7.5					
	GB	MC = 9.8		8.0	585.0

Test pit terminated at 8.0 feet below existing grade due to refusal in very dense native soil. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.



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# TEST PIT NUMBER TP-108

PROJECT NUMBER ES-8360.03 PROJECT NAME Sandstone Ridge  
 DATE STARTED 5/21/24 COMPLETED 5/21/24 GROUND ELEVATION 599 ft  
 EXCAVATION CONTRACTOR NW Excavating LATITUDE 47.73863 LONGITUDE -122.61686  
 LOGGED BY SKH CHECKED BY CGH GROUND WATER LEVEL:  
 NOTES \_\_\_\_\_  $\nabla$  AT TIME OF EXCAVATION \_\_\_\_\_  
 SURFACE CONDITIONS Forest duff AFTER EXCAVATION \_\_\_\_\_

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					
			TPSL		Dark brown TOPSOIL, roots to 24"
				1.0	598.0
					Brown silty SAND with gravel, medium dense, damp
2.5	GB	MC = 12.0 Fines = 19.8			[USDA Classification: very gravelly sandy LOAM] -probed 6"
					-becomes gray, very dense, weakly cemented
5.0			SM		
7.5					
	GB	MC = 9.7		8.5	590.5

Test pit terminated at 8.5 feet below existing grade due to refusal in very dense native soil. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

**Appendix B**  
**Laboratory Test Results**  
**ES-8360.03**

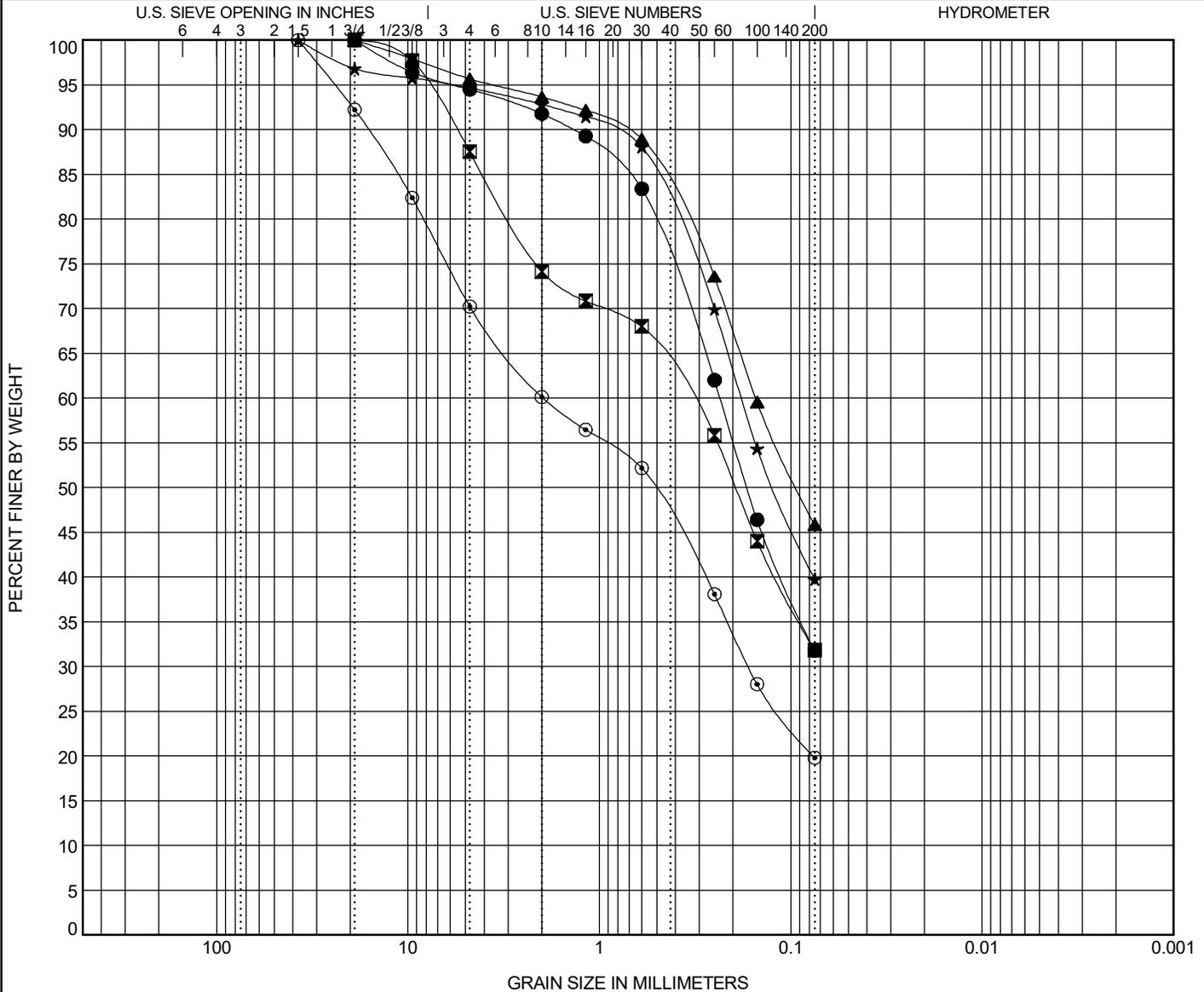


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# GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-8360.03

PROJECT NAME Sandstone Ridge



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification							Cc	Cu
● TP-102 10.00ft.	USDA: Gray Slightly Gravelly Sandy Loam. USCS: SM.								
⊠ TP-104 1.50ft.	USDA: Brown Gravelly Fine Sandy Loam. USCS: SM.								
▲ TP-105 9.00ft.	USDA: Gray Slightly Gravelly Fine Sandy Loam. USCS: SM.								
★ TP-106 7.50ft.	USDA: Gray Slightly Gravelly Fine Sandy Loam. USCS: SM.								
⊙ TP-108 2.00ft.	USDA: Brown Very Gravelly Sandy Loam. USCS: SM with Gravel.								
Specimen Identification	D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● TP-102 10.0ft.	19	0.234						31.8	
⊠ TP-104 1.5ft.	19	0.337						31.8	
▲ TP-105 9.0ft.	19	0.152						45.9	
★ TP-106 7.5ft.	37.5	0.18						39.8	
⊙ TP-108 2.0ft.	37.5	1.965	0.166					19.8	

GRAIN SIZE USDA ES-8360.03 SANDSTONE RIDGE.GPJ GINT US LAB.GDT 5/31/24