Geotechnical Engineering Report

Ford Pro Marysville
16100 Smokey Point Boulevard
Marysville, WA 98271

Prepared For:

Kendall Development Group
3449 East Copper Point Drive
Meridian, ID 83642

Attn: Todd McFarlane
Property Manager

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January 11, 2024
Project No. 23-3322

Kendall Development Group
3449 East Copper Point Drive
Meridian, ID 83642

Attention: Todd McFarlane
Property Manager

Regarding: **Geotechnical Engineering Report**
Ford Pro Marysville
16100 Smokey Point Boulevard
Marysville, WA 98271

Dear Mr. McFarlane,

As requested, GeoTest Services, Inc. is pleased to submit the following report summarizing the results of our geotechnical evaluation for the proposed Ford Pro Marysville to be constructed on parcel number 31052900400600, along Smokey Point Boulevard in Marysville, WA. This report has been prepared in general accordance with the terms and conditions established in our services agreement (Proposal No. 00-233322-P) dated December 12, 2023 and authorized by yourself.

GeoTest appreciates the opportunity to provide geotechnical services on this project and look forward to assisting you during construction. Should you have further questions regarding the information contained within the report, or if we may be of service in other regards, please contact the undersigned.

Respectfully,
GeoTest Services, Inc.

EDWARDO A. GARCIA
40819

01-11-24

Edwardo Garcia, P.E.
Geotechnical Department Manager

Enclosure: Geotechnical Engineering Report

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PURPOSE AND SCOPE OF SERVICES

The purpose of this investigation is to establish general subsurface conditions beneath the site from which conclusions and recommendations pertaining to project design can be formulated. Our scope of services includes the following tasks:

- Review previously prepared geotechnical reporting and analysis pertaining to the subject property. Specifically, we have reviewed a document titled *Geotechnical Report: Pilchuck Landing, Smokey Point Boulevard, Marysville, Washington,* prepared by Terra Associates, Inc., and dated March 2, 2005. GeoTest also reviewed *Geotechnical Engineering Development: Kendall Subaru Development, 16XXX Smokey Point Boulevard, Marysville, Washington,* prepared by Nelson Geotechnical Associates, Inc. and dated July 27, 2022.

- Explore soil and groundwater conditions underlying the site by advancing three cone penetrometer tests (CPT-1 through CPT-3) and seven test pit explorations (TP-1 through TP-7) with a tracked excavator. Cone penetration testing services were subcontracted by GeoTest, while the excavator was provided by Gaffney Construction.

- Perform laboratory testing on representative samples to classify and determine the engineering characteristics of the soils encountered and to assess on-site infiltration feasibility from a preliminary standpoint per the *2019 Stormwater Management Manual for Western Washington* (SMMWW).

- Provide a written report containing a description of surface and subsurface conditions, exploration logs, with findings and recommendations pertaining to site preparation and earthwork, including stripping depths, subgrade preparation below the planned building, reuse of on-site soils, wet weather earthwork and criteria for selection, placement, and compaction of Structural Fill.

- Provide recommendations for foundation support of the structures including bearing elevations, frost penetration depth, a discussion pertaining to potential foundation settlement (total and differential), and general foundation design recommendations.

- Provide recommendations for lateral earth pressures including active and at-rest conditions, allowable passive soil resistance, groundwater considerations, drainage recommendations, pavement design, temporary slopes and utilities.

- A discussion of the Seismic Site Class considerations based on the 2018 International Building Code (IBC).

- Provide recommendations for geotechnical monitoring, materials testing, and consultation during construction.

- An assessment of geologically hazardous areas per Marysville Municipal Code (MMC).

PROJECT DESCRIPTION

GeoTest understands that the 4.3-acre subject property (Parcel #31052900400600) will be improved through the construction of a new 24 Bay Commercial Truck Service Center with associated parking lots. The new development is planned to be built north of the existing Kendall Ford car dealership building. We generally anticipate that the new structure will be one- to two-story in height and will utilize wood or cold form steel framing with conventional concrete foundations and slab on grade floors. Structural loads are expected to be relatively light.

GeoTest generally anticipates between 1 and 3 feet of new Structural Fill to be placed on the project site and significant grading outside of the building footprint is not currently anticipated. It is our understanding that the project team has not yet embraced a specific stormwater plan, in which some strategies include on-site infiltration facilities and/or connecting to the City of Marysville stormwater main to the east of the site.

SITE CONDITIONS

This section includes a description of the general surface and subsurface conditions observed at the project site during the time of our field investigations. Interpretations of site conditions are based on the results and review of available information, site reconnaissance, subsurface explorations, laboratory testing, and previous experience in the project vicinity.

Surface Conditions

The subject parcel is located at 16100 Smokey Point Boulevard in Marysville, WA north of the existing Kendall Ford dealership. The property is vacant, lacks trees, and is vegetated with grasses and invasive weeds. There are two quarry spall entrances to the site, one in the northeast and one in the southeast corner of the project site. There are remnants of previous site grading and occupation with small mounds of soil and wooden fence posts, most specifically in the eastern half of the parcel.

The site is relatively flat with only a few feet of vertical relief across the site. The site is bordered by Toyota of Marysville to the north, Smokey Point Boulevard to the east, Interstate 5 to the west, and Kendall Ford of Marysville to the south.

Subsurface Soil Conditions

Subsurface conditions were explored and documented by advancing seven test pits (TP-1 through TP-7) and three CPT explorations (CPT-1 through CPT-3) on December 20 and 27, 2023, under the direction of a Geologist. Soils were classified in general accordance with the guidelines of the

American Society for Testing and Materials (ASTM) D2487 and D2488. Approximate locations of these explorations have been plotted on the *Site and Exploration Plan* (Figure 2). A *Soil Classification System and Key* can be found as Figure 4, detailed test pit logs are presented as Figures 5 through 8, with laboratory results as Figures 9 and 10. The CPT results can be found in *Appendix B*

Image 1. Facing southwest towards the existing Kendall Ford of Marysville dealership (Image 1). **Image 2** faces southwest looking towards a mound of vegetated soil with wooden fence posts in the eastern portion of the site. Images 1 and 2 were taken during our site visit on December 13, 2023.

Cone Penetration Testing

Cone penetration tests were advanced using a track-mounted rig operated by ConeTec, Inc. on December 20, 2023. Cone penetration tests assess the physical and engineering properties of subsurface soils in a continuous column. The CPT explorations were terminated at planned depths of roughly 10, 82, and 10.5 feet below ground surface (BGS), respectively. The purpose of these explorations was to assess the physical and engineering properties of the site soils at depth below the project site.

CPTs were performed in general accordance with ASTM D5778 by advancing a cone-shaped rod at a rate of 2 cm/s (approximately 0.75 in/s), during which tip resistance, sleeve friction, and pore pressure were continuously logged to the maximum explored depth. Shear wave velocity testing was performed in general accordance with ASTM D7400 at locations CPT-2 and CPT-3.

In general, the CPT explorations encountered approximately 0.5 to 1 feet of loose to silty topsoil. At the location of CPT-1, medium dense silty sands and sands were observed to the completion of the exploration. Similarly, the location CPT-3 had similar soil conditions, except thin interbeds of gravelly sands were observed at depths of approximately 6.5 and 9 feet BGS. These materials are interpreted as Recessional Outwash, locally referred to "Marysville Sand." These explorations were terminated at depths of approximately 10.3 and 10.5 feet, respectively.

Image 3*:* A track mounted CPT machine, pushing exploration CPT-1, facing southwest.

The CPT-2 exploration encountered medium dense to dense sand and gravel to depths of approximately 22 feet BGS. After approximately 22 feet BGS, the encountered soils transitioned to loose to medium dense sand with interbeds of silt and clay at depths of approximately 35, 66 and 69 feet BGS. At approximately 70 feet BGS, the soil transitioned to dense sand. At a depth of approximately 78 feet to the completion of the exploration at a depth of 82 feet, the CPT encountered medium stiff, sandy silts. Please note that during the original advancement of CPT-2, the cone encountered an obstruction that prevented further advancement. CPT-2 was moved approximately 20 feet to the west where the CPT was advanced to terminal depth.

It should be noted that soil type interpretation by CPT methods is indirect and based on established empirical guidelines. No physical sampling for confirmation of soil classification was performed below 7.5 feet BGS as part of this scope of services. The summary of CPT results is attached at the end of this report.

Test Pit Explorations

Test pit explorations were performed on December 27, 2023 and consisted of the excavation of shallow open pits with the use of a rubber tracked mini excavator and operator provided by Gaffney Construction. Select grab samples were obtained at approximately 2-foot intervals or upon changes in soil stratigraphy. Depths of the test pit explorations ranged from approximately 6 to 7.5 feet below the ground surface (BGS).

In TP-1, TP-3, and TP-7, GeoTest observed approximately 0.5 to 1 feet of topsoil consisting of loose, brown to black, moist, silty sand with variable gravel content and numerous roots. In TP-2, TP-4, TP-5 and TP-6, GeoTest observed 1.5 to 4 feet of uncontrolled fill consisting of loose, gray to dark brown, moist, silty sand with variable gravel content and varying amounts of organic materials, concrete debris, and rubbish.

Underlying the topsoil and fill was 1 to 2 feet of medium dense to dense, tan to orange, moist to damp, silty sand with variable gravel content interpreted to be weathered Marysville Sand. Below the weathered Marysville Sand, we observed medium dense, gray, moist, sand with variable, but generally low amounts, of silt and gravel that was interpreted to be unweathered Maryville Sand. The unweathered Marysville Sand deposits were observed to the terminal depth of all test pits.

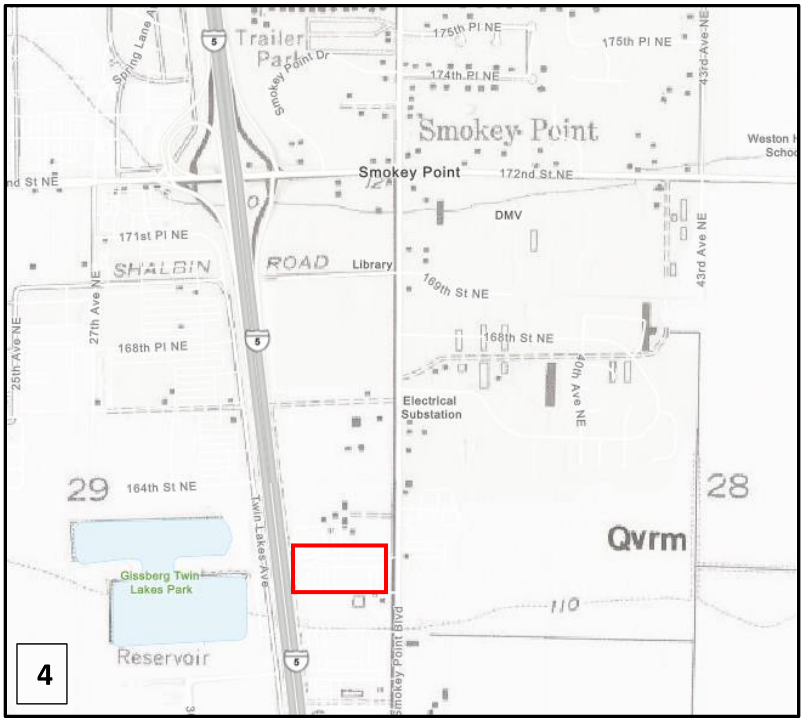

Image 4. Clip from the *Geologic Map of the Arlington 7.5 Minute Quadrangle,* Snohomish County, Washington (Minard, 1985) illustrating that the subject property is underlain by mapped Recessional Outwash Sands, also known as "Marysville Sand" (map unit Qvrm). Approximate site vicinity encapsulated by the red rectangle.

In general, the native soils observed in our test pits were consistent with the soils observed and described in the previously prepared reports titled *Geotechnical Report: Pilchuck Landing, Smokey Point Boulevard, Marysville, Washington* dated March 2, 2005 by Terra Associates, Inc. and *Geotechnical Engineering Development: Kendall Subaru Development, 16XXX Smokey Point Boulevard, Marysville, Washington dated July 27, 2022* by Nelson Geotechnical Associates, Inc. The test pits performed during GeoTest's evaluation, however, uncovered uncontrolled fill materials that were not identified in the other reports.

General Geologic Conditions

Geologic information for the project site was obtained from the *Geologic Map of the Arlington 7.5 Minute Quadrangle*, Snohomish County, Washington (Minard, 1985), published by the U.S. Geological Survey. According to the referenced map, subsurface soils in the vicinity of the project site consist of Marysville Sand Member Recessional Glacial Outwash (Qvrm) deposited during the Fraser glaciation event. The Marysville Sand Member generally consists of well-drained, stratified to massive, outwash sand with some pebble gravel with localized areas of silt and clay.

Native soils encountered during our subsurface explorations were generally consistent with the mapped glacial deposits. For the purposes of this report, GeoTest will refer to both the weathered and non-weathered Marysville Sand member of the Recessional Outwash as “Marysville Sand.”

Groundwater

Groundwater seepage was encountered between 2 and 7 feet in all of our test pit explorations. This seepage is similar in depths to those reported in the two previous geotechnical reports from the surrounding area, *Geotechnical Report: Pilchuck Landing, Smokey Point Boulevard, Marysville, Washington* dated March 2, 2005 by Terra Associates, Inc. and *Geotechnical Engineering Development: Kendall Subaru Development, 16XXX Smokey Point Boulevard, Marysville, Washington* by Nelson Geotechnical Associates, Inc. dated July 27, 2022.

GeoTest interprets the water encountered at depths of greater than about 6 feet BGS to be representative of the regional groundwater table or aquifer. While some scattered orange oxidation was observed within the near-surface Marysville Sands, no concentrated banding or oxidation horizons were observed within the lower Marysville Sands encountered at depths of about 5 feet or more.

Based on a review of publicly available well data from the Washington Department of Ecology *Well Log Viewer,* the regional water table in the Marysville Sand appeared to be at depths between 3 to 6 feet BGS in the vicinity of the subject property at the time those wells were documented. These water levels are consistent, if not slightly higher, than those found in our explorations for this study. The groundwater conditions reported on the exploration logs are for the specific locations and dates indicated, and therefore may not be indicative of other locations and/or times. Groundwater levels are variable and groundwater conditions will fluctuate depending on local subsurface conditions, precipitation, and changes in on-site and off-site use.

Web Soil Survey

According to the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) *Web Soil Survey* website, one relevant soil unit is present on the subject property, Custer fine sandy loam. Please reference Table 1 below for general characteristics of the mapped site soils. Based on their erosion “K” factor assigned by the NRCS, the soils present on-site are considered to have a **moderate** susceptibility to erosion. The value of the erosion factor “K” ranges from 0.02 to 0.69; the higher the value, the more susceptible the soil is to sheet and rill erosion by water. Mapped site soils are generally consistent with the soils observed during our explorations.

Subclass “w” is made up of soils for which excess water is the dominant hazard or limitation affecting their use, due to low permeability and inability to drain. The soils found within the project vicinity are considered to have a moderate susceptibility to erosion based on their K Factor ratings. However, the soil’s vulnerability to sheet and rill erosion are considered **low** based on little to no slope inclination that is present at the subject site. In our opinion, erosion may be managed during and following construction using conventional best management practices.

Table 1
USDA NRCS Soil Classifications

Map Unit Symbol	13
Map Unit Name	Custer fine sandy loam
Soil Description	Fine sandy loam to sand
Landform	Outwash plains
Parent Material	Glacial Outwash
Land Capability Classification	5w
Erosion K Factor, Whole Soil	0.20

GEOLOGIC HAZARD ASSESSMENT

Based on Marysville Municipal Code (MMC) 22A.020.080, *Geologic Hazard Areas* are “lands or areas characterized by geologic, hydrologic, and topographic conditions that render them susceptible to potentially significant or severe risk of landslides, erosion, or seismic activity.” The subject property and surrounding areas are flat. There does not appear to be landslide or erosion hazards, as defined by the Marysville Municipal Code, on the project site.

Liquefaction is defined as a significant rise in pore water pressure within a soil mass caused by earthquake-induced cyclic shaking. The shear strength of liquefiable soils is reduced during large and/or long duration earthquakes as the soil consistency approaches that of semi-solid slurry. Liquefaction can result in significant and widespread structural damage if not properly mitigated. Deposits of loose, granular soil below the groundwater table are most susceptible to liquefaction. Damage caused by foundation rotation, lateral spreading, and other ground movements can result from soil liquefaction.

Based on a review of information obtained from the *Geologic Information Portal*, the subject site is classified as having a **"low to moderate"** liquefaction susceptibility. However, this map only provides an estimate of the likelihood that soil will liquefy as a result of an earthquake and is meant as a general guide to delineate areas prone to liquefaction.

Subsurface conditions exhibited within our explorations consisted of interbedded strata of dominantly medium dense, slightly silty to very silty sand and/or sandy silt underlying loose topsoil and uncontrolled fill. Groundwater seepage at the time of our investigation was encountered from approximately 2 to 7.5 feet BGS at test pit locations.

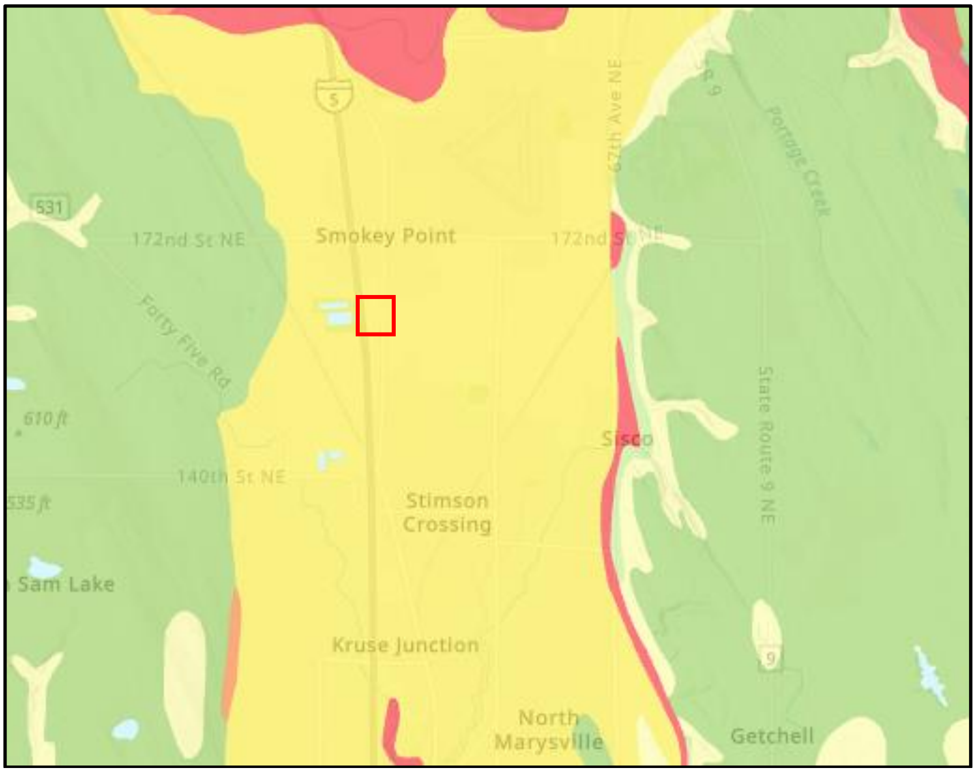

Image 5. Screenshot from the DNR Geologic Information Portal, in which the entire project site is considered to possess a low to moderate liquefaction susceptibly (yellow). Approximate site location is located within the red box.

Due to the mapped site rating, GeoTest performed a liquefaction analysis. The analysis was completed using *LiquefyPro,* Version 5.8h, published by CivilTech Software©. The method of analysis was a simplified procedure originally proposed by Seed and Idriss (1971) that has been modified by Youd and Idriss (2001). Cone Penetration Test data obtained in explorations CPT-2 was analyzed to estimate the factor of safety against liquefaction and associated settlement which could occur below the planned building under a design level seismic event.

The static groundwater level was assumed to be at 6 feet below existing grades. The liquefaction potential was evaluated for a large design-level earthquake having a 2 percent probability of exceedance in a 50-year period. The liquefaction analyses assume a peak horizontal ground acceleration of 0.46g and an earthquake magnitude of 7. The amount of ground subsidence will depend on many factors, including the intensity and duration of seismic shaking, and local soil and groundwater conditions. Therefore, the extent of liquefaction, if any, may vary from the estimation below.

The maximum amount of post-liquefaction ground subsidence, assuming no ground improvements and only minimal amounts of Structural Fill under the foundations can be estimated using methods developed by Ishihara. Using this approach, **the magnitude of post-liquefaction settlement under existing conditions was calculated to be less than 2 inches. This settlement is expected to be non-uniform with potential differential settlements of up to 1 inch.** Notably, this calculation does not include significant thicknesses of Structural Fill or the confining pressures that new construction might exert over the building footprint. Conversely, stronger seismic events with a prolonged duration could lead to settlements that exceed our modeled results.

Based on the results of our liquefaction analysis, and in light of the limitations of the analysis and prescribed assumptions, it is GeoTest's opinion that there is a **moderate probability** of liquefaction occurring beneath the project site under the design level earthquake. Due to the low angle topography in the site vicinity, settlement resulting from liquefaction is expected to be primarily vertical in nature. We do not expect lateral spreading to be an issue at the project site.

Mitigating Liquefaction Induced Settlement

Based on the results of our liquefaction analysis, the magnitude of post-liquefaction induced total settlement under proposed conditions was calculated to be less than **2 inches**. This settlement is expected to be non-uniform with potential differential settlements of up to **1 inch.** Therefore, we recommend that the building foundations implement interconnected grade beams or structural slab floors to mitigate differential settlement due to liquefaction. Grade beam reinforcement will not prevent total building settlement but will encourage the building to settle as a unit, thus reducing structural damage incurred due to differential settlement. A structural slab could be used in lieu of a grade beam system to mitigate against differential settlements.

It must be understood that these mitigations **will not** address total settlements, but will help mitigate differential settlement across the building footprint. As such, the Owner must accept the risk of total settlement that may occur during a seismic event if ground improvements or deep foundation systems are not incorporated into the plan for site development.

It is our understanding that deep foundation systems and ground improvement methods are not currently being considered for the project. If, however, deep foundation systems or ground improvement approaches are preferred by the project ownership, GeoTest would be pleased to provide updated recommendations to facilitate the design of such a system.

CONCLUSIONS AND RECOMMENDATIONS

Based on the evaluation of the data collected during this investigation, it is our opinion that the subsurface conditions at the site are suitable for the proposed development, provided the recommendations contained herein are incorporated into the project design.

The site is relatively flat and is underlain by approximately 0.5 to 1 feet of topsoil consisting of loose, brown to black, damp, silty sand with variable gravel content and numerous roots. In the eastern half of the project site, GeoTest observed the presence of uncontrolled fill to depths of up to 3.5 feet BGS. The uncontrolled fill consisted of loose, black to orange, damp, silty sand with variable gravel content (including quarry spalls) and organic debris (roots, weeds, wood, etc.). Underlying the topsoil and, where encountered, the uncontrolled fill, GeoTest observed loose to medium dense, native soil which GeoTest interpreted to be representative of Marysville Sand.

When encountered and generally on the eastern half of the project site, uncontrolled fill, deleterious materials, organic debris, and loose/unsuitable portions of native soil (which cannot be readily recompacted) should be removed from below the building footprint and replaced with suitable Structural Fill. We recommend the Client plan for typical stripping depths below the building footprint of approximately 1 foot in the western half of the project site and between 1.5 to 3.5 feet on the eastern half of the site.

GeoTest is assuming that the Owner is unlikely to do a full removal of existing uncontrolled fill below planned pavements and drive paths. Leaving uncontrolled fill in place and below pavement sections does present risk of long-term settlement and/or increased maintenance, but this risk is generally preferred to the costs associated with a full removal and replacement with Structural Fill materials. In parking and drive path areas, GeoTest recommends only 2 feet of stripping and remedial compaction of exposed mineral soil to a firm and unyielding condition prior to replacement with Structural Fill and road base materials. Highly organic soil should, however, be removed to expose mineral soil.

Based on our analysis, the site is considered to present a moderate potential for liquefaction induced settlement during a design level seismic event. As such, we recommend that the project incorporate mitigation to address this potential hazard. Differential settlement due to liquefaction can be mitigated through the incorporation of grade beams (or structural slabs) into the foundation design. Please note that grade beams and/or structural slabs will not prevent the settlement of the building due to liquefaction occurring on the project site. Post-construction settlements due to liquefaction can only be prevented through the use of a deep foundation system and/or ground improvements. If up to 2 inches of total and 1 inch of differential settlement is considered unacceptable for the planned structure, deep-foundations or ground improvement approaches should be considered for the building.

Based on the native soils encountered in the test pits, it appears that the subject site may be suitable if stormwater management approaches that include infiltration are selected. If infiltration is selected for this project site, GeoTest anticipates that any new facilities will need to account for the potential for reduced amounts of separation between groundwater and the facility. GeoTest has presented preliminary design infiltration rates based on unconsolidated grain size analyses that may assist the Stormwater Designer with their design.

Site Preparation and Earthwork

The portions of the site proposed for foundation(s), floor slabs, pavements, and/or sidewalks development should be prepared by removing topsoil, deleterious material, and significant accumulations of organics. Below the building footprint, all existing topsoil and uncontrolled fill should be removed and replaced with Structural Fill. Below pavement and drive paths, GeoTest recommends only 2 feet of removal provided that mineral soil is exposed after the removal. In all cases, the exposed subgrade should be viewed by the Geotechnical Engineer or his representative before being compacted to a firm and unyielding condition. Verification of compaction can be accomplished through proof rolling with a loaded dump truck, large self-propelled vibrating roller, or similar piece of equipment applicable to the size of the excavation. The purpose of this effort is to identify loose or soft soil deposits so that, if feasible, the soil distributed during site work can be recompacted.

Areas exhibiting significant deflection, pumping, or over-saturation that cannot be readily compacted should be overexcavated to firm soil. Overexcavated areas should be backfilled with compacted granular material placed in accordance with subsequent recommendations for Structural Fill. During periods of wet weather, proof rolling could damage the exposed subgrade. Under these conditions, qualified geotechnical personnel should observe subgrade conditions to determine if proof rolling is feasible.

Proof rolling may not be feasible for certain locations within excavations, trench areas, or other difficult to access zones when using a full-size dump truck or other large machinery. In this situation, we recommend alternate means of verification such as Dynamic Cone Penetrometer (DCP) testing or soil probe methods be employed to verify suitability of field conditions.

Please note the near surface native site soils are expected to be moisture sensitive. As such, we recommend that earthwork be performed during extended periods of dry weather, such as the summer and early fall, when feasible. Earthwork performed during wet site conditions will likely incur unavoidable expense when compared to dry weather construction.

Fill and Compaction

Structural Fill used to obtain final elevations for footings, grade beams and soil-supported floor slabs must be properly placed and compacted. In most cases, any non-organic, predominantly granular soil may be used for fill provided the material is properly moisture conditioned prior to placement and compaction, and the specified degree of compaction is obtained. Material containing topsoil, wood, trash, organic content, or construction debris is not suitable for reuse as Structural Fill and should be properly disposed off-site or placed in nonstructural areas.

Soils containing more than approximately 5 percent fines are considered moisture sensitive and are difficult to compact to a firm and unyielding condition when over the optimum moisture content by more than approximately 2 percent. The optimum moisture content is that which allows the greatest dry density to be achieved at a given level of compactive effort.

Reuse of On-Site Soil – Uncontrolled Fill

The uncontrolled fill that was observed on the project site contained construction debris, trash, and organic debris, all of which is not acceptable for reuse as Structural Fill. Uncontrolled fill should be stripped and stockpiled outside of areas proposed for improvement. The project team may elect to reuse uncontrolled fill materials as "Non-Structural Fill", but it should be noted that the uncontrolled fill was of poor quality.

Reuse of On-Site Soil – Native Maryville Sand

The near surface non-organic, native Marysville Sand soils contain variable amounts of silt and are considered to be moisture sensitive. These soils may be suitable for reuse as Structural Fill when placed at or near optimum moisture contents, as determined by ASTM D1557, if allowed for in the project plans and specifications, and when placed during extended periods of dry weather. Due to the moisture sensitivity, reuse of on-site soils will be considerably more difficult to use during extended periods of wet weather and during the wet season (October 1 – April 30). If using on-site materials, the Contractor or Owner should be prepared to manage over optimum moisture content soils. The moisture content of the soils may be difficult to control during periods of wet weather.

Shallow groundwater seepage was encountered during the subsurface explorations. Soil below a depth of about 6 feet should be expected to be saturated, although the groundwater elevation should generally be expected to drop during extended periods of dry weather. Saturated soils cannot reasonably be assumed to be reused as Structural Fill materials without extensive moisture conditioning to dry these soils back to within 2 percent of optimum moisture contents. The Contractor and Owner should be prepared to manage over-optimum moisture content soils and it should be expected that the moisture content of the site soils will be difficult to control during extended periods of wet weather.

Imported Structural Fill

GeoTest recommends that imported Structural Fill consist of clean, well-graded sandy gravel, gravelly sand, or other approved naturally occurring granular material (pit run), or well-graded crushed rock. We recommend Structural Fill for dry weather construction be similar to

Washington State Department of Transportation (WSDOT) Standard Specification 9-03.14(2) for “Select Borrow” with the added requirement that 100 percent pass a 4-inch-square sieve. Soil containing more than about 5 percent fines (that portion passing the U.S. No. 200 sieve) cannot consistently be compacted to a dense, non-yielding condition when the water content is greater than optimum. If a proposed material does not meet the referenced WSDOT specification, GeoTest should be allowed to review the material prior to its importation.

Accordingly, GeoTest recommends that imported Structural Fill for wet weather construction be similar to WSDOT Standard Specification 9-03.14(1) for “Gravel Borrow” with the added requirement that no more than 5 percent pass the U.S. No. 200 sieve. Due to wet weather or wet site conditions, soil moisture contents could be high enough that it may be very difficult to compact even ‘clean’ imported select granular fill to a firm and unyielding condition. Soils with over-optimum moisture contents should be scarified and dried back to more suitable moisture contents during periods of dry weather or removed and replaced with fill soils at a more suitable range of moisture contents.

The Owner may elect to import materials other than what is referenced within this report for use as Structural Fill. In this event, GeoTest recommends that imported materials be submitted for review prior to transporting them to the site. Knowledge about the silt content and/or composition of the proposed import materials may benefit the Owner and allow them to make a more informed decision about the suitability of the materials in question.

Backfill and Compaction

Structural Fill should be placed in horizontal lifts. The Structural Fill must measure 8 to 10 inches in loose thickness and be thoroughly compacted. All Structural Fill placed under load bearing areas should be compacted to at least 95 percent of the maximum dry density, as determined using test method ASTM D1557. The top of the compacted Structural Fill should extend outside all foundations and other structural improvements a minimum distance equal to the thickness of the fill. We recommend that compaction be tested after placement of each lift in the fill pad.

Wet Weather Earthwork

The near-surface portions of Maryville Sand contain elevated fines content and are susceptible to degradation during wet weather. As a result, it may be difficult to control the moisture content of site soils during the wet season. If construction takes place during wet weather, GeoTest recommends that Structural Fill consist of imported, clean, well-graded sandy gravel or gravelly sand as described above. If fill is to be placed or earthwork is to be performed in wet conditions, the contractor may reduce soil disturbance by:

- Limiting the size of areas that are stripped and left exposed
- Accomplishing earthwork in small sections
- Limiting construction traffic over unprotected soil

- Sloping excavated surfaces to promote runoff
- Limiting the size and type of construction equipment used
- Providing gravel 'working mats' over areas of prepared subgrade
- Removing wet surficial soil prior to commencing fill placement each day
- Sealing the exposed ground surface by rolling with a smooth drum compactor or rubber-tired roller at the end of each working day
- Providing up-gradient perimeter ditches or low earthen berms and using temporary sumps to collect runoff and prevent water from ponding and damaging exposed subgrades

Seismic Design Considerations

The Pacific Northwest is seismically active, and the site could be subject to movement from a moderate or major earthquake. Consequently, moderate levels of seismic shaking should be accounted for during the design life of the project, and the proposed structure should be designed to resist earthquake loading using appropriate design methodology.

For structures designed using the seismic design provisions of the 2018 International Building Code, the generally medium-dense Marysville Sand at depth is classified as Site Class D, according to ASCE 7-16. The Structural Engineer should select the appropriate design response spectrum based on Site Class D soil and the geographical location of the proposed construction.

Foundation Support

GeoTest assumes that mitigation for differential settlement due to liquefaction will consist of an interconnected grade beam foundation system or structural slab foundations. The intent of the grade beam or structural slab foundation is to have the building settle as a unit and limit the amount of differential settlement that occurs across the building footprint. The use of either of these approaches requires that the Owner accept the risk of future settlement under the structure during a design seismic event. There should not be an expectation that grade beams or structural slabs will prevent settlement that can occur during a design seismic event. Recommendations for interconnected grade beams and structural slabs are presented below.

To provide proper support, GeoTest recommends that existing topsoil, uncontrolled fill, and/or loose upper portions of the native soil be removed from beneath the building foundation area(s) and be replaced with properly compacted Structural Fill as described in the *Fill and Compaction* section of this report.

Localized overexcavations can be backfilled to the design footing elevation with suitable Structural Fill or controlled density fill (CDF), or foundations may be extended to bear on undisturbed native soil. In areas requiring overexcavation to competent native soil, the limits of the overexcavation should extend laterally beyond the edge of each side of the footing a distance equal to the depth of the excavation below the base of the footing. If CDF is used to backfill the overexcavation, the limits of the overexcavation need only extend a nominal distance beyond the width of the footing. In addition, GeoTest recommends that foundation elements for the proposed structure(s) bear entirely on similar soil conditions to help prevent differential settlement from occurring.

Continuous and isolated spread footings should be founded 18 inches, minimum, below the lowest adjacent final grade for freeze/thaw protection. The footings should be sized in accordance with the Structural Engineer's prescribed design criteria and seismic considerations.

Shallow Conventional Foundations and Grade Beams

GeoTest recommends that the proposed building be supported by shallow conventional foundations with interconnected grade beams. GeoTest is assuming a rectangular unit foundation in which grade beams, equally spaced and suitably reinforced, can be inserted within the footprint of the building. Grade beams should be structurally connected to the foundation to provide a "snowshoe" effect that will help limit differential settlement across the building footprint.

Foundation elements should be founded on proof-rolled, remedially compacted, medium dense native soils or on properly compacted Structural Fill placed directly over firm and unyielding native soil. GeoTest must confirm that suitable bearing conditions have been achieved prior to the placement of reinforcing steel and formwork within the foundations and grade beams. Any overexcavation should be backfilled to the design elevations with compacted Structural Fill.

Structural Slab Foundation

An alternative option for mitigating post-construction differential settlements is to construct the proposed building on a thickened edge structural slab. With this option, the building foundation will be placed on proof-rolled, remedially compacted, medium dense native soil or on properly compacted Structural Fill placed directly over firm and unyielding native soil. Like the grade beams approach, utilizing a structural slab will not reduce the total settlements beneath the planned structure. Rather, it will help reduce damaging differential settlement and encourage the building to settle as a unit.

Qualified geotechnical personnel must confirm that suitable bearing conditions have been achieved prior to the placement of reinforcing steel within the structural slab. Any overexcavation should be backfilled to the design elevations with compacted Structural Fill.

All exterior thickened edges should be founded a minimum of 18 inches below the lowest adjacent final grade for freeze/thaw protection. The structural slab should be sized in accordance with the Structural Engineer's prescribed design criteria and seismic considerations.

Allowable Bearing Capacity

Based on the soil conditions encountered during our field exploration program, and assuming the above foundation support criteria are satisfied, prepared subgrade soil should be suitable to support a net allowable bearing pressure of 2,000 pounds per square foot (psf) for conventional foundations, grade beams, or the thickened edge portion of structural slabs. Please note that the thickened edge portion of the structural slab is assumed to be constructed and to function the same as a conventional foundation system, which is why it can be proportioned for the referenced bearing pressure. For the interior portions of the structural slab, GeoTest assumes a total distributed load of no more than 500 psf across the remainder of the structural slab footprint.

The term “net allowable bearing pressure” refers to the pressure that can be imposed on the soil at foundation level resulting from the total of all dead plus live loads, exclusive of the weight of the footing or any backfill placed above the footing.

Foundation Settlement

The settlement of shallow foundations depends on foundation size and bearing pressure, as well as the strength and compressibility characteristics of the underlying soil. If construction is accomplished as recommended and at the maximum allowable soil bearing pressure, GeoTest estimates the total settlement of building foundations under static conditions to be less than one inch. Differential settlement between two adjacent load-bearing components supported on competent soil is estimated to be less than one half the total settlement. Due to the liquefaction potential that exists on this site, the Owner should expect additional settlements during a seismic event, although the use of grade beams or structural slabs are intended to reduce the amount of differential settlement that can occur across the building footprint.

Floor Support

Floor slabs for the proposed structures can be supported on Structural Fill overlying remedially compacted, firm and unyielding native soil. GeoTest anticipates that stripping will need to occur within the building footprint to expose native soil, although the stripping is generally expected to be largely in the eastern half of the building.

GeoTest recommends that interior concrete slab-on-grade floors be underlain with at least 6 inches of clean, compacted, angular or fractured, free-draining gravel. The gravel should contain less than 3 percent passing the U.S. Standard No. 200 sieve (based on a wet sieve analysis of that portion passing the U.S. Standard No. 4 sieve). The purpose of this gravel layer is to provide uniform support for the slab, provide a capillary break, and act as a drainage layer. To help reduce the potential for water vapor migration through floor slabs, a continuous 15-mil minimum thick polyethylene sheet with tape-sealed joints should be installed below the slab to serve as an impermeable vapor barrier. The vapor barrier should be installed and sealed in accordance with the manufacturer's instructions.

The American Concrete Institute (ACI) guidelines suggest that the slab may either be poured directly on the vapor barrier or on a granular curing layer placed over the vapor barrier depending on construction conditions. GeoTest recommends that the Architect or Structural Engineer specify if a curing layer should be used. If moisture control within the building is critical, we recommend a representative of GeoTest observe the vapor barrier to confirm that joints and penetrations have been properly sealed.

A Subgrade Modulus (k) of 200 pounds per cubic inch (pci) is recommended for use in the design of concrete slab elements placed on suitably compacted near-surface soils and Structural Fill.

Exterior concrete slabs-on-grade, such as sidewalks, may be supported directly on undisturbed native soil or on properly placed and compacted Structural Fill; however, long-term performance will be enhanced if exterior slabs are placed on a layer of clean, durable, well-draining granular material.

Floor Considerations

Please note that long spans of slab-on-grade concrete floors may be more susceptible to cracking and floor flatness issues due to normally occurring concrete shrinkage and/or minor floor settlements that would not normally impact smaller facilities. Thus, special considerations may be required to mitigate post-construction cracking of the floor slab. These considerations could include, but are not limited to, the inclusion of additional structural steel within the slab, fibers added to concrete mixes, more frequent crack control joints, a reduction in the water-cement ratio of concrete in floor areas, or a specialized and/or enhanced Structural Fill section below floor slabs. It is our expectation that inclusions or considerations to mitigate post-construction floor cracking will be a collaborative effort from the design team, but that the Structural Engineer will likely have the most influence on the final design of the floor slab. GeoTest is available to participate in discussions regarding the mitigation of floor slab cracking.

Foundation and Site Drainage

Positive surface gradients should be provided adjacent to new foundation and/or retaining wall areas to direct surface water away from the building and toward suitable drainage facilities. Roof drainage should not be introduced into the perimeter footing drains but should be separately discharged directly to the stormwater collection system or similar municipality-approved outlet. Pavement and sidewalk areas, if present, should be sloped and drainage gradients should be maintained to carry surface water away from foundation areas towards an approved stormwater collection system. Surface water should not be allowed to pond and soak into the ground surface near buildings or paved areas during or after construction. Construction excavations should be sloped to drain to sumps where water from seepage, rainfall, and runoff can be collected and pumped to a suitable discharge facility.

To reduce the potential for groundwater and surface water to seep into interior spaces, GeoTest recommends that an exterior footing drain system be constructed around the perimeter of new foundations as shown in the *Conceptual Footing and Wall Drain Section* (Figure 3) of this report. The drain should consist of a perforated pipe measuring 4 inches in diameter at minimum, surrounded by at least 12 inches of filtering media. The pipe should be sloped to carry water to an approved collection system.

The filtering media may consist of open-graded drain rock wrapped in a nonwoven geotextile fabric such as Tencate® Mirafi® 140N (or equivalent). For foundations walls, drainage backfill should be carried up the back of the wall and be at least 12 inches wide. The drainage backfill should extend from the foundation drain to within approximately 1 foot of the finished grade and consist of open-graded drain rock containing less than 3 percent fines by weight passing the U.S. Standard No. 200 sieve (based on a wet sieve analysis of that portion passing the U.S. Standard No. 4 sieve). The invert of the footing drain pipe should be placed at approximately the same elevation as the bottom of the footing or 12 inches below the adjacent concrete slab grade (whichever is deeper) so that water will be contained. This process prevents water from seeping through walls or floor slabs. The drain system should include cleanouts to allow for periodic maintenance and inspection.

Please understand that the above recommendations are intended to assist the design engineer and/or architect in development of foundation and site drainage parameters and are based on our experience with similar projects in the area. The final foundation and site drainage plan that will be incorporated into the project plans is to be determined by the design team.

Buoyant Force Considerations

Buoyant forces develop when a submerged structural element is placed below a water table, with the resultant force having the potential to "float" the structure. Buoyant forces are likely to develop if structural elements are included in the design that are more than about 6 feet below existing site grades. It should be noted that water elevations observed during our explorations in December 2023 are expected to be approaching wet season highs. A seasonal groundwater monitoring assessment extending throughout the wet season would, however, be necessary to confirm seasonal groundwater highs for this project site. GeoTest is not currently under contract to perform such monitoring.

Below grade elements such as vaults and elevator pits that extend below the water table should be designed to resist buoyant forces. GeoTest also recommends that, where appropriate, submerged elements have adequate water stops and waterproofing to resist the intrusion of water into the structural element.

GeoTest recommends that additional information be provided for our review once a construction plan has been developed so that we can get a better understanding of where buoyant forces may develop. GeoTest should be allowed to revise our recommendations if submerged structural elements are included in the final design.

Resistance to Lateral Loads

The lateral earth pressures that develop against foundation walls will depend on the method of backfill placement, degree of compaction, slope of backfill, type of backfill material, provisions for drainage, magnitude and location of any adjacent surcharge loads, and the degree to which the wall can yield laterally during or after placement of backfill. If the wall is allowed to rotate or yield so the top of the wall moves an amount equal to or greater than about 0.001 to 0.002 times its height (a yielding wall), the soil pressure exerted comprises the active soil pressure. When a wall is restrained against lateral movement or tilting (a nonyielding wall), the soil pressure exerted comprises the at rest soil pressure. Wall restraint may develop if a rigid structural network is constructed prior to backfilling or if the wall is inherently stiff.

GeoTest recommends that yielding walls under drained conditions be designed for an equivalent fluid density of 35 pounds per cubic foot (pcf) for Structural Fill and Maryville Sands in active soil conditions. Nonyielding walls under drained conditions should be designed for an equivalent fluid density of 55 pcf for Structural Fill and Maryville Sands in at-rest conditions. GeoTest should be contacted if the final design includes submerged walls so that we provided updated recommendations.

The design of walls should include appropriate lateral pressures caused by surcharge loads located within a horizontal distance equal to or less than the height of the wall. For uniform surcharge pressures, a uniformly distributed lateral pressure equal to 35 percent and 50 percent of the vertical surcharge pressure should be added to the lateral soil pressures for yielding and nonyielding walls, respectively.

For structures designed using the seismic provisions of the International Building Code, GeoTest recommends that foundation walls include a surcharge in addition to the equivalent fluid densities presented above. We recommend that a seismic surcharge of approximately 8*H (where H is the height of the wall in feet) be used for design purposes. The seismic surcharge should be modeled as a rectangular distribution with the resultant applied at the midpoint of the wall. The surcharge assumes that the wall is allowed to rotate or yield. If the wall is restrained, GeoTest should be contacted so that we can provide a revised seismic surcharge pressure.

Passive earth pressures developed against the sides of building foundations, in conjunction with friction developed between the base of the footings and the supporting subgrade, will resist lateral loads transmitted from the structure to its foundation. For design purposes, the passive resistance of well-compacted fill placed against the sides of foundations is equivalent to a fluid with a density of 300 pounds per cubic foot. The recommended value is based on the assumption that the ground surface adjacent to the structure is level and the referenced soil unit extends in the direction of movement for a distance equal to or greater than twice the embedment depth. The recommended value includes a factor of safety of 1.5 and assumes drained conditions that will prevent the buildup of hydrostatic pressure in the compacted fill. Foundation walls should include a drain system constructed in general accordance with the recommendations presented in the *Foundation and Site Drainage* section of this report. In design computations, the upper 12 inches of passive resistance should be neglected if the soil is not covered by floor slabs or pavement. If future plans call for the removal of the soil providing resistance, the passive resistance should not be considered.

An allowable coefficient of base friction of 0.35, applied to vertical dead loads only, may be used between the underlying native soils or imported granular Structural Fill and the base of the footing. If passive and frictional resistance are considered together, one half the recommended passive soil resistance value should be used since larger strains are required to mobilize the passive soil resistance as compared to frictional resistance. A safety factor of about 1.5 is included in the base friction design value. GeoTest does not recommend increasing the coefficient of friction to resist seismic or wind loads.

Temporary and Permanent Slopes

The contractor is responsible for construction slope configurations and maintaining safe working conditions, including temporary excavation stability. All applicable local, state, and federal safety codes should be followed. All open cuts should be monitored during and after excavation for any evidence of instability. If instability is detected, the contractor should flatten the side slopes or install temporary shoring.

Temporary excavations in excess of 4 feet should be shored or sloped in accordance with Safety Standards for Construction Work Part N, WAC 296-155-66403.

The onsite Marysville Sands and uncontrolled fill soils encountered at the project site are classified, according to WAC 296-155-66401, as Type C soil. As such, temporary, unsupported excavations may be sloped as steep as 1.5:1 (Horizontal: Vertical). Soils encountered in the presence of groundwater seepage are classified as Type C soil and should be sloped as steep as 1.5:1 (H:V). Flatter slopes or temporary shoring may be required in areas where groundwater flow is present and unstable conditions develop. Temporary slopes and excavations should be protected as soon as possible using appropriate methods to prevent erosion from occurring during periods of wet weather.

GeoTest recommends that permanent cut or fill slopes be designed for inclinations of 2H:1V or flatter. Permanent cuts or fills used in detention ponds, retention ponds, or earth slopes intended to hold water should be sloped 3H:1V or flatter. All permanent slopes should be vegetated or otherwise protected to limit the potential for erosion as soon as practical after construction.

Utilities

It is important that utility trenches be properly backfilled and compacted to reduce cracking or localized loss of foundation, slab, or pavement support. It is anticipated that excavations for new shallow underground utilities will be in medium dense native Marysville Sand soils.

Trench backfill in improved areas (beneath structures, pavements, sidewalks, etc.) should consist of Structural Fill as defined earlier in this report. Trench backfill should be placed and compacted in accordance with the report section *Structural Fill and Compaction*.

Surcharge loads on trench support systems due to construction equipment, stockpiled material, and vehicle traffic should be included in the design of any anticipated shoring system. The contractor should implement measures to prevent surface water runoff from entering trenches and excavations. In addition, vibration as a result of construction activities and traffic may cause caving of the trench walls.

Actual trench configurations should be the responsibility of the contractor. All applicable local, state, and federal safety codes should be followed. All open cuts should be monitored by the contractor during excavation for any evidence of instability. If instability is detected, the contractor should flatten the side slopes or install temporary shoring. If groundwater or groundwater seepage is present, and the trench is not properly dewatered, the soil within the trench zone may be prone to caving, channeling, and running. The contractor should plan for elevated water tables and/or perched groundwater that may be encountered during construction due to silty restriction layers observed on site during our explorations. Trench widths may be substantially wider than under dewatered conditions.

Dewatering Considerations

Shallow groundwater seepage was encountered as shallow as 2 feet BGS, but generally observed at approximately 4 to 5 feet below existing site grades within most of our exploration test pits. GeoTest observed substantial amounts of caving below 6 feet, which is likely representative of the regional groundwater table. Based on our previous experience, groundwater elevations seasonally vary and can raise or lower several feet. Typically, groundwater elevations are highest in the late winter and early spring months, and lowest in late summer or early fall. Groundwater elevations vary with season, adjacent site land usage, and recent rainfall.

When feasible, GeoTest recommends that utility trenching occur during late summer or early fall, when the water table is at its lowest elevation. Even if excavations occur during seasonal lows, it is likely that dewatering may have to occur for deeper utilities. It is the Contractor’s responsibility to provide a suitable dewatering plan based on the type and depth of the excavation and the groundwater elevation during construction.

Pavement Subgrade Preparation

The selection of a pavement section is typically a choice relative to a higher initial cost and lower long-term maintenance, or a lower initial cost with more frequent maintenance. For this reason, GeoTest recommends that the Owner participate in the selection of the proposed pavement sections planned for the site. Site grading plans should include provisions for sloping of the subgrade soils in proposed pavement areas, so that passive drainage of the pavement section(s) can proceed uninterrupted during the life of the project. The proposed pavement areas should be prepared as indicated in the *Site Preparation and Earthwork* section of this report.

Light-Duty Flexible Pavement

GeoTest anticipates that asphalt pavement will be used for new passenger vehicle access drives and parking areas. We recommend that a standard, or ‘light duty,’ pavement section consist of 2.5 inches of ½-inch HMA asphalt above 6 inches of crushed surfacing base course (CSBC) meeting criteria set forth in the Washington State Department of Transportation (WSDOT) Standard Specification 9-03.9[3] Crushed Surfacing Base Course.

Heavy-Duty Flexible Pavement

Areas that will be accessed by more heavily loaded vehicles, emergency access vehicles, garbage trucks, and similar vehicles will require a thicker asphalt section and should be designed using a paving section consisting of 3 inches of Class ½-inch HMA asphalt surfacing above 6 inches of CSBC meeting criteria set forth in WSDOT Standard Specification 9-03.9[3].

Concrete Pavement

Concrete pavements could be used for access and drive areas. Design of concrete pavements is a function of concrete strength, reinforcement steel, and the anticipated loading conditions for the roads. For design purposes, a vertical modulus of subgrade reaction of 200 pounds per cubic inch (pci) should be expected for concrete roadways constructed over properly placed and compacted Structural Fill. GeoTest expects that concrete pavement sections, if utilized, will be at least 6 inches thick and be founded on a minimum of 6 inches of compacted CSBC. The design of concrete pavements will need to be performed by a Structural Engineer. GeoTest recommends that subgrade soils supporting concrete pavement sections include minor grade changes to allow for passive drainage away from the pavement.

GeoTest is available to further consult, review, and/or modify our pavement section recommendations based on further discussion and/or analysis with the project team/Owner. The above pavement sections are initial recommendations and may be accepted and/or modified by the site Civil Engineer based on the actual finished site grading elevations and/or the Owner’s preferences.

Stormwater Infiltration Potential

Based on the presence of predominantly granular materials, it is our opinion that the on-site infiltration of stormwater is feasible for this project site. However, groundwater was generally found to be at a depth of 6 feet below existing site grades and shallower indications of water seepage were observed during our December 2023 explorations. In all cases, the Stormwater Designer must take into account the presence of shallow groundwater and maintain suitable amounts of separation between the bottom of facilities and the water table.

Test Pit Gradation Results

From the explorations excavated in the areas of interest, three representative soil samples were selected and mechanically tested for grain size distribution and calculation according to the soil grain size analysis method per the Manual. A summary of these results is reproduced in Table 2 below.

Table 2
Preliminary Infiltration Results Based on Grain Size Analyses

Test Pit ID & Depth	Geologic Unit	Preliminary, Corrected K_{sat} Infiltration Rate [in/hr]
TP-2 (3.5 ft)	Weathered Marysville Sand	6.7
TP-5 (4 ft)	Weathered Marysville Sand	7.0
TP-7 (5 ft)	Marysville Sand	7.0

Notes:
- Ksat = Initial Saturated Hydraulic Conductivity
- Correction Factors Used: CFv = 0.45, CFt = 0.40, CFm =0.9, Total Correction Factor = 0.162

The rates presented in Table 2 are representative of loose soil conditions and do not take the relative density of the soil into account. These rates should be considered preliminary when considering that facility sizes and depths are not currently known.

Stormwater infiltration potential is a function of the relative permeability of the site soils, and the separation between the base of the proposed stormwater facility and the groundwater table. Based on the results presented in Table 2 and the relative depth to the groundwater table (observed at about 6 feet BGS), the on-site infiltration of stormwater is feasible for the project site. For facilities based in the weathered Marysville Sand unit, GeoTest recommends an unmounded, preliminary design infiltration rate of 6.7 inches per hour. At the time of this report, a stormwater design showing facility sizes and depths is not available. It should generally be expected that multiple iterations of the stormwater design may be needed to size facilities and determine if reductions to the infiltration rate to due to groundwater mounding will be needed.

Stormwater Treatment

The on-site stormwater facilities may require some form of pollutant pretreatment with an amended soil prior to on-site infiltration or off-site discharge. The reuse of on-site topsoil is often the most sustainable and cost-effective method for pollutant treatment purposes. Cation exchange capacities, organic contents, and pH of site subsurface soils were also tested to determine possible pollutant treatment suitability.

Table 3
Cation Exchange Capacity, Organic Content, and pH Laboratory Test Results

Test Pit ID	Sample Depth (ft)	Cation Exchange Capacity (meq/100 grams)	Organic Content (%)	pH
TP-1	2	13.4	4.23	6.0
TP-2	0.5	20.2	7.0	5.8
Method		SM 4500-H+B	ASTM D2974	EPA 9081

-**Stormwater treatment requirements per the Manual:**
- CEC ≥ 5.0 meq/100 grams and.
- Organic Content ≥ 1.0%

Cation exchange capacity, organic content, and pH tests were performed by Northwest Agricultural Consultants on two soil samples collected from the explorations shown in Table 3. A summary of the laboratory test results is presented in Table 3 above.

Suitability for on-site pollutant treatment is determined in accordance with site suitability criteria SSC-6 of the Manual. Soils with an organic content greater than or equal to 1 percent and a cation exchange capacity of greater than or equal to 5 meq/100 grams are characterized as suitable soils for stormwater treatment. Based on the results shown in Table 3 the near-surface soils are suitable for stormwater treatment purposes.

Geotechnical Consultation and Construction Monitoring

GeoTest recommends that we be involved in the project design review process. The purpose of the review is to verify that the recommendations presented in this report are understood and incorporated in the design and specifications.

We also recommend that geotechnical construction monitoring services be provided. These services should include observation by GeoTest personnel during Structural Fill placement, compaction activities, and subgrade preparation operations to confirm that design subgrade conditions are obtained beneath the areas of improvement.

Periodic field density testing should be performed to verify that the appropriate degree of compaction is obtained. The purpose of these services is to observe compliance with the design concepts, specifications, and recommendations of this report. In the event that subsurface conditions differ from those anticipated before the start of construction, GeoTest Services, Inc. would be pleased to provide revised recommendations appropriate to the conditions revealed during construction.

GeoTest is available to provide a full range of materials testing and special inspection during construction as required by the local building department and the International Building Code. This may include specific construction inspections on materials such as reinforced concrete, reinforced masonry, wood framing, and structural steel. These services are supported by our fully accredited materials testing laboratories.

USE OF THIS REPORT

GeoTest Services, Inc. has prepared this report for the exclusive use of Kendall Development Group, Mr. Todd McFarlane, and their design consultants for specific application to the design of the proposed Ford Pro Marysville building located at 16100 Smokey Point Boulevard in Marysville, WA (Parcel No. 31052900400600). Use of this report by others is at the user’s sole risk. This report is not applicable to other site locations. Our services are conducted in accordance with accepted practices of the geotechnical engineering profession; no other warranty, express or implied, is made as to the professional advice included in this report.

Our site explorations indicate subsurface conditions at the dates and locations indicated. It is not warranted that these conditions are representative of conditions at other locations and times. The analyses and conclusions contained in this report are based on site conditions to the limited depth and time of our explorations, a geological reconnaissance of the area, and a review of previously published geological information for the site. If variations in subsurface conditions are encountered during future construction that differ from those contained within this report, GeoTest should be allowed to review our report and, if necessary, make revisions. If there is a substantial lapse of time between submission of this report and the start of construction, or if conditions change due to construction operations at or adjacent to the project site, we recommend that we review this report to determine the applicability of the conclusions contained herein.

The future prospective earthwork contractor is responsible for performing all work in conformance with all applicable WISHA/OSHA regulations. GeoTest Services, Inc. is not responsible for job site safety on this project, and this responsibility is specifically disclaimed.

Attachments:	Figure 1	Vicinity Map
	Figure 2	Site and Exploration Plan
	Figure 3	Conceptual Footing & Wall Drain Section
	Figure 4	Soil Classification System & Key
	Figures 5 – 8	Log of Test Pits
	Figures 9 – 10	Grain Size Test Data

NW Agricultural Consultants Lab Results (1 page)
Report Limitations and Guidelines for Its Use (4 pages)
Appendix A: Liquefaction Analysis (1 page)
Appendix B: In Situ Engineering CPT Logs (3 pages)

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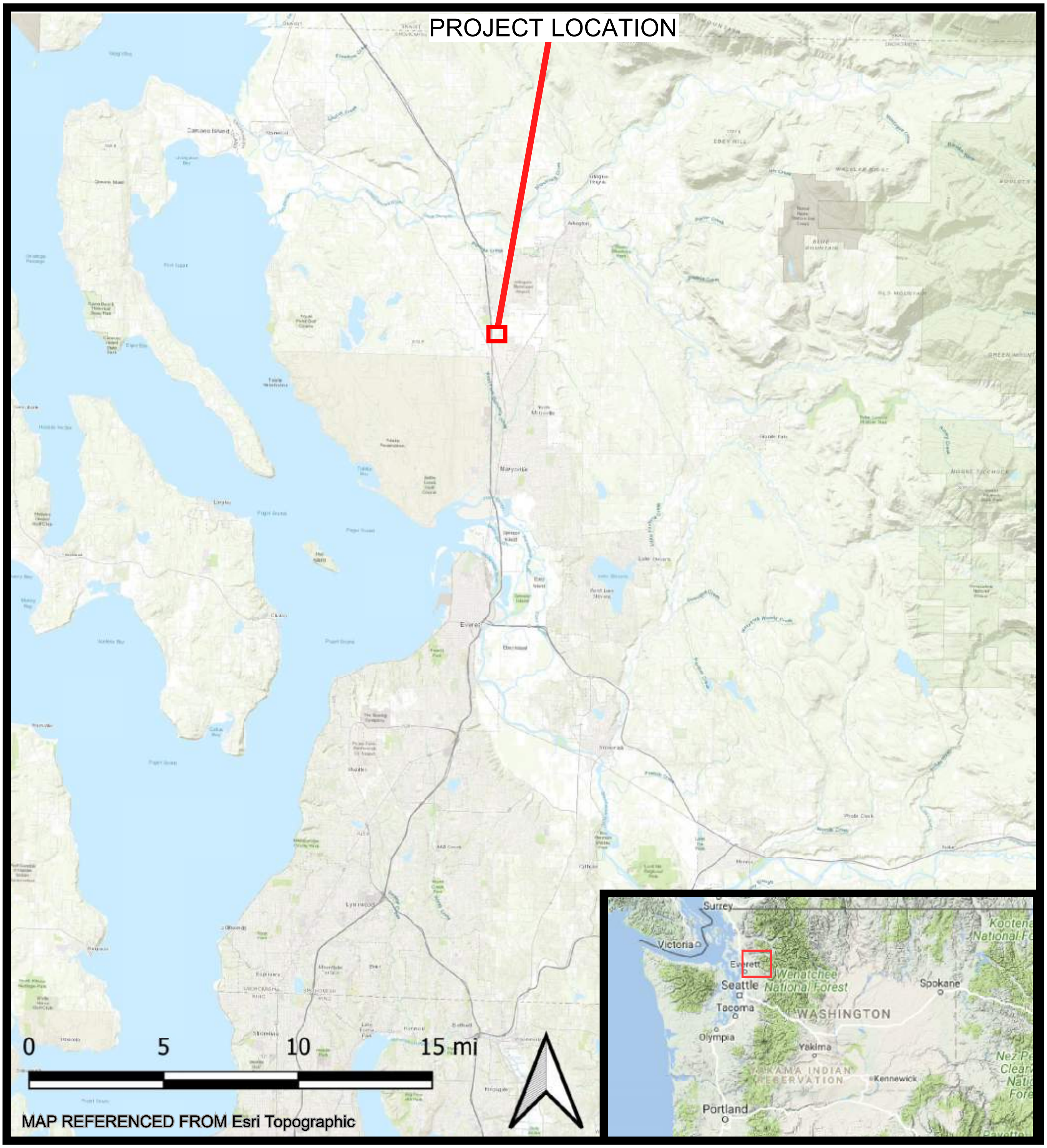
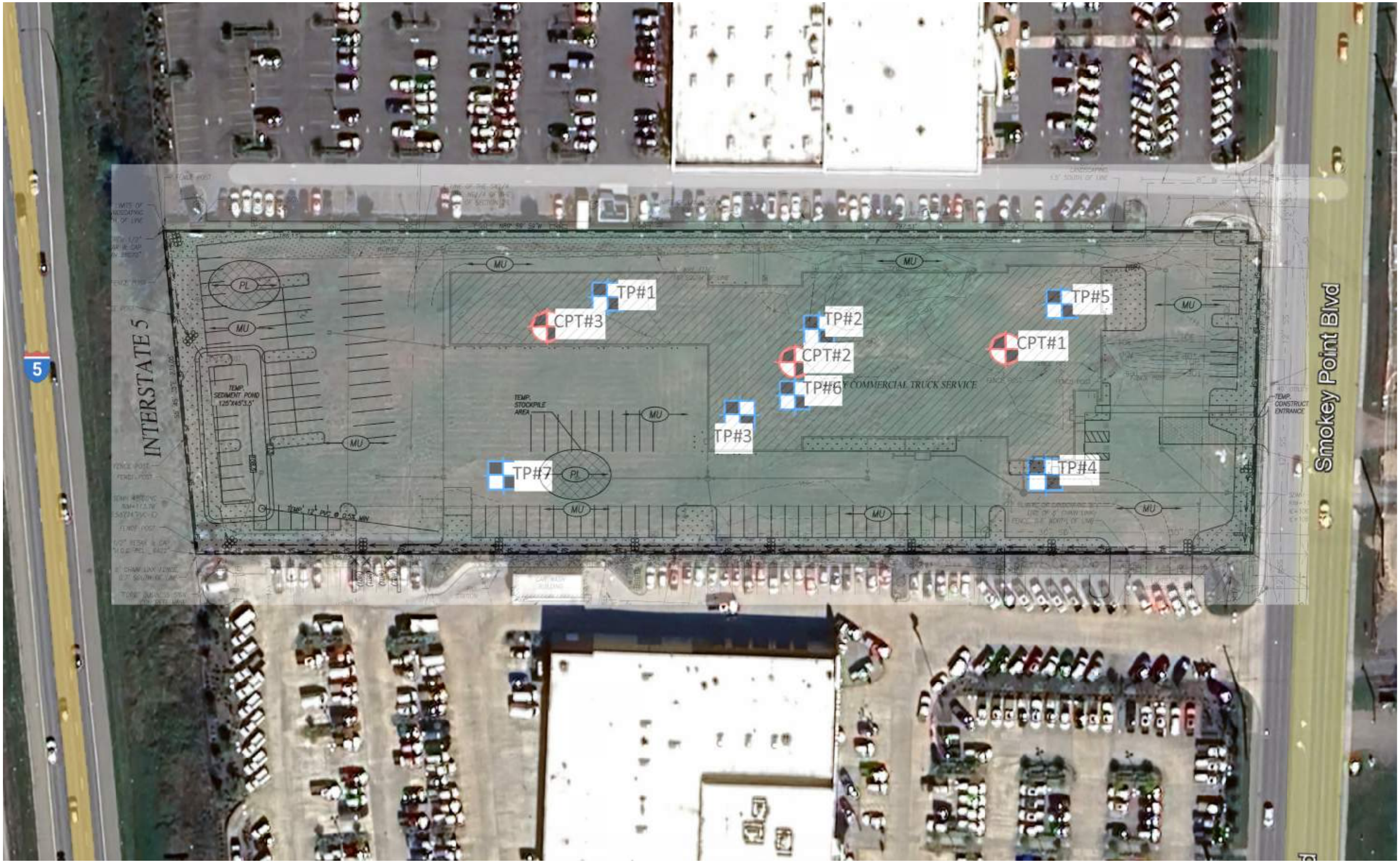


GEOTEST
An RMA Company

Date: 1-8-24
By: SEM
Scale: As Shown
Project
23-3322

VICINITY MAP
FORD PRO MARYSVILLE
16100 SMOKEY POINT BOULEVARD
MARYSVILLE, WA

Figure
1



⊕ CPT# =Approximate Cone Penetrometer Test Location

▚ TP# = Approximate Test Pit Location

GEOTEST
An RMA Company

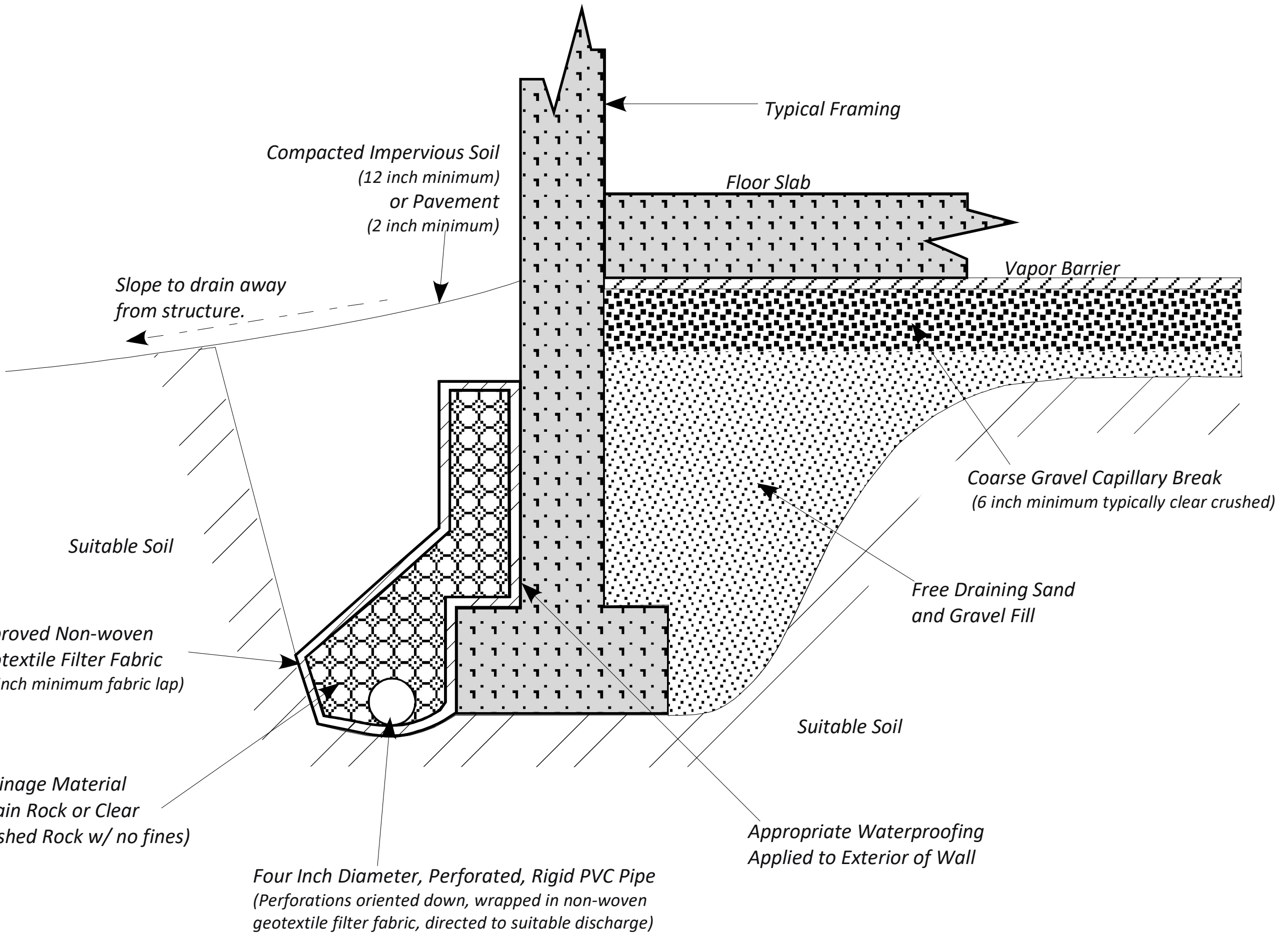
Date: 1-09-24 By: SEM Scale: As shown

SITE AND EXPLORATION PLAN
FORD PRO MARYSVILLE
16100 SMOKEY POINT BOULEVARD
MARYSVILLE, WA

Project
23-3322

Figure
2

SHALLOW FOOTINGS WITH INTERIOR SLAB-ON-GRADE



Notes:

This figure is not intended to be representative of a design. This figure is intended to present concepts that can be incorporated into a functional foundation drain designed by a civil engineer. In all cases, refer to the civil plan sheet for drain details and elevations.

Footings should be properly buried for frost protection in accordance with the International Building Code or local Municipal building codes (typically 18 inches below exterior finished grades).

The footing drain will need to be modified from this typical drawing to fit the dimensions of the planned footing and slab configuration.

GEOTEST
An RMA Company

Date: 1-8-23 | By: SEM | Scale: None

TYPICAL FOOTING & WALL DRAIN SECTION
FORD PRO MARYSVILLE
16100 SMOKEY POINT BOULEVARD
MARYSVILLE, WA

Project
23-3322

Figure
3

Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL	TYPICAL DESCRIPTIONS(1)(2)
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)	⁘	**GW**	Well-graded gravel; gravel/sand mixture(s); little or no fines
			⁘	**GP**	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)	⁘	**GM**	Silty gravel; gravel/sand/silt mixture(s)
			⁘	**GC**	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)	▒	**SW**	Well-graded sand; gravelly sand; little or no fines
			▒	**SP**	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)	▥	**SM**	Silty sand; sand/silt mixture(s)
			▩	**SC**	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)		▥	**ML**	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
			▨	**CL**	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
			≈	**OL**	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)		▥	**MH**	Inorganic silt; micaceous or diatomaceous fine sand
			▨	**CH**	Inorganic clay of high plasticity; fat clay
			≋	**OH**	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL		▒	**PT**	Peat; humus; swamp soil with high organic content

OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT	■	**AC or PC**	Asphalt concrete pavement or Portland cement pavement
ROCK	▧	**RK**	Rock (See Rock Classification)
WOOD	≋	**WD**	Wood, lumber, wood chips
DEBRIS	▩	**DB**	Construction debris, garbage

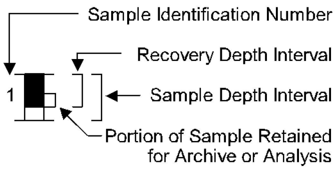
Notes: 1. Soil descriptions are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, as outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the *Standard Test Method for Classification of Soils for Engineering Purposes*, as outlined in ASTM D 2487.

2. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

Primary Constituent: > 50% - "GRAVEL," "SAND," "SILT," "CLAY," etc.
Secondary Constituents: > 30% and ≤ 50% - "very gravelly," "very sandy," "very silty," etc.
> 12% and ≤ 30% - "gravelly," "sandy," "silty," etc.
Additional Constituents: > 5% and ≤ 12% - "slightly gravelly," "slightly sandy," "slightly silty," etc.
≤ 5% - "trace gravel," "trace sand," "trace silt," etc., or not noted.

Drilling and Sampling Key

SAMPLE NUMBER & INTERVAL



SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Other - See text if applicable

Groundwater

∇ ATD Approximate water elevation at time of drilling (ATD) or on date noted. Groundwater levels can fluctuate due to precipitation, seasonal conditions, and other factors.

Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
GT	Other Geotechnical Testing
CA	Chemical Analysis

GEOTEST
An RMA Company

Ford Pro Marysville
16100 Smokey Pt. Blvd.
Marysville, WA

Soil Classification System and Key

Figure
4

TP-1

Excavation Method: Tracked Excavator

Ground Elevation (ft): Undetermined

SAMPLE DATA				SOIL PROFILE		GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	USCS Symbol		
0				SM	Loose, dark brown, damp, silty SAND, rootlets (Topsoil)	
	1	d				
2	2	d	W = 21 GS	SM	Loose, tan, damp, silty SAND (Weathered Marysville Sand)	
				SM	Loose, gray, damp, slightly silty SAND, trace gravel (Marysville Sand)	
4	3	d				∇ Slight groundwater seepage encountered at 4.0 ft.
6	4 5	d d	W = 25 GS		Caving @ 6' BGS	
8						
10						

Test Pit Completed 12/27/23
Total Depth of Test Pit = 7.0 ft.

TP-2

Excavation Method: Tracked Excavator

Ground Elevation (ft): Undetermined

SAMPLE DATA				SOIL PROFILE		GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	USCS Symbol		
0				SM	Loose, dark brown, damp, gravelly, silty SAND, organics, frequent concrete (Fill)	
	6	d				
2	7	d				
				SM	Medium dense, tan, damp, slightly silty SAND, trace gravel (Weathered Marysville Sand)	
4	8	d	W = 11 GS			
				SM	Medium dense, gray, damp, slightly silty SAND, trace gravel (Marysville Sand)	
6	9	d				∇ Slight groundwater seepage encountered at 6.0 ft.
	10	d				∇ Slight groundwater seepage encountered at 7.0 ft.
8						
10						

Test Pit Completed 12/27/23
Total Depth of Test Pit = 7.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST
An RMA Company

Ford Pro Marysville
16100 Smokey Point Boulevard
Marysville WA

Log of Test Pits

Figure
5

TP-3

SAMPLE DATA

SOIL PROFILE

GROUNDWATER

Excavation Method: Tracked Excavator

Ground Elevation (ft): Undetermined

Depth (ft): 0, 2, 4, 6, 8, 10

Sample Number & Interval	Sampler Type	Test Data
11	d	
12	d	
13	d	
14	d	
15	d	W = 23 GS

USCS Symbol	
SM	Loose, dark brown, damp, silty SAND, rootlets (Topsoil)
SM	Medium dense, tan, damp, silty SAND, roots (Weathered Marysville Sand)
SP	Medium dense, gray, damp, slightly gravelly, poorly graded SAND, trace silt (Marysville Sand) Becomes coarser with depth Terminated @7.5 BGS due to collapse.

▽ Slight groundwater seepage encountered at 4.0 ft.

▽ Slight groundwater seepage encountered at 7.0 ft.

Test Pit Completed 12/27/23
Total Depth of Test Pit = 7.5 ft.

TP-4

SAMPLE DATA

SOIL PROFILE

GROUNDWATER

Excavation Method: Tracked Excavator

Ground Elevation (ft): Undetermined

Depth (ft): 0, 2, 4, 6, 8, 10

Sample Number & Interval	Sampler Type	Test Data
16		
17		W = 16 GS
18		
19		

USCS Symbol	
GM/ SM	Medium dense, dark brown, damp, gravelly, silty SAND, roots, rebar, concrete (Fill)
SM	Dense, tan/ornange, damp, slightly silty SAND (Weathered Marysville Sand)
SM	Dense, gray, damp, slightly silty SAND (Marysville Sand) Terminated at 6.5' BGS due to collapse.

▽ Slight groundwater seepage encountered at 4.0 ft.

▽ Slight groundwater seepage encountered at 6.0 ft.

Test Pit Completed 12/27/23
Total Depth of Test Pit = 6.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

Ford Pro Marysville 16100 Smokey Point Boulevard Marysville WA	Log of Test Pits	Figure 6

TP-5

Excavation Method: Tracked Excavator

Ground Elevation (ft): Undetermined

SAMPLE DATA

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data
0			
	20	d	
	21	d	
2	22	d	
4	23	d	W = 19 GS
	24	d	W = 16 GS
6	25	d	
	26	d	
8			
10			

SOIL PROFILE

USCS Symbol	Description
GP	Loose, black/dark brown, damp, sandy GRAVEL (Fill)
GP	Loose, gray, damp, sandy GRAVEL, roots, rootlets (Fill)
SM	Loose, gray with black chunks of organic matter, damp, silty SAND, rootlets, roots (Fill)
SM	Medium dense, orange/tan, damp, slightly silty SAND, trace gravel (Weathered Marysville Sand)
SP	Medium dense, gray, damp, poorly graded SAND, trace gravel, trace silt (Marysville SAND) Terminated @ 7.5' BGS due to collapse.

GROUNDWATER

∇ Slight groundwater seepage encountered at 5.0 ft.

∇ Slight groundwater seepage encountered at 7.0 ft.

Test Pit Completed 12/27/23
Total Depth of Test Pit = 7.5 ft.

TP-6

Excavation Method: Tracked Excavator

Ground Elevation (ft): Undetermined

SAMPLE DATA

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data
0			
	27	d	
2	28	d	
4	29	d	
6			
8			
10			

SOIL PROFILE

USCS Symbol	Description
SM	Loose, dark brown, damp, gravelly, silty SAND, organics, twine, frequent concrete (Fill)
SM	Medium dense, tan/orange, damp, slightly silty SAND, trace gravel (Weathered Marysville Sand)
SM	Medium dense, gray, damp, slightly silty SAND, trace gravel (Marysville Sand) Terminated at 6.0' BGS due to collapse

GROUNDWATER

∇ Slight groundwater seepage encountered at 4.0 ft.

Test Pit Completed 12/27/23
Total Depth of Test Pit = 6.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST
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Ford Pro Marysville
16100 Smokey Point Boulevard
Marysville WA

Log of Test Pits

Figure 7

TP-7

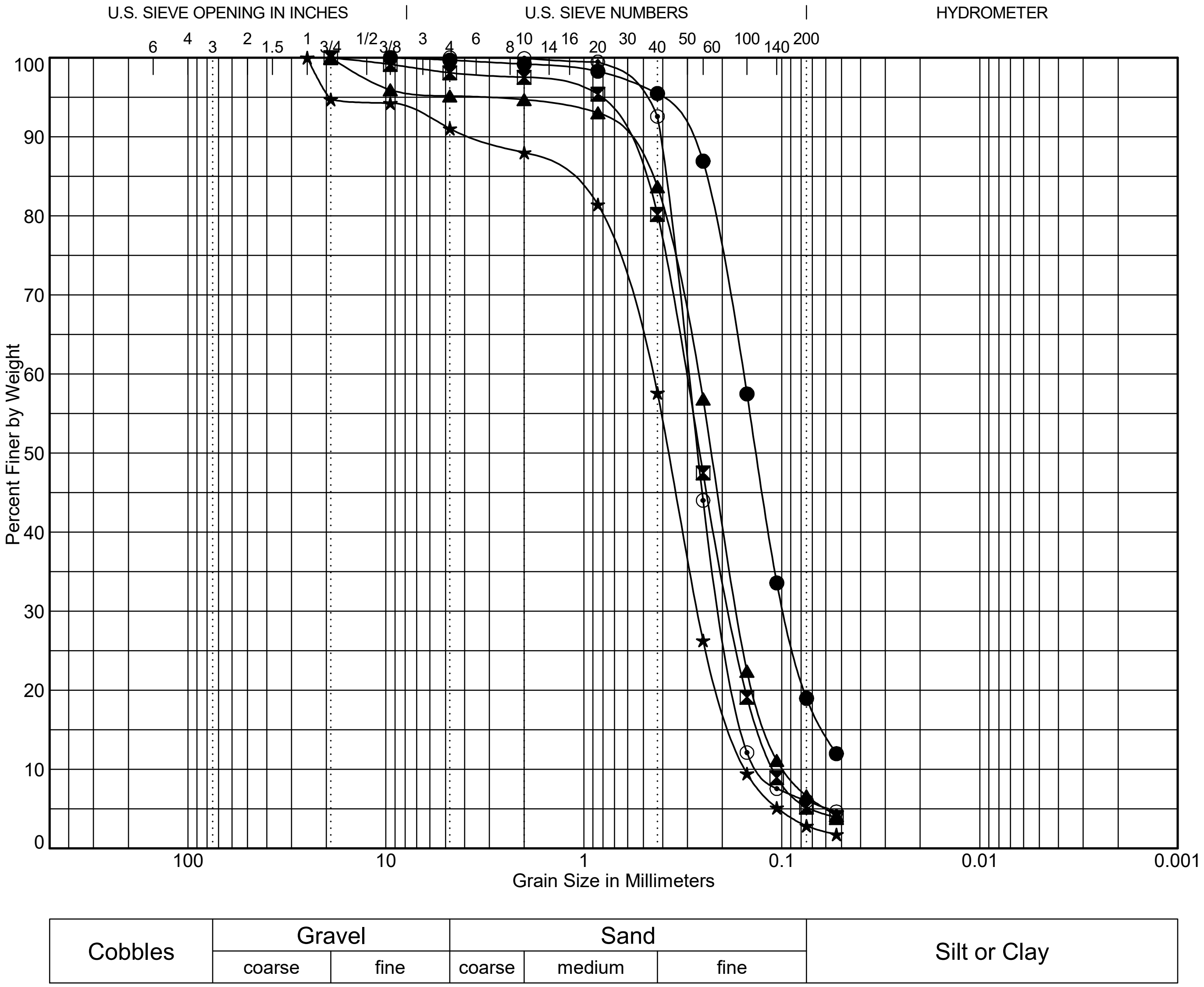
SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Undetermined	
0	30	d			SM	Loose, dark brown, damp, silty SAND, rootlets (Topsoil)	
					ML	Loose, orange, moist, sandy SILT (Fill)	
2	31	d					∇ Slight groundwater seepage encountered at 2.0 ft.
	32	d					
4	33	d			SM	Dense, gray, moist, slightly silty SAND, trace gravel (Marysville Sand) Terminated at 6' BGS due to collapse.	∇ Moderate groundwater seepage encountered at 4.0 ft.
	34	d	W = 29 GS				
6							
8							
10							

Test Pit Completed 12/27/23
Total Depth of Test Pit = 6.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST An RMA Company

Ford Pro Marysville 16100 Smokey Point Boulevard Marysville WA	Log of Test Pits	Figure 8



Point	Depth	Classification	LL	PL	PI	C_c	C_u
● TP-1	1.5	Silty SAND (SM)					
⧗ TP-1	6.0	Slightly silty SAND, trace gravel (SM)				0.99	2.79
▲ TP-2	3.5	Slightly silty SAND, trace gravel (SM)				1.09	2.74
★ TP-3	7.0	Slightly gravelly, poorly graded SAND, trace silt (SP)				1.02	2.99
⊙ TP-4	2.0	Slightly silty SAND (SM)				1.05	2.33

Point	Depth	D_{90}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
● TP-1	1.5	0.303	0.157	0.135	0.097		0.0	0.3	0.5	3.7	76.5	19.0
⧗ TP-1	6.0	0.665	0.306	0.26	0.183	0.11	0.0	1.9	0.6	17.3	75.0	5.2
▲ TP-2	3.5	0.679	0.266	0.226	0.168	0.097	0.0	4.8	0.5	11.0	77.0	6.6
★ TP-3	7.0	3.54	0.456	0.374	0.266	0.153	5.3	3.7	3.0	30.4	54.8	2.8
⊙ TP-4	2.0	0.413	0.298	0.267	0.2	0.128	0.0	0.0	0.1	7.3	86.6	6.0

$C_c = D_{30}^2/(D_{60}* D_{10})$

$C_u = D_{60}/D_{10}$

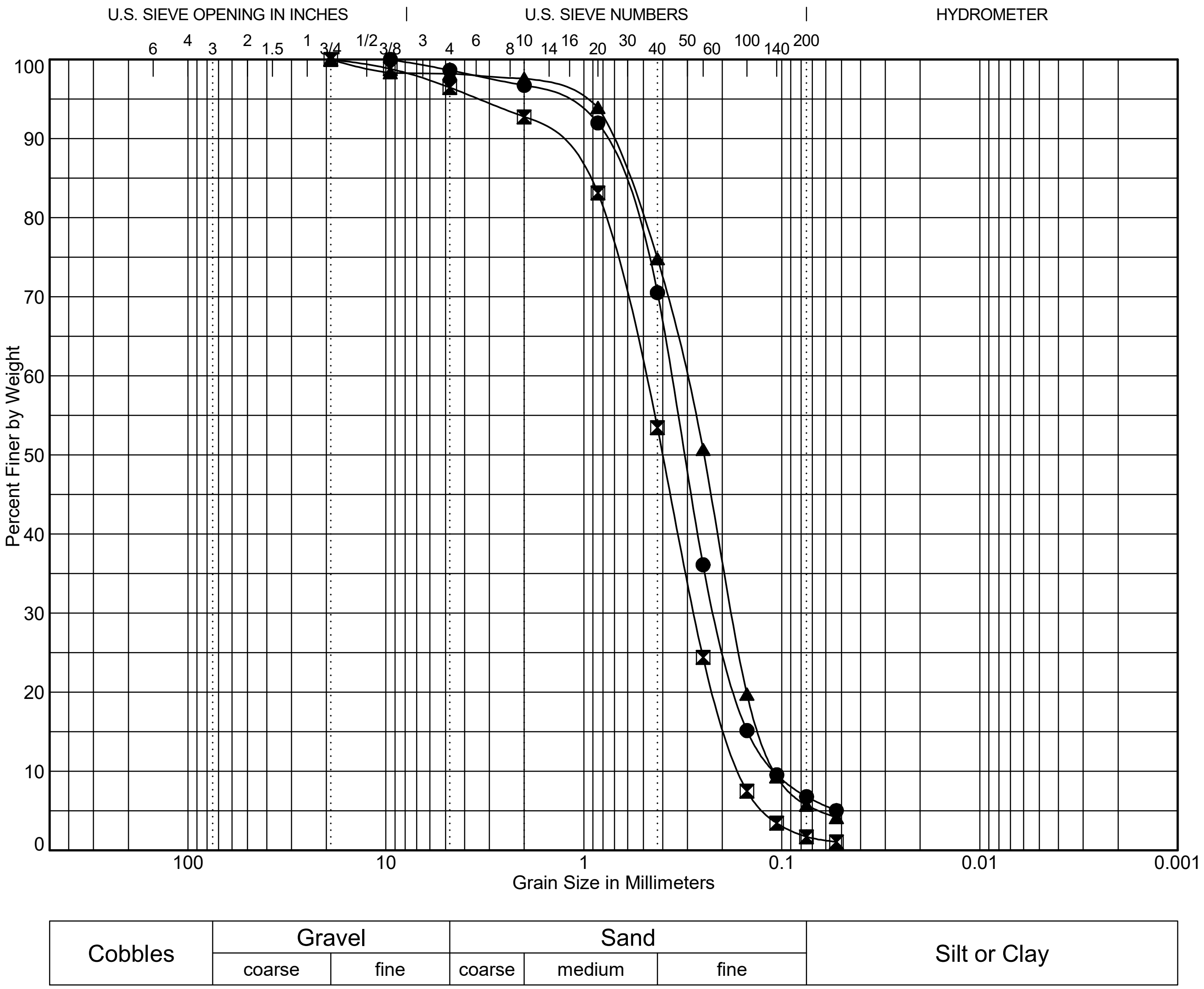
To be well graded: 1 < C_c < 3 and
C_u > 4 for GW or C_u > 6 for SW

GEOTEST
An RMA Company

Ford Pro Marysville
16100 Smokey Point
Boulevard
Marysville WA

Grain Size Test Data

Figure
9



	Point	Depth	Classification	LL	PL	PI	C_c	C_u
●	TP-5	4.0	Slightly silty SAND, trace gravel (SM)				1.18	3.32
⧗	TP-5	5.0	Poorly graded SAND, trace gravel, trace silt (SP)				0.96	3.06
▲	TP-7	5.0	Slightly silty SAND, trace gravel (SM)				0.95	2.83

	Point	Depth	D_{90}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
●	TP-5	4.0	0.797	0.361	0.31	0.215	0.109	0.0	1.4	1.9	26.2	63.7	6.8
⧗	TP-5	5.0	1.566	0.495	0.399	0.277	0.162	0.0	3.5	3.7	39.3	51.7	1.7
▲	TP-7	5.0	0.737	0.307	0.247	0.178	0.109	0.0	1.8	0.6	22.8	69.1	5.7

$C_c = D_{30}^2/(D_{60} * D_{10})$

$C_u = D_{60}/D_{10}$

To be well graded: $1 < C_c < 3$ and

$C_u > 4$ for GW or $C_u > 6$ for SW

Ford Pro Marysville
16100 Smokey Point
Boulevard
Marysville WA

Grain Size Test Data

Figure
10

REPORT LIMITATIONS AND GUIDELINES FOR ITS USE[1]

Subsurface issues may cause 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:

Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

At GeoTest our geotechnical engineers and geologists structure their services to meet specific needs of our clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of an owner, a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineer who prepared it. And no one – not even you – should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report is Based on a Unique Set of Project-Specific Factors

GeoTest's geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the clients goals, objectives, and risk management preferences; the general nature of the structure involved its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless GeoTest, who conducted the study specifically states otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

1Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed, for example, from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed construction,
- alterations in drainage designs; or
- composition of the design team; the passage of time; man-made alterations and construction whether on or adjacent to the site; or by natural alterations and events, such as floods, earthquakes or groundwater fluctuations; or project ownership.

Always inform GeoTest's geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. Do not rely on the findings and conclusions of this report, whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact GeoTest before applying the report to determine if it is still relevant. A minor amount of additional testing or analysis will help determine if the report remains applicable.

Most Geotechnical and Geologic Findings are Professional Opinions

Our site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoTest's engineers and geologists review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ – sometimes significantly – from those indicated in your report. Retaining GeoTest who developed this report to provide construction observation is the most effective method of managing the risks associated with anticipated or unanticipated conditions.

A Report's Recommendations are Not Final

Do not over-rely on the construction recommendations included in this report. Those recommendations are not final, because geotechnical engineers or geologists develop them principally from judgment and opinion. GeoTest's geotechnical engineers or geologists can finalize their recommendations only by observing actual subsurface conditions revealed during construction. GeoTest cannot assume responsibility or liability for the report's recommendations if our firm does not perform the construction observation.

A Geotechnical Engineering or Geologic Report may be Subject to Misinterpretation

Misinterpretation of this report by other design team members can result in costly problems. Lower that risk by having GeoTest confer with appropriate members of the design team after submitting the report. Also, we suggest retaining GeoTest to review pertinent elements of the design teams plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having GeoTest participate in pre-bid and preconstruction conferences, and by providing construction observation.

Do not Redraw the Exploration Logs

Our geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors of omissions, the logs included in this report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable; but recognizes that separating logs from the report can elevate risk.

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In that letter, consider advising the contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with GeoTest and/or to conduct additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

In addition, it is recommended that a contingency for unanticipated conditions be included in your project budget and schedule.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering or geology is far less exact than other engineering disciplines. This lack of understanding can create unrealistic expectations that can lead to disappointments, claims, and disputes. To help reduce risk, GeoTest includes an explanatory limitations section in our reports. Read these provisions closely. Ask questions and we encourage our clients or their representative to contact our office if you are unclear as to how these provisions apply to your project.

Environmental Concerns Are Not Covered in this Geotechnical or Geologic Report

The equipment, techniques, and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study. For that reason, a geotechnical engineering or geologic report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated containments, etc. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk management guidance. Do not rely on environmental report prepared for some one else.

Obtain Professional Assistance to Deal with Biological Pollutants

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts biological pollutants from growing on indoor surfaces. Biological pollutants includes but is not limited to molds, fungi, spores, bacteria and viruses. To be effective, all such strategies should be devised for the express purpose of prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional biological pollutant prevention consultant. Because just a small amount of water or moisture can lead to the development of severe biological infestations, a number of prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of this study, the geotechnical engineer or geologist in charge of this project is not a biological pollutant prevention consultant; none of the services preformed in connection with this geotechnical engineering or geological study were designed or conducted for the purpose of preventing biological infestations.

Appendix A:

Liquefaction Analysis

LIQUEFACTION ANALYSIS

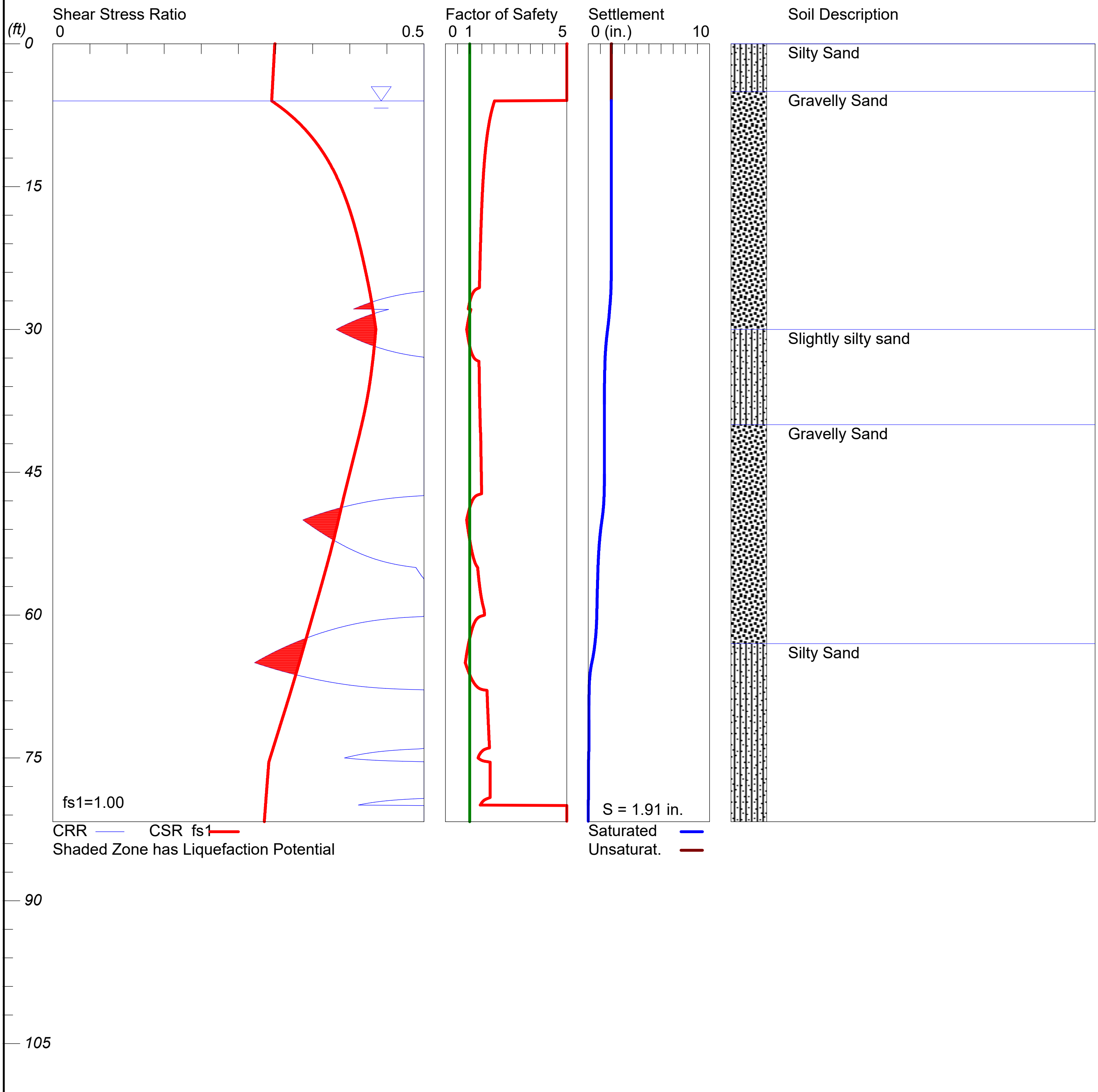
Kendall Ford

Hole No.=CPT-2   Water Depth=6 ft   Surface Elev.=0

Ground Improvement of Fill=1 ft

Magnitude=7

Acceleration=0.46g



Appendix B:

Cone Penetrometer Logs

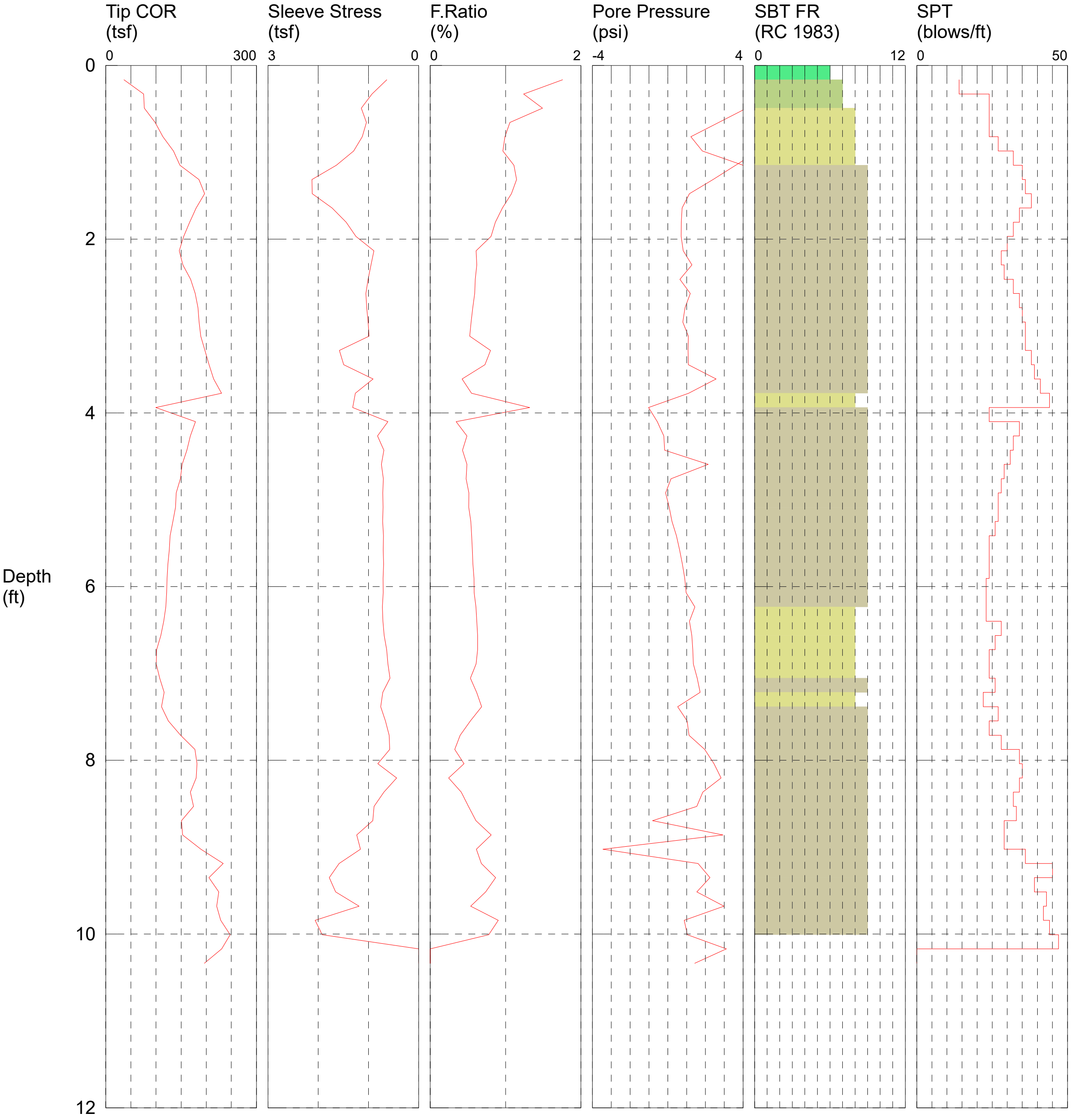
GEOTEST

An RMA Company

CPT01

CPT Contractor: In SItu Engineering
CUSTOMER: GeoTest
LOCATION: Marysville
JOB NUMBER: 23-3322

OPERATOR: Okbay
CONE ID: DDG1263
TEST DATE: 12/20/2023 9:34:56 AM
PREDRILL: 0 ft
BACKFILL: 20% Bentonite slurry & Chips
SURFACE PATCH: None



TOTAL DEPTH: 10.335 ft

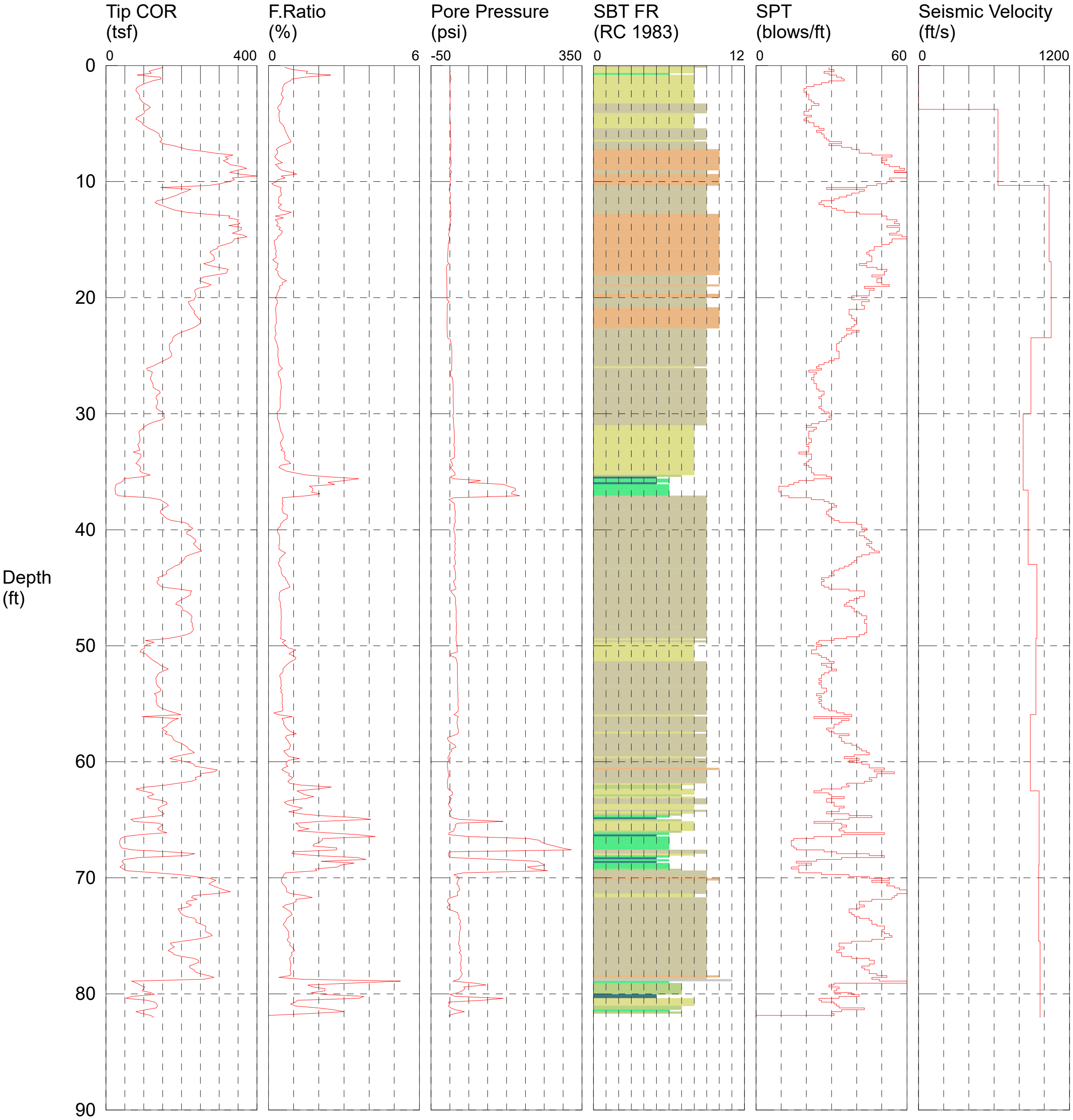
🟥 1 sensitive fine grained	🟦 4 silty clay to clay	🟩 7 silty sand to sandy silt	🟧 10 gravelly sand to sand
🟥 2 organic material	🟦 5 clayey silt to silty clay	🟨 8 sand to silty sand	⬜ 11 very stiff fine grained (*)
🟦 3 clay	🟩 6 sandy silt to clayey silt	🟫 9 sand	⬛ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

CPT02B

CPT Contractor: In SItu Engineering
CUSTOMER: GeoTest
LOCATION: Marysville
JOB NUMBER: 23-3322

OPERATOR: Okbay
CONE ID: DDG1369
TEST DATE: 12/20/2023 10:58:29 AM
PREDRILL: 0 ft
BACKFILL: 20% Bentonite slurry & Chips
SURFACE PATCH: None



TOTAL DEPTH: 82.021 ft

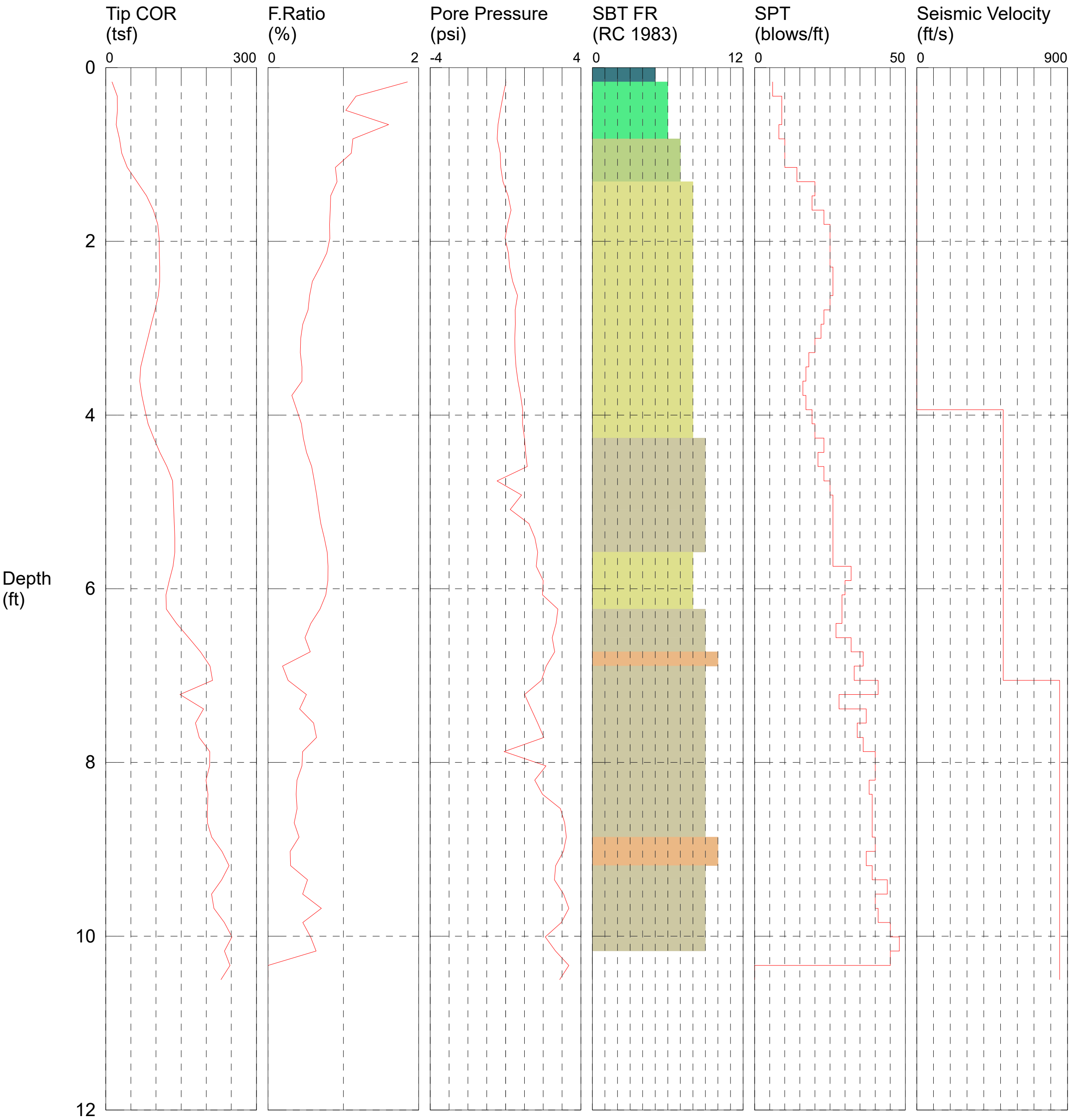
🟥 1 sensitive fine grained
🟥 2 organic material
🟦 3 clay
🟦 4 silty clay to clay
🟦 5 clayey silt to silty clay
🟩 6 sandy silt to clayey silt
🟩 7 silty sand to sandy silt
🟨 8 sand to silty sand
🟫 9 sand
🟧 10 gravelly sand to sand
⬜ 11 very stiff fine grained (*)
⬛ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

CPT03

CPT Contractor: In SItu Engineering
CUSTOMER: GeoTest
LOCATION: Marysville
JOB NUMBER: 23-3322

OPERATOR: Okbay
CONE ID: DDG1369
TEST DATE: 12/20/2023 12:41:13 PM
PREDRILL: 0 ft
BACKFILL: 20% Bentonite slurry & Chips
SURFACE PATCH: None



TOTAL DEPTH: 10.499 ft

🟥 1 sensitive fine grained
🟥 2 organic material
🟦 3 clay
🟦 4 silty clay to clay
🟦 5 clayey silt to silty clay
🟩 6 sandy silt to clayey silt
🟩 7 silty sand to sandy silt
🟨 8 sand to silty sand
🟫 9 sand
🟧 10 gravelly sand to sand
⬜ 11 very stiff fine grained (*)
⬛ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983