Geotechnical Engineering Report

Proposed Equipment Rental Facility
3304 156th Street NE
Marysville, WA 98271

Prepared For:

Pilchuck Construction, LLC
3224 165th Avenue SE
Snohomish, WA 98290

Attn.: Mr. Camron Harvey

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June 19, 2023
Project No. 23-0299

Pilchuck Construction, LLC
3224 165th Avenue SE
Snohomish, WA 98290

Attn.: **Mr. Camron Harvey**

Regarding: **Geotechnical Engineering Report**
Proposed Equipment Rental Facility
3304 156th Street NE
Marysville, WA 98271
Parcel No. 31053200102800

Dear Mr. Harvey,

As requested, GeoTest Services, Inc. [GeoTest] is pleased to submit the following report summarizing the results of our geotechnical evaluation for the proposed equipment rental facility located at 3304 156th Street NE in Marysville, WA (see *Vicinity Map,* Figure 1). This report has been prepared in general accordance with the terms and conditions established in our services agreement dated March 2, 2023 and authorized by yourself.

GeoTest appreciates the opportunity to provide geotechnical services on this project and looks forward to assisting you during the construction phase. Should you have any 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.

GERRY D. BAUTISTA
STATE OF WASHINGTON
51531
REGISTERED
PROFESSIONAL ENGINEER
6/19/23

Gerry D. Bautista, Jr., P.E.
Project Geotechnical Engineer

Enclosure: Geotechnical Engineering Report

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PURPOSE AND SCOPE OF SERVICES

The purpose of this evaluation 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:

- Explore soil and groundwater conditions underlying the site by advancing five test pits with a client-provided excavator.

- Perform laboratory testing on representative samples to classify and evaluate the engineering characteristics of the soils encountered and to assess on-site infiltration capacity.

- Provide a written report containing a description of subsurface conditions and exploration logs. The findings and recommendations in this report pertain to site preparation and earthwork, fill and compaction, seismic design, foundation recommendations, concrete slab-on-grade construction, foundation and site drainage, infiltration feasibility, utilities, temporary and permanent slopes, pavement structures, geotechnical consultation, and construction monitoring.

- Assess Geologic Hazard Areas (if present) per Marysville Municipal Code (MMC).

PROJECT DESCRIPTION

The generally level, approximately 3.2-acre project site is located at the northwest corner of 156th Street NE and Smokey Point Boulevard in Marysville, WA. A barn originally constructed in 1922 is located at the north-central portion of the property, and a one-story garage/shop originally constructed in 2003 is located at the center of the property. The remainder of the property is covered with gravel and serves as an equipment parking and storage area. The perimeter of the subject property is lined with chain link fence.

GeoTest understands that the existing structures on the subject property will be removed and a two-story equipment rental building will be constructed at the south-central portion of the property. The proposed building will have an approximate footprint of 199 feet by 60 feet and contain two stories (main story warehouse and second-story mezzanine containing office space). We anticipate that the proposed structure will be steel framed and utilize shallow conventional foundation and slab-on-grade floors. New asphalt parking is planned for the eastern portion of the property that fronts Smokey Point Boulevard. Structural loads are anticipated to be light to moderate.

Information regarding proposed stormwater facilities was not known at the time that this report was written. However, GeoTest understands that existing facilities may be used if feasible.

The planned improvements are expected to require minor grading, and GeoTest does not expect that more than a few feet of cut or fill will be required to achieve desired finish grades.

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 investigation. 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 west of Smokey Point Boulevard and south of 156th Street NE. The subject property currently contains an equipment rental business operating on-site. Most of the lot is covered in gravel with grass vegetation around structures and at the edge of the property.

The site is relatively flat with minor elevation changes. Interstate 5 runs to the west with a vegetated buffer between the parcel and the northbound freeway lanes. A single-story industrial building and storage facility are to the south.

Image 1. Surface conditions of site consisted of a graveled lot with a few buildings, facing northeast.
Images 1 and 2 were taken on May 11, 2023.

Subsurface Soil Conditions

Subsurface conditions were explored by advancing five test pits (TP-1 through TP-5) on May 11, 2023. All test pit explorations were advanced to depths of 6 to 7 feet below ground surface (BGS) using an excavator provided by the Client (Pilchuck Construction). The presence of groundwater seepage at 4 to 6.5 feet BGS, and caving soils between 6 and 7 feet BGS, prevented further advancement of the test pits. The approximate locations of these explorations have been plotted on the *Site and Exploration Plan* (Figure 2).

Test Pit Explorations

All five test pits encountered similar subsurface conditions. At the surface, the explorations generally encountered approximately 0.5 to 1 foot of loose, gray, slightly silty, very sandy gravel, interpreted to be gravel fill at most of the test pits. The near-surface gravel fill in TP-2 was slightly silty and contained less gravel than encountered in the other test pits. Underlying the gravel fill was approximately 1 foot of medium-dense to dense, slightly silty, very sandy gravel, interpreted to be fill. Below the fill was approximately 0.5 to 1 foot of dark brown, gravely, silty sand, interpreted to be relict topsoil.

Image 2. Surface conditions within TP-1. Near-surface soils consist of gray gravel fill overlying sandy gravel fill, relict topsoil, and weathered Marysville Sand that transitions to unweathered, brown Marysville Sand.

Underlying the topsoil in all the test pits was native, medium-dense, tan to gray, mottled, damp to moist, slightly silty sands. These native soils were interpreted to be weathered Marysville Sand. At approximately 3 feet BGS in most of the test pits, the Marysville Sand became unweathered and gray. In TP-3 and TP-4 at approximately 5 feet BGS, a thin lens of medium dense, orange, wet, slightly silty sand (also Marysville Sand) was encountered. In TP-5, at a depth of 5 feet BGS, the unweathered Marysville Sand became gray/blue and very silty. The unweathered Marysville Sand soils were encountered to the maximum explored depth of the test pits. As discussed previously, the presence of groundwater seepage and caving soils prevented advancement of the test pits beyond 6 to 7 feet BGS.

More detailed logs of the subsurface conditions encountered at the exploration locations are presented in the *Test Pit Logs* (Figures 5 through 7).

General Geologic Conditions

Geologic information for the project site was obtained from the *Geologic Map of the Marysville West 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 exploration were generally consistent with the mapped glacial deposits. For this report, the native Glacial Outwash soils are referred to as ‘Marysville Sand’.

Groundwater

Groundwater seepage was encountered at an approximate depth of 4 to 6.5 feet BGS in all of the test pits. 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 with 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. Seasonal groundwater monitoring was outside of our scope of work for this report.

GEOLOGIC HAZARDS

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.”

As the subject property is generally level with no discernible elevation change, the subject property is not located within a *Landslide Hazard Area* as defined in MMC 22A.020.130 or *Erosion Hazard Area* as defined in MMC 22A.020.060. Thus, no mitigations to address Landslide or Erosion Hazards are needed.

The subject property is mapped as having a low to moderate susceptibility to liquefaction. The following section provides a discussion of Seismic Hazards with respect to the subject property.

Seismic Hazard Areas

Seismic Hazard Areas are defined by MMC 22A.020.200 as areas that, due to a combination of soil and groundwater conditions, are subject to severe risk of ground shaking, subsidence, or liquefaction of soils during earthquakes. These areas are typically underlain by soft or loose saturated soils (such as Alluvium), have a shallow groundwater table, and are typically located on the floors or river valley. Seismic Hazard Areas as classified as follows:

(1) Low Hazard. Areas underlain by dense soils or bedrock.

(2) High Hazard. Areas underlain by soft or loose saturated soils.

Based on the online interactive Geologic Map of Washington State, published by the Washington State Department of Natural Resources, the subject site is rated as a low to moderate liquefaction susceptibility area, as shown in Image 3. However, this map only provides an estimate of the likelihood that soil will liquefy because of earthquake shaking and is meant as a general guide to delineate areas prone to liquefaction. Near-surface conditions at the site typically consist of loose to medium dense Marysville Sand deposits (generally silty sand to clean sand) that became denser with depth. Groundwater seepage was encountered in all of the test pits at approximately depths of 4 to 6.5 feet BGS.

Liquefaction is defined as a significant rise in porewater 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 property 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.

Recent liquefaction analyses that GeoTest has performed on nearby projects in the vicinity suggest that the subject property will have a reasonably low risk of liquefaction. Past evaluations also suggest that liquefaction-induced settlements may be on the order of 2 inches or less. Please note that GeoTest did not perform a site-specific evaluation for this report, but regional maps and our previous experience with nearby projects support less than 2 inches of liquefaction-induced settlement. Thus, the project team should anticipate 2 inches of potential settlement due to liquefaction. If this anticipated settlement is not acceptable, GeoTest can perform a site-specific evaluation upon request as part of a separate scope of work. This would require a further soils investigation with either borings or Cone Penetration Tests (CPTs).

It should be noted that a seismic event could cause cracking or shifting of structural elements that can be associated with long-term problems with a building. These risks would, however, be present throughout seismically active areas such as Puget Sound. As such, it is generally expected that new construction will utilize design and construction practices that are current with modern design codes and standards. Furthermore, there are post-construction settlement mitigations, such as additional structural steel in foundations or supporting buildings on mat foundations, which can be implemented to help mitigate differential settlements below buildings. We can provide recommendations on these measures upon request.

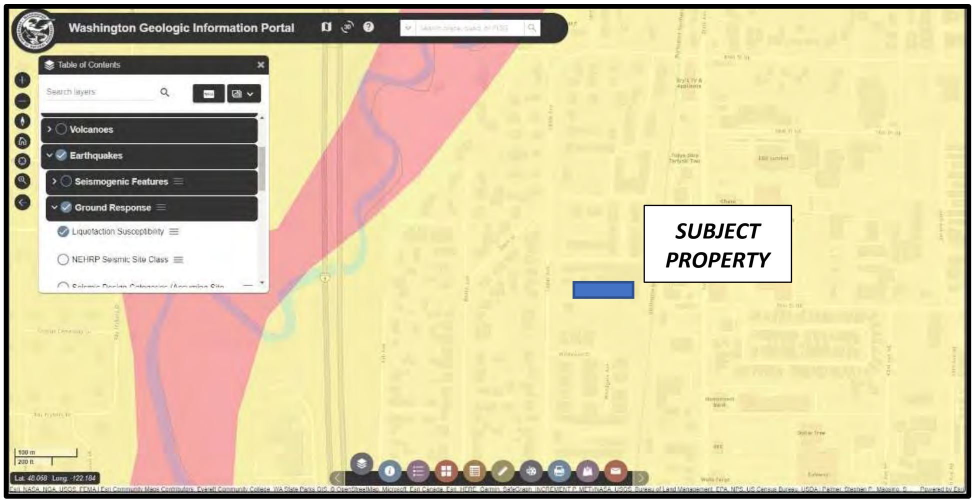

Image 3. Screenshot from *Washington Geologic Information Portal* showing liquefaction susceptibility. Yellow is Low-to-Moderate, Red is High. Subject Property shown in blue. Retrieved on June 2, 2023.

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.

Subsurface explorations conducted in the proposed development area generally encountered native, loose to medium-dense, weathered Marysville Sand directly underlying the near-surface fill and relict topsoil at approximately 2 to 3 feet BGS. The native soils became unweathered at approximately 3 to 5 feet BGS. GeoTest recommends that the undocumented fill soils and relict topsoil be removed from the proposed building footprint down to the native, weathered or unweathered, Marysville Sand soil. GeoTest anticipates that about 2 to 3 feet of stripping will be needed to expose the competent weathered/unweathered soils.

Once competent native soils have been exposed, GeoTest recommends that the subgrade surface be compacted to a firm and unyielding condition with an appropriate piece of construction equipment. The foundations can bear directly on the prepared native subgrade or on compacted structural fill placed atop prepared native subgrades. Further recommendations regarding the placement and compaction of structural fill can be found in the *Fill and Compaction* section of this report.

Other foundation alternatives that were discussed with the project team included the following:

- Overexcavating footings and replacement with structural fill, then supporting the floor slabs on recompacted existing fill soils. Some settlement of the slabs could be expected due to the near-surface relict topsoil remaining in place.
- As above, except that grade beams would be incorporated into the foundation system to help mitigate differential settlement.

As of the writing of this report, GeoTest understands that the project team is opting to overexcavate the entire building footprint and replace with compacted structural fill. GeoTest can provide additional recommendations and consultation regarding the two foundation alternatives above upon request.

If the pavement sections will be placed on existing fill, GeoTest recommends that these areas be stripped down to firm, non-organic soils. The subgrade should then be compacted prior to the placement of structural fill. Because a layer of relict topsoil was encountered in nearly all of the explorations, some settlement of pavement sections may still occur if these structures are supported on existing fill soils and the relict topsoil remains in place. If this potential settlement is not desirable, the pavement sections should also be supported on the native Marysville Sand soil found approximately 2 to 3 feet BGS, or on compacted structural fill placed atop these soils.

Stormwater infiltration appears to be feasible for the proposed development based on the presence of predominantly granular soils. We have presented preliminary design infiltration rates based on grain size analyses, per the *Stormwater Management Manual for Western Washington* (SMMWW), in a subsequent section of this report. The SMMWW is the manual currently adopted by the City of Marysville. However, these rates do not account for mounding, as groundwater seepage was encountered at approximately 4 to 6.5 feet BGS in all of the explorations. It should be noted that seasonal groundwater monitoring or a mounding analysis was not included in our scope of services.

Site Preparation and Earthwork

The portions of the site proposed for foundations, pavements, and floor slabs should be prepared by removing topsoil, loose fill, deleterious material, and significant accumulations of organics. GeoTest anticipates between 2 and 3 feet of stripping to expose suitable and native subgrade soils below foundation areas, floor slab areas, and pavement areas depending on location and subgrade preparation methods chosen. If the pavement areas are to be supported on existing fill soils, GeoTest anticipates about 1 foot of stripping to remove the near-surface gravel section.

Prior to placement of any foundation elements or structural fill, the exposed subgrade under all areas to be occupied by soil-supported floor slabs, spread, or continuous foundations should be recompacted 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 disturbed during site work can be recompacted.

Proof rolling should be carefully observed by qualified geotechnical personnel. 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 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.

Fill and Compaction

Structural fill used to obtain final elevations for footings and soil-supported floor slabs must be properly placed and compacted. In most cases, suitable, non-organic, predominantly granular soil may be used for fill material 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 material, or construction debris is not suitable for reuse as structural fill and should be properly disposed offsite 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

The existing, non-organic gravel fill and native Marysville Sand underlying the near-surface organic topsoil is suitable for reuse as structural fill when placed at or near optimum moisture contents, as determined by ASTM D1557 and if allowed for in the project plans and specifications. The weathered soils may contain elevated silt content and may be difficult to use during periods of wet weather.

The Contractor and Owner should be prepared to manage over-optimum moisture content soils. Moisture content of the site soils may be difficult to control during 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) with at least 30 percent retained on the No. 4 sieve, or a well-graded crushed rock. Structural fill for dry weather construction may contain up to 10 percent fines (that portion passing the U.S. No. 200 sieve) based on the portion passing the U.S. No. 4 sieve. The use of an imported fill having more than 10 percent fines may be feasible, but the use of these soils should generally be reviewed by the design team prior to the start of construction.

Imported structural fill with less than five percent fines should be used during wet weather conditions. Due to wet site conditions, soil moisture contents could be high enough that it may be difficult to compact even clean imported select granular fill to a firm and unyielding condition. Soils with an over-optimum moisture content should be scarified and dried back to a suitable moisture content during periods of dry weather or removed and replaced with drier structural fill.

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

Fine grained native soils are particularly 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 sand or sand and gravel 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 of topsoil 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 medium-dense Marysville Sand soils underlying the site are 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 development.

Foundation Support

Continuous or isolated spread footings founded on proof-rolled, firm and unyielding, native Marysville Sand soils or on properly compacted structural fill placed directly over undisturbed, firm and unyielding, native soil can provide foundation support for the proposed improvements. We recommend that qualified geotechnical personnel confirm that suitable bearing conditions have been reached prior to placement of structural fill or foundation formwork. To provide proper support, GeoTest recommends that existing topsoil, existing fill, and/or loose upper portions of the native soil be removed from beneath the building foundation area.

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.

Allowable Bearing Capacity

Assuming the above foundation support criteria are satisfied, continuous or isolated spread footings founded directly on native, firm and unyielding, Marysville Sand soils or on compacted structural fill placed directly over undisturbed native soils may be proportioned using a net allowable soil bearing pressure of 2,500 pounds per square foot (psf).

The 'net allowable bearing pressure' refers to the pressure that can be imposed on the soil at foundation level. This pressure includes all dead loads, live loads, the weight of the footing, and any backfill placed above the footing. The net allowable bearing pressure may be increased by one-third for transient wind or seismic loads.

Foundation Settlement

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.

Liquefaction-Induced Settlement

The amount of liquefaction-induced settlement is expected to be minor based on our regional experience and, in our opinion, does not require mitigation if the building can tolerate 2 inches of liquefaction-induced settlement. Due to the intended building use, however, the Owner may wish to consider mat slab construction or the inclusion of grade beams on the interior of the building, or similar structural improvements, to add a degree of rigidity to the building that will further mitigate settlement during a seismic event. GeoTest recommends that the design team review the requirements of the International Building Code, the recommendations contained in this report, and consider similar construction in close proximity to this property when determining if mat slabs, grade beams, or similar structural elements to mitigate liquefaction are to be included in the final design. The inclusion of more robust seismic mitigations has the added benefit of reducing the risk of differential settlement across the footprint of the building under both static and seismic conditions.

Floor Support

Conventional slab-on-grade floor construction is feasible for the planned site improvements. Floor slabs may be supported on properly prepared native subgrade or on properly placed and compacted structural fill placed over properly prepared native soil. Prior to placement of the structural fill, the native soil should be proof rolled as recommended in the *Site Preparation and Earthwork* section of this report.

GeoTest recommends that interior concrete slab-on-grade floors be underlain with at least 6 inches of clean, compacted, 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 10-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.

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.

Foundation and Site Drainage

Positive surface gradients should be provided adjacent to the proposed building 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 should be sloped and drainage gradients should be maintained to carry surface water away from the building 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 building foundations as shown in the *Typical 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 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 drainpipe should be placed at approximately the same elevation as the bottom of the footing or 12 inches below the adjacent floor 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 the 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 Forces

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 4 to 6.5 feet below existing site grades. 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 can 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 in active soil conditions. Nonyielding walls under drained conditions should be designed for an equivalent fluid density of 55 pcf, for structural fill in at-rest conditions. GeoTest should be contacted if submerged walls are expected as part of the final design.

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. GeoTest also recommends that a seismic surcharge of 8H be included where H is the wall height. The seismic surcharge should be modeled as a rectangular distribution with the resultant applied at the midpoint of the wall.

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 pcf. The recommended value includes a safety factor of about 1.5 and assumes that the ground surface adjacent to the structure is level in the direction of movement for a distance equal to or greater than twice the embedment depth. The recommended value also assumes drained conditions that will prevent the buildup of hydrostatic pressure in the compacted fill. Retaining 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 work calls 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 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.

Temporary unsupported excavations in the medium dense, slightly silty, poorly graded sands, encountered at the project site are classified as a Type C soil according to WAC 296-155-66401 and may be sloped as steep as 1.5:1 (Horizontal: Vertical). All soils encountered are classified as Type C soil in the presence of groundwater seepage. 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 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

Utility trenches must be properly backfilled and compacted to reduce cracking or localized loss of foundation, slab, or pavement support. Excavations for new shallow underground utilities are expected to be placed within loose to medium-dense Marysville Sand.

Trench backfill in improved areas (beneath structures, pavements, sidewalks, etc.) should consist of structural fill as defined in the *Fill and Compaction* section of this report. Outside of improved areas, trench backfill may consist of reused native material provided the backfill can be compacted to the project specifications. Trench backfill should be placed and compacted in general accordance with the recommendations presented in the *Fill and Compaction* section of this report.

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 activity and traffic may cause caving of the trench walls.

The contractor is responsible for trench configurations. 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. Trench widths may be substantially wider than under dewatered conditions.

Utility Trench Backfill Considerations

The majority of the near-surface soils excavated from the site will be moist, fine to medium sand with relatively low amounts of silt and gravel. These soils are suitable for use as backfill material, provided they are placed at or near optimum moisture contents. It should be noted, however, that GeoTest encountered groundwater seepage at approximately 4 to 6.5 feet BGS in our explorations. We understand that utility trenches on this project may not be as deep. However, if deep trenches are planned, GeoTest anticipates that soil below the water table will consist of saturated fine to medium sands that will not be suitable for backfill without significant moisture conditioning efforts.

Utility Trench Base Support

There is a potential that utility trenches excavated below the groundwater table could experience a “quick” condition. A quick condition develops when the seepage pressure exceeds the resisting pressure. In this case, it would be the upwards vertical flow of water exceeding the unit weight of the soils at the bottom of the trench. The potential for a quick condition to develop is based on the hydraulic head difference between the water table level, the trench bottom, and the unit weight of the surrounding soils. The probability of a quick condition developing decreases as the elevation differential between groundwater levels and the bottom of the trench decreases.

If a quick condition does develop within utility trenches, it will be necessary to add quarry spall rock to the bottom of the trench during the excavation process. The quarry spall rock will add weight to the saturated sands and provide resistance against hydrostatic forces. If quick conditions develop in a lateral direction (i.e., running sand), mitigating the differential forces will be more difficult and will likely require that the water table be lowered to below the depth of the excavation.

Dewatering Considerations

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. Based on our experience, it is likely that groundwater will be controlled by using sump pumps during trench excavations or through the use of well points placed along the trench alignment. It is, however, 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

Selection of a pavement section is typically a choice relative to higher initial cost and lower long-term maintenance, or lower initial cost with more frequent maintenance. For this reason, we recommend that the owner participate in the selection of proposed pavement improvements 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 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].

Heavy-Duty Flexible Pavement

Areas that will be accessed by more heavily loaded vehicles, semi and garbage trucks, etc. will require a thicker asphalt section and should be designed using a paving section consisting of 4 inches of Class ½-inch HMA asphalt surfacing above 8 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 150 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 8 inches thick and be founded on a minimum of 8 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.

Test Pit Gradation Results

From the explorations excavated in the areas of interest, five representative soil samples were selected and mechanically tested for grain size distribution and calculation according to the soil grain size analysis method of the SMMWW. A summary of these results is reproduced in Table 1. The rates presented in Table 1 are representative of loose soil conditions and do not take the relative density of the soil into account. These rates should be considered preliminary and utilized for conceptual stormwater facility sizing and general project feasibility.

Table 1: Preliminary Infiltration Rates Based on Grain Size Analysis

Exploration ID:	Depth (ft)	Geologic Unit	Corrected K_{sat} Infiltration Rate (in/hr)
TP-2	6.0	Marysville Sand	10.0 *
TP-3	2.1	Weathered Marysville Sand	9.6
TP-3	5.0	Marysville Sand	8.5
TP-5	4.7	Weathered Marysville Sand (silt lens)	1.8**
TP-5	7.0	Marysville Sand	10.0 *

Notes:
-Correction Factors Utilized: CFv = 0.75, CFt = 0.4, CFm = 0.9, Overall Correction Factor: 0.288
-K_{sat} = Initial Saturated Hydraulic Conductivity
*GeoTest does not recommend using corrected infiltration rates higher than 10 inches per hour due to limitations of the grain-size analysis method (Massman equation).

Stormwater infiltration potential is a function of the relative permeability of site soils, and the separation between the base of the proposed stormwater facility and the groundwater table. Based on the results presented in Table 1, on-site infiltration of stormwater is feasible for the project site. **We recommend a preliminary infiltration rate of 8.5 inches per hour be used for conceptual sizing and project feasibility for facilities founded in the native, weathered or unweathered, Marysville Sand soils.** If facilities are to be sited within the near-surface weathered soils, confirmatory explorations should be performed near the proposed facilities to verify that no silt lenses are encountered within the weathered soils (see ** in Table 1).

At the time of this report, a specific infiltration facility design is not available. As such, it should be expected that iterative project work may be needed to initially size facilities and then determine if reductions to the presented infiltration rate will/may be necessary to account for groundwater mounding. A mounding analysis is outside of the scope of work of this report.

Stormwater Treatment

The stormwater facilities on-site 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.

Cation exchange capacity, organic content, and pH tests were performed by Northwest Agricultural Consultants on three soil samples collected from the explorations shown in Table 2. A summary of the laboratory test results is presented in Table 2 below.

Table 2: SSC-6 Stormwater Treatment Testing Results

Exploration ID:	Depth (ft)	Geologic Unit	Cation Exchange Capacity (meq/100 grams)	Organic Content (%)	pH (unitless)
TP-1	6.0	Marysville Sand	2.7	1.08	5.9
TP-2	1.0	Relict Topsoil	12.2	5.02	5.7
TP-2	2.0	Weathered Marysville Sand	5.9	2.48	5.6

Notes:
-Treatment Criteria: CEC ≥ 5, OC ≥ 1

Suitability for onsite pollutant treatment is determined in accordance with SSC-6 of the SMMWW. Soils with an organic content of 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 for stormwater treatment. Based on the results shown in Table 2, the on-site topsoil and near-surface Marysville Sand is suitable for stormwater treatment.

On-site soils can be amended by mixing higher silt content soils or adding mulch (or other admixtures) to elevate the cation exchange capacity and organic contents. On-site amended soil requires additional testing to confirm compliance with ecological regulations. GeoTest is available to perform additional laboratory testing as part of an expanded scope of services if the soil is to be amended. Alternatively, the owner may elect to import amended soils with the desired properties for planned treatment facilities.

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 subgrade preparation operations, structural fill placement, and compaction efforts 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. If 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 Pilchuck Construction, LLC, and their design consultants for specific application to the design of the proposed equipment rental facility located at 3304 156th Avenue SE in Marysville, WA. 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, conclusions, and recommendations 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 construction that differ from those contained within this report, GeoTest should be allowed to review the recommendations 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 and recommendations contained herein.

The earthwork contractor is responsible to perform 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	Typical Footing and Wall Drain Section
	Figure 4	Soil Classification System and Key
	Figures 5 through 7	Test Pit Logs
	Figures 8 and 9	Grain Size Test Data
	Attachment	Northwest Agricultural Services Test Data
	Attachment	Report Limitations and Guidelines for Its Use

REFERENCES

Gariepy, D., Graul, C., Heye, A., Howie, D., Labib, F., & Song, K. (n.d.), *2019 Stormwater Management Manual for Western Washington* (2019 SMMWW) (pp. 1-1108) (United States, Washington State Department of Ecology).

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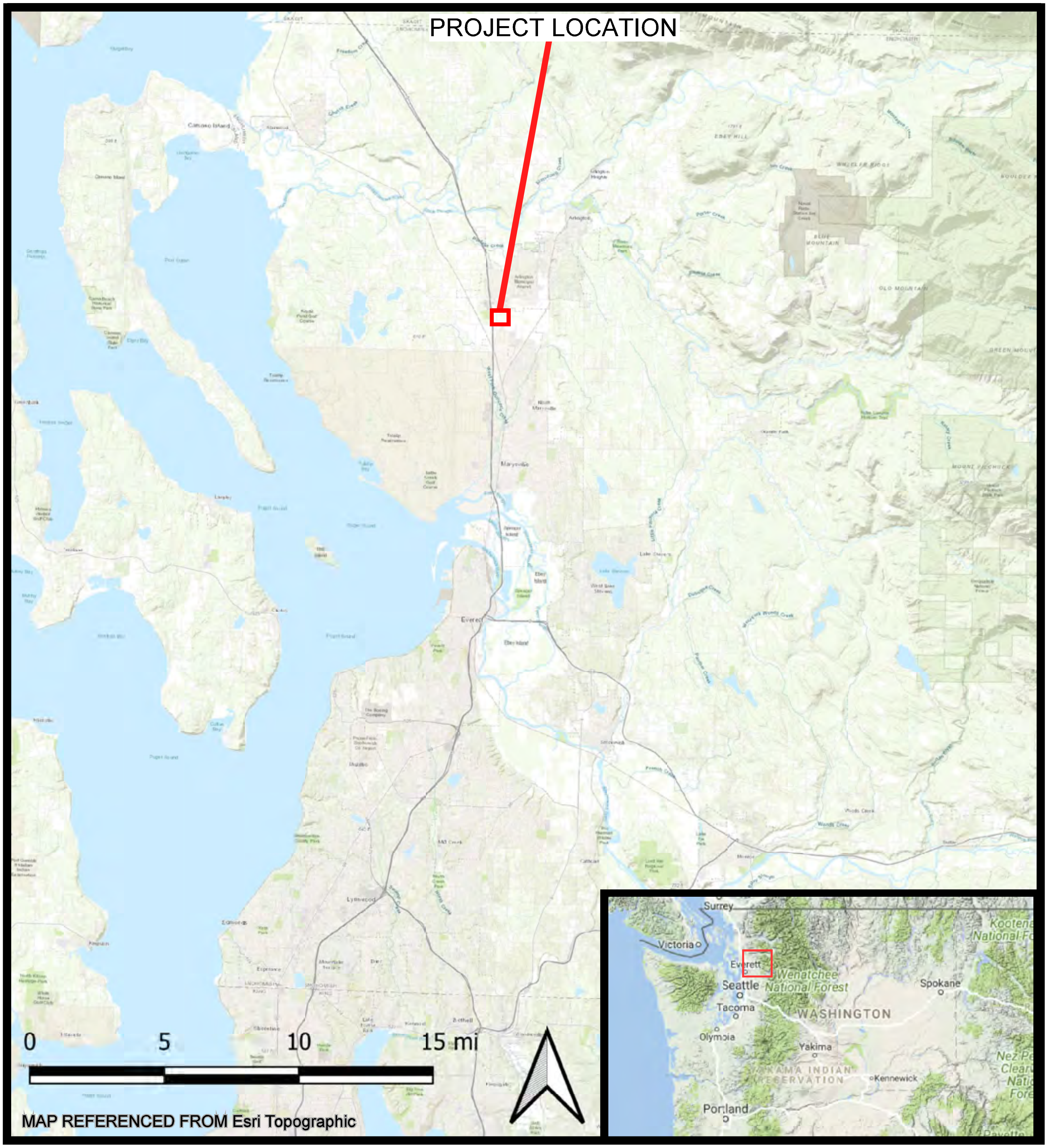


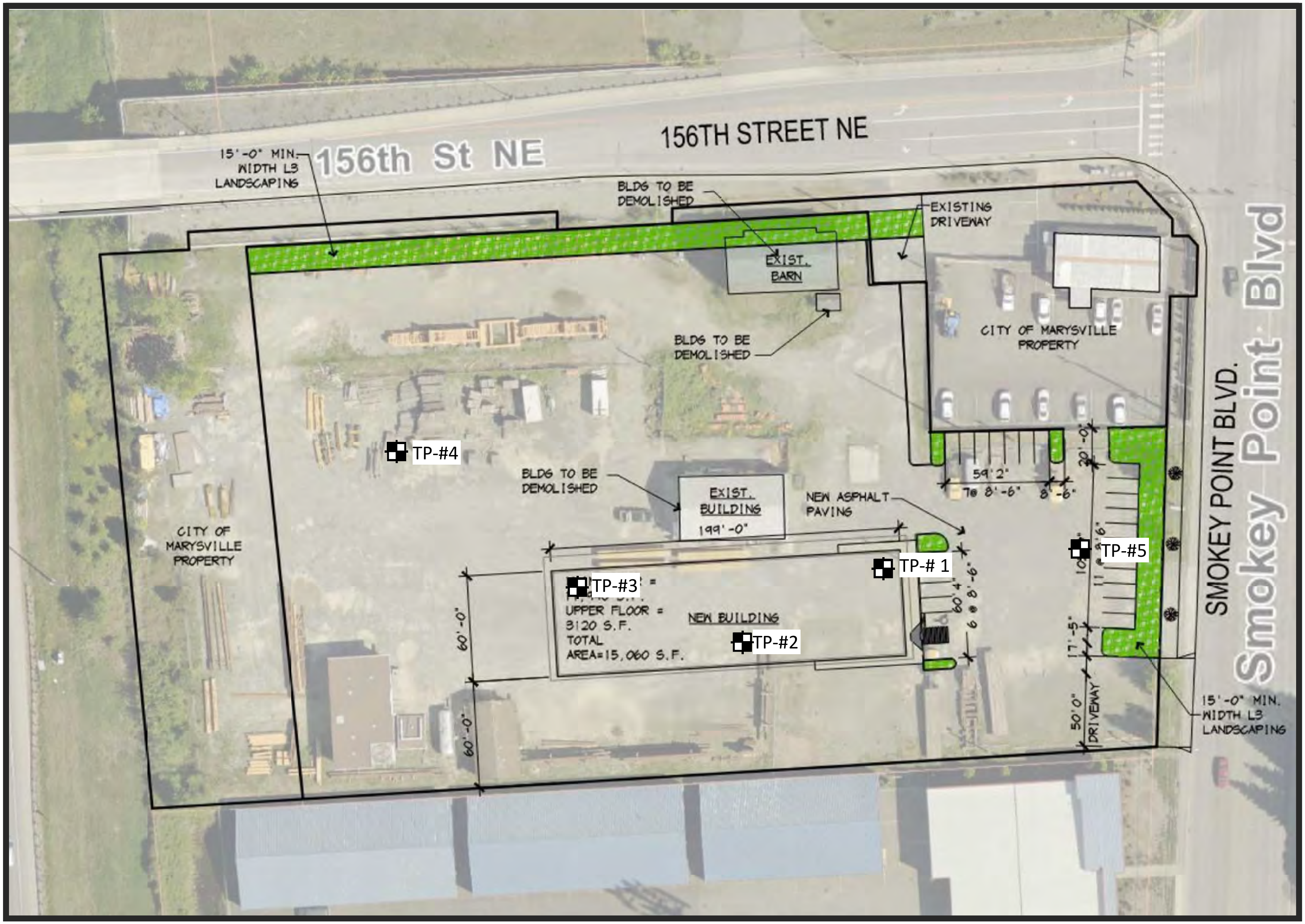
GEOTEST
An RMA Company

Date: 5-15-23	By: SEM	Scale: As Shown	Project 23-0299

VICINITY MAP
PROPOSED EQUIPMENT RENTAL FACILITY
3304 156TH STREET NE
MARYSVILLE, WA 98271

Figure 1

MAP PROVIDED BY 2812 ARCHITECTURE



TP-# = Test Pit Location

Date: 6-19-23	By: SEM	Scale: NTS	Project 23-0299

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SITE AND EXPLORATION PLAN

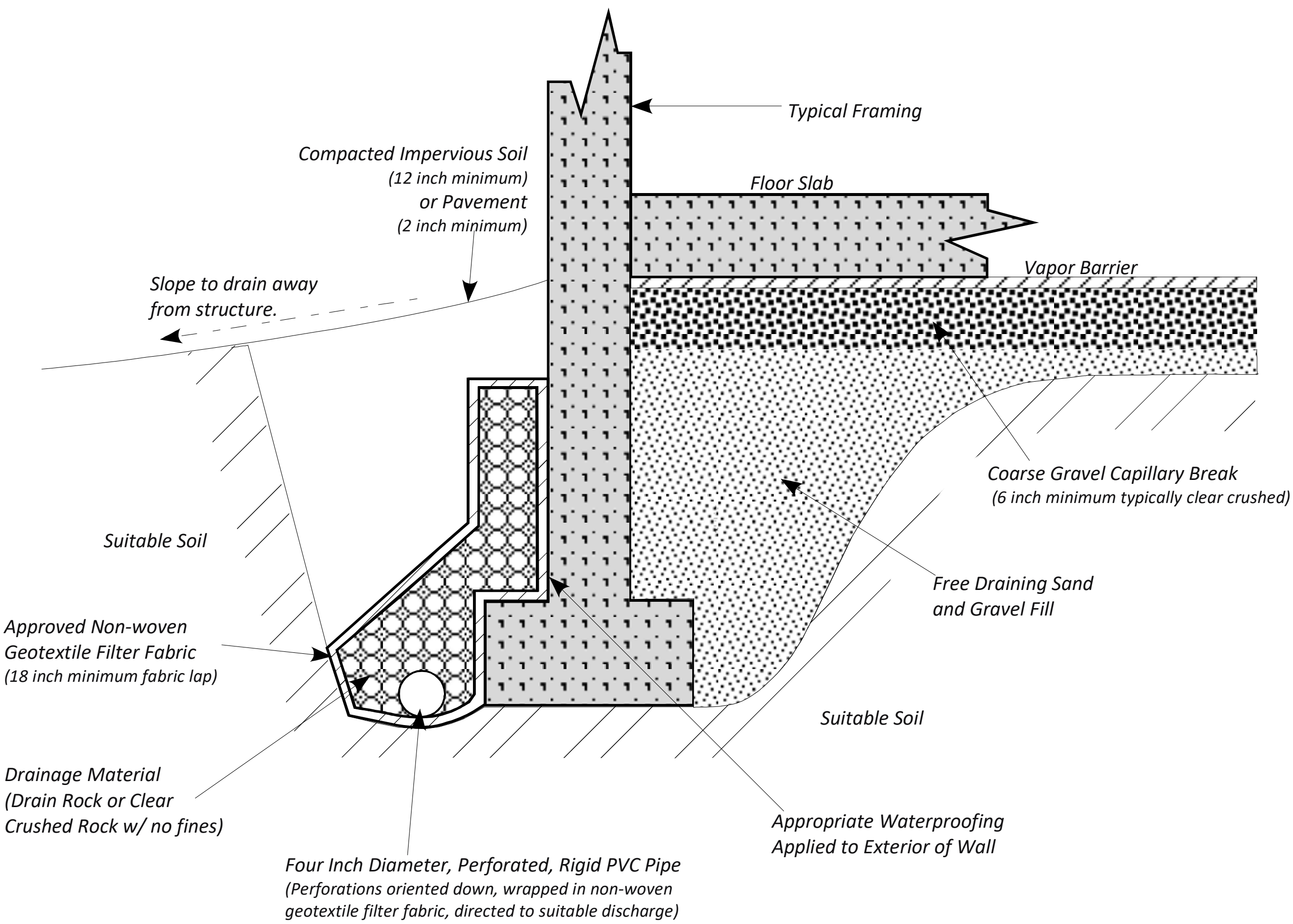
Proposed Equipment Rental Facility

3304 156th Street NE

Marysville, WA 98271

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: 5-31-23	By: SEM	Scale: None	Project 23-0299
	TYPICAL FOOTING & WALL DRAIN SECTION PROPOSED EQUIPMENT RENTAL FACILITY 3304 156TH STREET NE MARYSVILLE, WA 98271			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

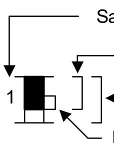
OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		AC or PC	Asphalt concrete pavement or Portland cement pavement
ROCK		RK	Rock (See Rock Classification)
WOOD		WD	Wood, lumber, wood chips
DEBRIS		DB	Construction debris, garbage

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

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Soil Classification System and Key

Figure 4

TP-1

SAMPLE DATA			SOIL PROFILE		GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type / Test Data	USCS Symbol	Description	

Excavation Method: Tracked Excavator

Ground Elevation (ft): 108

Excavated By: Pilchuck Const. (Logged: SM)

Sample Number	Test Data
1	W = 2, GS
2	W = 5, GS
3	W = 39, GS
4	
5	
6	
7	
8	

USCS Symbol	Description
GM	Loose, damp, gray, slightly silty, very sandy GRAVEL (Gravel Fill)
GM/SP	Medium dense, brown, damp, slightly silty, very sandy GRAVEL (Fill)
SM	Dense, brown, moist, gravelly, silty SAND (Fill)
SM	Dense, brown, moist, gravelly, silty SAND, abundant organics (Relict Topsoil)
SP/SM	Medium dense, tan/gray mottled, moist, slightly silty SAND (Weathered Marysville Sand)
SP/SM	Medium dense, gray, moist to very moist, slightly silty SAND (Marysville Sand)
	Terminated @ 7.0 BGS due to caving.

Groundwater: Groundwater seepage encountered at 6.5 ft.

Test Pit Completed 05/11/23
Total Depth of Test Pit = 7.0 ft.

TP-2

SAMPLE DATA			SOIL PROFILE		GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type / Test Data	USCS Symbol	Description	

Excavation Method: Tracked Excavator

Ground Elevation (ft): 110

Excavated By: Pilchuck Const. (Logged: SM)

Sample Number	Test Data
9	
10	
11	
12	
13	W = 23, GS

USCS Symbol	Description
GM/SP	Loose, gray, damp, slightly silty, very sandy GRAVEL (Fill)
SM	Medium dense, dark brown, damp, gravelly, silty SAND, abundant organics (Relict Topsoil)
SP/SM	Medium dense, gray/tan mottled, moist, slightly silty SAND (Weathered Marysville Sand)
SP/SM	Medium dense, gray, moist to very moist, poorly graded SAND with trace silt and gravel (Marysville Sand)
	Terminated @ 6.0 BGS due to caving.

Groundwater: Groundwater seepage encountered at 4.0 ft.

Test Pit Completed 05/11/23
Total Depth of Test Pit = 6.0 ft.

Notes: Elevations obtained with My Elevation app by RHD Software.

TP-3

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	USCS Symbol	Soil Profile	Groundwater
0	14			GM	Loose, damp, gray, slightly silty, very sandy GRAVEL (Gravel Fill)	
	15			GM/ SP	Medium dense, brown, damp, slightly silty, very sandy GRAVEL (Fill)	
	16			SM	Medium dense, brown, moist, damp, gravelly, silty SAND, abundant organics (Relict Topsoil)	
2	17		W = 17 GS	SP/ SM		
				SP/ SM	Medium dense, tan/gray, moist, slightly silty SAND (Weathered Marysville Sand)	Groundwater seepage encountered at 4.0 ft.
4	18, 19, 20		W = 28 GS		Medium dense, gray, moist, slightly silty SAND (Marysville Sand) @4' becomes orange, very moist to wet @5.2' becomes gray, moist	
6	21, 22				Terminated @ 7.0' BGS due to caving	

Excavation Method: Tracked Excavator
Ground Elevation (ft): 111
Excavated By: Pilchuck Const. (Logged: SM)

Test Pit Completed 05/11/23
Total Depth of Test Pit = 7.0 ft.

TP-4

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	USCS Symbol	Soil Profile	Groundwater
0	23			GM/ SP	Dense, gray, damp, slightly silty very sandy GRAVEL (Fill)	
	24			SM	Dense, dark brown, moist, gravelly, silty SAND, abundant organics (Relict Topsoil)	
2	25			SP/ SM	Medium dense, tan/gray mottled, moist, slightly silty SAND (Weathered Marysville Sand)	
4	26, 27			SP/ SM	Medium dense, gray, moist, slightly silty SAND (Marysville Sand) @4.5' becomes orange, very moist to wet @5' becomes gray, moist	Groundwater seepage encountered at 4.5 ft.
6	28, 29				Terminated @ 7.0' BGS due to caving	

Excavation Method: Tracked Excavator
Ground Elevation (ft): 110
Excavated By: Pilchuck Const. (Logged: SM)

Test Pit Completed 05/11/23
Total Depth of Test Pit = 7.0 ft.

Notes: Elevations obtained with My Elevation app by RHD Software.

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Log of Test Pits

Figure 6

TP-5

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): 112 Excavated By: Pilchuck Const. (Logged: SM)	
0	30				GM/ SP	Dense, gray/tan, damp, slightly silty, very sandy GRAVEL (Fill)	
2	31 32				SM	Medium dense, dark brown, damp, silty SAND, wood chunks (Fill)	
					SP/ SM	Medium dense, gray, moist, slightly silty SAND (Weathered Marysville Sand/Possible Fill?)	
4	33 34		W = 64 GS		SM	Medium dense, gray/blue/tan mottled, moist, very silty SAND, trace gravel (Weathered Marysville Sand)	
6	35 36		W = 17 GS		SP	Medium dense, blue/gray, moist, very gravelly, poorly graded SAND, trace gravel (Marysville Sand)	Groundwater seepage encountered at 6.0 ft.
						Terminated @ 7.0' BGS due to caving	
8							

Test Pit Completed 05/11/23
Total Depth of Test Pit = 7.0 ft.

Notes: Elevations obtained with My Elevation app by RHD Software.

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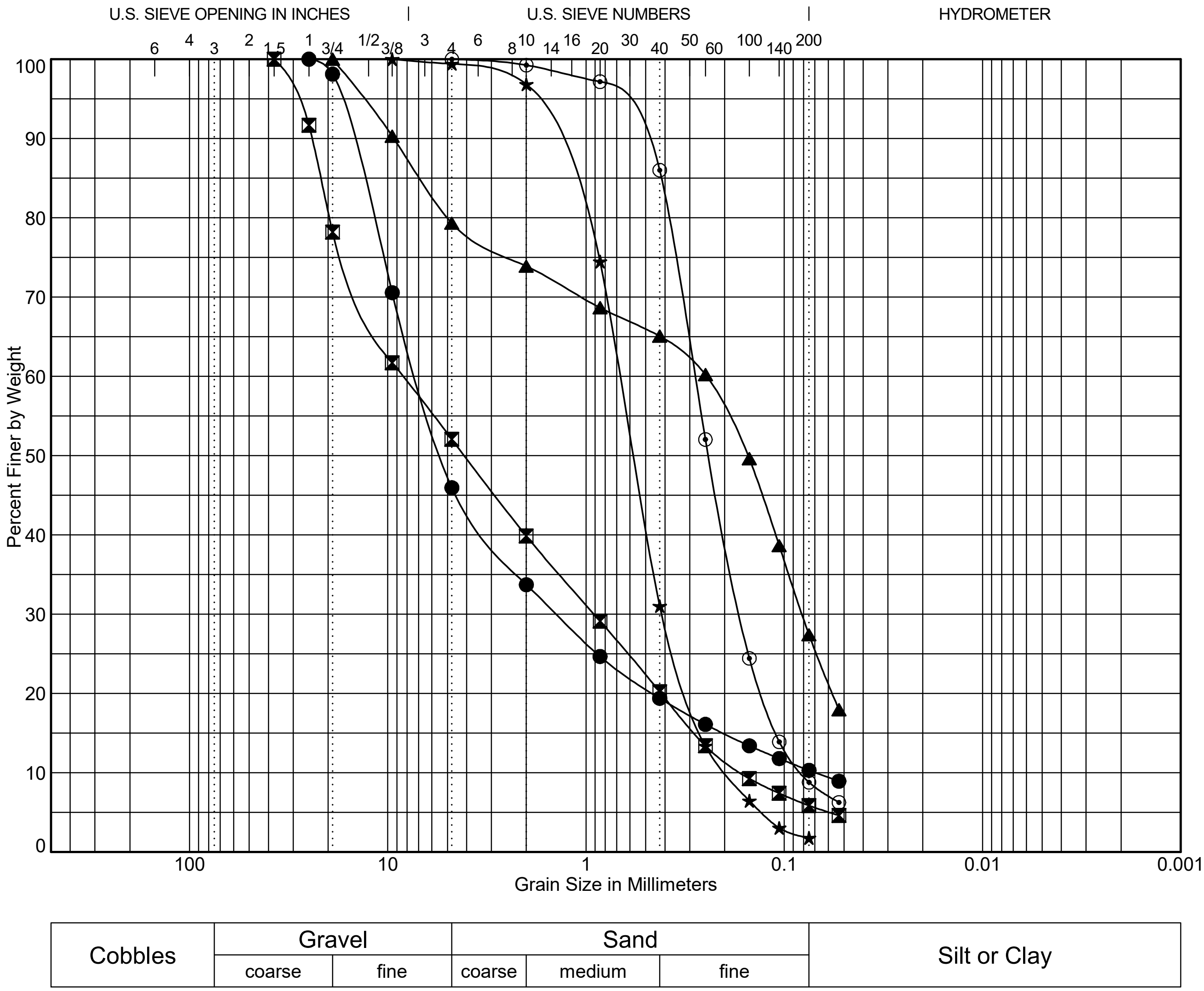
Proposed Equipment Rental Facility 3304 156th Street NE Marysville, WA 98271	Log of Test Pits	Figure 7



Point	Depth	Classification	LL	PL	PI	C_c	C_u
● TP-1	0.2	Slightly silty, very sandy GRAVEL (GM)				4.04	101.42
⌛ TP-1	0.7	Slightly silty, very sandy GRAVEL (GM/SP)				0.60	51.11
▲ TP-1	1.5	Gravelly, silty, SAND (SM)					
★ TP-2	6.0	Poorly graded SAND, trace silt and gravel (SP)				1.29	3.46
⊙ TP-3	2.1	Slightly silty SAND (SP/SM)				1.20	3.48

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	0.2	15.493	7.058	5.325	1.409	0.07	1.9	52.2	12.2	14.3	9.1	10.3
⌛ TP-1	0.7	24.166	8.413	4.106	0.912	0.165	21.8	26.1	12.2	19.7	14.4	5.9
▲ TP-1	1.5	9.326	0.247	0.153	0.081	0.04*	0.0	20.7	5.4	8.8	37.7	27.4
★ TP-2	6.0	1.54	0.675	0.575	0.412	0.195	0.0	0.6	2.6	65.8	29.2	1.8
⊙ TP-3	2.1	0.545	0.283	0.241	0.166	0.081	0.0	0.0	0.8	13.3	77.2	8.8

*Extrapolated from data

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

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

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

GEOTEST

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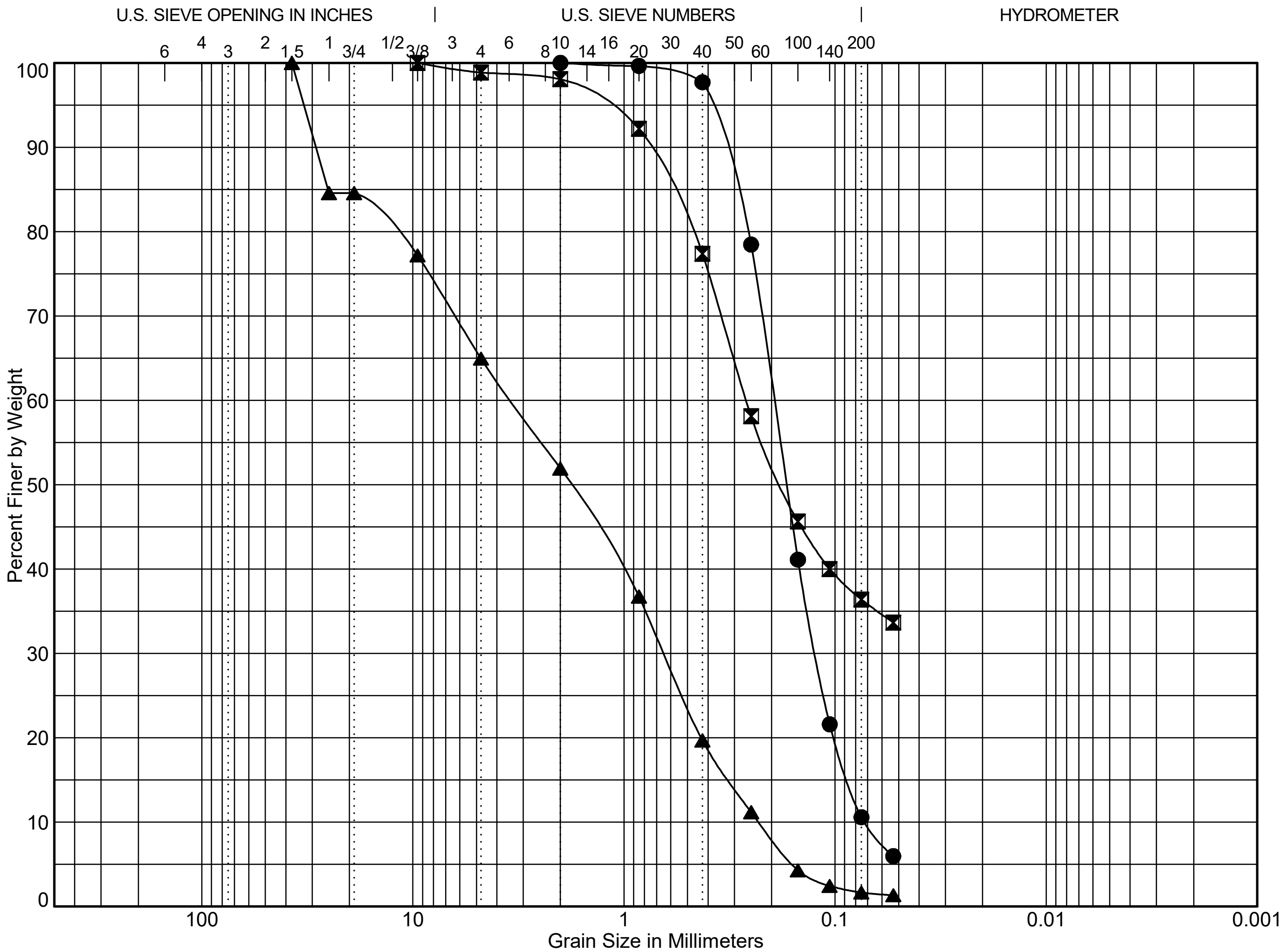
Grain Size Test Data

Figure 8



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

	Point	Depth	Classification	LL	PL	PI	C_c	C_u
●	TP-3	5.0	Slightly silty SAND (SP/SM)				1.09	2.70
⧗	TP-5	4.7	Very silty SAND, trace gravel (SM)					
▲	TP-5	7.0	Very gravelly, poorly graded SAND, trace silt (SP)				0.53	14.93

	Point	Depth	D_{90}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
●	TP-3	5.0	0.344	0.194	0.169	0.123	0.072	0.0	0.0	0.0	2.3	87.1	10.6
⧗	TP-5	4.7	0.767	0.263	0.179	0.033*	0.003*	0.0	1.1	0.8	20.7	41.0	36.4
▲	TP-5	7.0	28.834	3.42	1.795	0.646	0.229	15.4	19.6	13.0	32.2	18.0	1.7

*Extrapolated from data

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

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

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

GEOTEST An RMA Company

Proposed Equipment Rental Facility
3304 156th Street NE
Marysville, WA 98271

Grain Size Test Data

Figure 9

Northwest Agricultural Consultants

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Kennewick, WA 99336
509.783.7450
www.nwag.com
lab@nwag.com

PAP-Accredited

NAPT

GeoTest Services Inc.
741 Marine Drive
Bellingham, WA 98225

Report: 63636-1-1
Date: May 15, 2023
Project No: 23-0299
Project Name: Proposed Equip Rental Facility

Sample ID	pH	Organic Matter	Cation Exchange Capacity
TP1 @ 6.0’	5.9	1.08%	2.7 meq/100g
TP2 @ 1.0’	5.7	5.02%	12.2 meq/100g
TP2 @ 2.0’	5.6	2.48%	5.9 meq/100g
Method	**SM 4500-H^+ B**	**ASTM D2974**	**EPA 9081**

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.

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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.

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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.

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