Geotechnical Engineering Report

Bazara Short Plat
12508 45th Drive NE
Marysville, WA 98271

Prepared For:

Walid Bazara
12508 45th Drive NE
Marysville, WA 98271

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April 13, 2023
Project No. 23-0200

Walid Bazara
12508 45th Drive NE
Marysville, WA 98271

Attention: Walid Bazara

Regarding: Geotechnical Engineering Report
Bazara Short Plat
12508 45th Drive NE
Marysville, WA 98271
(Parcel No. 00655700001000)

Dear Walid,

GeoTest Services, Inc. [GeoTest] is pleased to submit the following report summarizing the results of our geotechnical engineering evaluation for the proposed short plat at 12508 45th Drive 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 22, 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.

EDWARDO A. GARCIA
STATE OF WASHINGTON
40819
REGISTERED
PROFESSIONAL ENGINEER
04-13-23

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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 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 two test pit explorations at predetermined locations using a track-mounted excavator subcontracted by GeoTest.

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

- Provide a preliminary assessment of the on-site infiltration capability based on USDA textural classification based on the *Stormwater Management Manual of Western Washington [Manual].* The Manual is the adopted stormwater management manual for the City of Marysville.

- 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, temporary and permanent slopes, geotechnical consultation, and construction monitoring.

- Assessment of Geologically Hazardous Areas (if present) per the City of Marysville Municipal Code (MMC).

PROJECT DESCRIPTION

GeoTest understands that an approximately 22,216 square-foot property will be short platted with the end result being a total of two separate properties. 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.

There is currently an existing house on the property that is to remain during construction. GeoTest was informed that the new construction will include a single-family residence. GeoTest has not been provided with structural loads, but the building is expected to be relatively light.

Information regarding proposed stormwater infiltration facilities, or if existing facilities on site would be used, was not known at the time that this report was written. GeoTest assumes that stormwater infiltration facilities may be incorporated into the proposed development if infiltration is found to be feasible. It should also be noted that the drafting of a “Preliminary

Storm Drainage" report is outside the scope of this proposal and should be conducted by a Civil Engineer.

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 a review of available information, site reconnaissance, subsurface explorations, laboratory testing, and previous experience in the project vicinity.

Surface Conditions

There is an existing single-family residence and pole building on the property that will remain, unaltered, after the new construction occurs. An existing gazebo and patio will be demolished to provide driveway access to the proposed short plat area along the property's southern perimeter. Client-provided preliminary plans show the short plat will be built in the area where a grass backyard currently exists. A wooden fence surrounds the proposed development area. GeoTest anticipates access to the new building will likely come from the east and along the southern perimeter of the parcel.

45th Drive NE borders the eastern perimeter of the proposed short plat. The properties in the area typically consist of typical one- and two-story single-family residences in a suburban environment. The site is relatively flat with less than a few feet of elevation differentials across the property.

Images 1 and 2: Current condition of the proposed development area on the western portion of the parcel , facing north (Image 1). Existing gazebo structure to be demolished prior to development, facing east (Image 2). Images 1 through 4 taken on March 30, 2023.

Subsurface Soil Conditions

Subsurface conditions were explored and documented by advancing two test pits (TP-1 and TP-2) on March 30, 2023, under the direction of a Licensed 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 Figure 5, with laboratory results as Figure 6.

Test pit explorations consisted of the excavation of shallow open pits with the use of a rubber tracked mini excavator and operator subcontracted to GeoTest. Grab samples were obtained at approximately 2-foot intervals or upon changes in soil stratigraphy. Depths of the test pit explorations ranged to depths of approximately 8 to 9 feet below the ground surface (BGS).

Images 3 and 4: General soil sequence observed in the test pits explorations where topsoil was overlying weathered Marysville Sand which was overlying non-weathered Maryville Sand (TP-1 – Image 3, TP-2 – Image 4).

The on-site subsurface soils generally consisted of about 1-foot of dark brown, loose, silty sand with appreciable organics that were interpreted to be topsoil. Underlying the topsoil, GeoTest observed loose to medium dense, orange-brown, slightly silty, gravelly sand that was interpreted as weathered Marysville Sand, a member of the Recessional Outwash locally mapped in the vicinity of the project. At a depth of about 3 feet below existing site grades, the weathered

Marysville Sand graded to a medium dense, tan to gray, poorly graded sands with trace gravel that was interpreted to be non-weathered Marysville Sand. See the attached *Site and Exploration Plan* (Figure 2) for the approximate locations of our explorations.

General Geologic Conditions

Geologic information for the project site was obtained from the *Geologic Map of the Marysville 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."

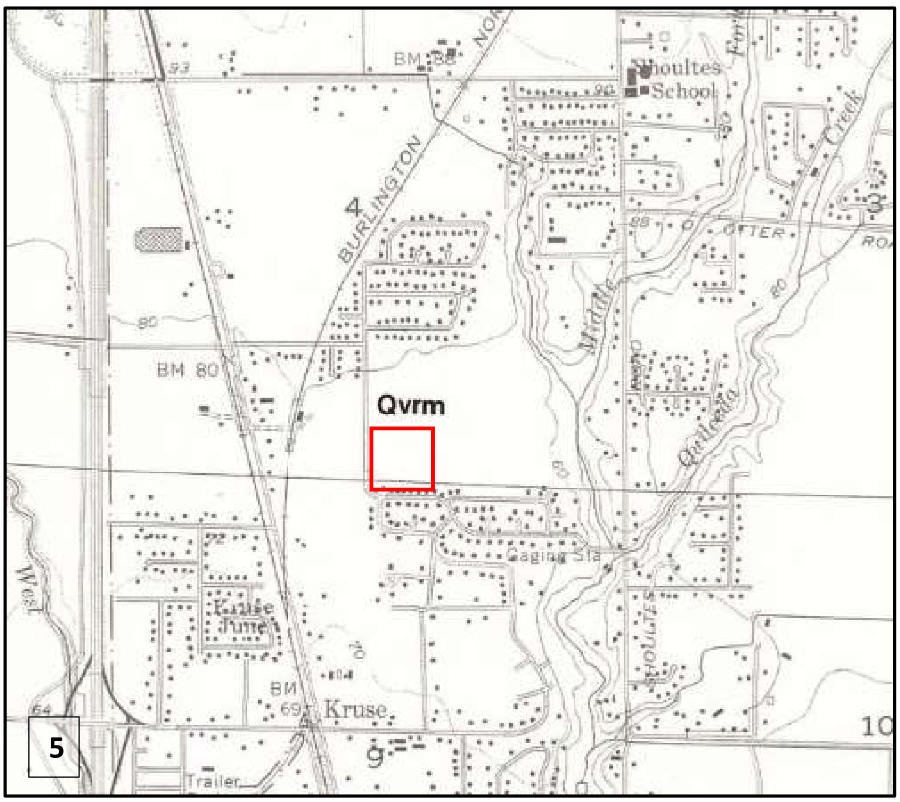

Image 5. Clip from the *Geologic Map of the Marysville Quadrangle, Snohomish County, Washington (Minard, 1985)* illustrating that the subject property is underlain by the Marysville Sand. Approximate site vicinity encapsulated by the red polygon.

Groundwater

At the time of our site visit on March 30, 2023, groundwater was not encountered. Notably, GeoTest performed our explorations during the wet season (October 1 – April 30), when season water tables would be expected to be elevated.

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 and seepage 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 is not currently part of our scope of services.

Web Soil Survey

According to the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) *Web Soil Survey* website, two primary soils are present within the vicinity of the subject property.

Table 1 USDA NRCS Soil Classifications	
Map Unit Symbol	30
Map Unit Name	Lynnwood loamy sand, 0 to 3 percent slopes
Soil Description	Loamy sand to sand
Landform	Terraces, outwash plains
Parent Material	Glacial outwash
Land Capability Classification	4s
Erosion K Factor, Whole Soil	0.20

This soil is classified as Lynnwood loamy sand, 0 to 3 percent. See Table 1 above for a summary of the USDA *Web Soil Survey* classification information. Values of K range from 0.02 to 0.69; the higher the value, the more susceptible the soil is to sheet and rill erosion by water. It is interpreted that the site has a **moderate** erosion factor based on the findings in Table 1.

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. Thus, there does not appear to be Geologic Hazards, as defined by the MMC, for landslide or erosion hazards. Because these hazards are not present on the property, GeoTest does not have any formal recommendations for mitigating landslide or erosion hazards.

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 of river valleys." Seismic hazard areas are classified as follows:

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

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

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 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.

The site is underlain by loose to medium-dense Marysville sand with interbeds of denser Marysville sand. At the time of our subsurface explorations, groundwater was not encountered at depth. According to the *Geologic Information Portal*, the subject property is mapped as having a "low to moderate" potential for seismic liquefaction and the closest active faults are in the vicinity of Mukilteo as part of the Southern Whidbey Island Fault Zone. However, this map only provides an estimate of the likelihood that soil will liquefy as a result of earthquake shaking and is meant as a general guide to delineate areas prone to liquefaction.

Based on the existing site conditions, proposed construction, as well as our local experience in the area, it is GeoTest's opinion that there is a relatively low to moderate risk of liquefaction occurring beneath the subject site during a design level earthquake. Mitigations against total and differential settlement could include structurally connected grade beams into the project design. Alternatively, typical shallow conventional foundations could be structurally reinforced to create a more rigid foundation system that would help limit the potential for differential settlement during a seismic event.

Please keep in mind that the Pacific Northwest is seismically active. Large Cascadia subduction zone earthquakes with possible magnitudes of 8 or 9 could produce ground shaking events with the potential to significantly impact the subject property regardless of the topography or subsurface conditions. Cascadia subduction zone earthquakes have occurred 6 times in the last

3,500 years with the most recent taking place in 1700, approximately 322 years ago. They have been determined to have an average recurrence interval of approximately 300 to 700 years (Atwater and Haley, 1997).

Image 6. Screenshot from the DNR Geologic Information Portal, in which the entire project site is considered to possess a low to moderate liquefaction susceptibly (yellow).

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.

As previously mentioned, the site is relatively level and underlain by medium dense sands typical of the Marysville area. The Marysville Sand was typically encountered within 1 foot of predeveloped site grades and is suitable for foundation support when recompacted to a firm and unyielding condition. If encountered, existing fill, deleterious materials, organics, and loose/unsuitable portions of native soil (if remedial compaction is infeasible) should be removed and replaced with suitable Structural Fill. The native Marysville Sand may be suitable for reuse as Structural Fill when placed and compacted as recommended in this report. We recommend the client plan for a typical stripping depth of 1 foot for building footprints, an ancillary driveway, and pavement structures.

No groundwater was observed during our site visit, nor were there signs such as mottling or oxidation that would indicate shallow groundwater levels. Due to the poorly graded nature of the on-site soils, stormwater infiltration should be feasible if stormwater facilities are installed below the weathered Marysville Sand.

It should also be noted that a site development plan showing the building type, footprint, or stormwater facilities was not available to us at the time of writing this report. Thus, it should be expected that additional design services, possibly paired with additional field work and collaboration with the project Civil Engineer, may be needed to complete the stormwater design.

Site Preparation and Earthwork

The portions of the site proposed for foundation(s), floor slabs, pavement and/or sidewalks development should be prepared by removing existing pavements, topsoil, deleterious material, and significant accumulations of organics. Based on our explorations, GeoTest anticipates at least 1 foot of removal to expose mineral soil. 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 distributed 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. Alternatively, Dynamic Cone Penetrometers or soil probing by a qualified GeoTest representative can confirm firm and unyielding conditions if a proof roll cannot be performed. 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.

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 native Marysville Sand 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. Reuse of on-site soils may be considerably more difficult to use during the wet weather 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.

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 5 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

The upper, weathered portions of the Marysville Sand have fines content on the order of 5 to 6 percent by weight. As such, these soils may be susceptible to degradation during wet weather. 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 Marysville Sand 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

Foundation support for the proposed developments can be established via slab-on-grade and/or structurally reinforced foundations bearing directly on firm and unyielding, remedially compacted, native soils (Marysville Sand), or on compacted Structural Fill placed atop firm and unyielding soils. GeoTest expects that approximately 1 foot of excavation may be required to remove loose topsoil/fill soils and reveal competent bearing soils. GeoTest recommends 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(s) or be replaced with properly compacted Structural Fill as described in the *Fill and Compaction* section of this report. Localized overexcavation, if necessary, can be backfilled to the design footing elevation with lean concrete, 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 lean concrete 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.

Allowable Bearing Capacity

Assuming the above foundation support criteria are satisfied, continuous or isolated spread footings founded directly on properly prepared native soils or on compacted Structural Fill placed directly over undisturbed native soils may be proportioned using a net allowable soil bearing pressure of 2,000 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 to be less than one inch under static conditions. Differential settlement between two adjacent load-bearing components supported on competent soil is estimated to be less than one half the total settlement.

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 crushed gravel to serve as a capillary break. This material should be clear, crushed, ¾-inch rock with no fines or similar. 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- to 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. American Concrete Institute (ACI) guidelines suggest that the slab may be poured directly on the vapor barrier.

A Subgrade Modulus (k) of 150 pounds per cubic inch (pci) is recommended for use in design of concrete slab elements placed on near-surface soils remedially compacted to Structural Fill requirements.

Exterior concrete slabs-on-grade, such as for parking and sidewalks, may be supported directly on properly prepared existing site soils. However, long-term performance will be enhanced if exterior slabs are placed on a layer of clean, durable, well-draining granular material above existing site soils.

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, if present, 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.

The filtering media may consist of open-graded drain rock wrapped in a nonwoven geotextile fabric such as Mirafi 140N (or equivalent) or wrapped with a graded sand and gravel filter. For foundations supporting retaining 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 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.

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.

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 the final design includes submerged walls so that we provided updated recommendations.

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 soil and the base of the footing. If passive and frictional resistance are considered together, one half of 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. Marysville Sands 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 and may be sloped as steep as 1.5:1. 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 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. GeoTest does not anticipate saturated soils to be encountered, however any 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.

Pavement Subgrade Preparation

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, we recommend 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 8 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 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

The presence of native, medium dense, poorly graded sands with gravel within our subsurface explorations appear to be suitable for infiltration at depths of 1 foot or greater BGS. Silt lenses, if encountered, may present challenges during construction of the planned facilities. We recommend these soils be removed from the footprint of the planned stormwater infiltration facilities.

Design Considerations

GeoTest is assuming that the bottom of infiltration facilities will be located within the Marysville Sand and likely at a depth of at least 1 foot below finished site grades. As such, GeoTest elected to run our sieve analyses for samples encountered 2 to 8 feet below existing site grades for grain size distribution and calculation according to the soil grain size analysis method per the Manual. Based on the results presented in Table 2, it is GeoTest's opinion that the Marysville Sands are permeable and have physical characteristics that would allow it to infiltrate water. Groundwater was not encountered at depths and is not expected to impact the design of shallow infiltration facilities.

For facility bottoms within the shallow Marysville Sands, GeoTest recommends that the Civil Engineer use an infiltration rate of **7.1 inches per hour** for preliminary design purposes. Please note that the rates given in this section are based on a soil grain size calculation. A more accurate design rate can be established by performing a Pilot Infiltration Test.

Table 2
Preliminary Infiltration Results Based on Grain Size Analysis

Test Pit ID & Depth	Geologic Unit	Preliminary, Corrected K_{sat} Infiltration Rate [in/hr]
TP-1 (2 feet)	Weather Marysville Sand	7.1
TP-1 (6 feet)	Marysville Sand	10*
TP-2 (4 feet)	Marysville Sand	10*
TP-3 (8 feet)	Marysville Sand	10*

Notes:
- Ksat = Initial Saturated Hydraulic Conductivity
- Correction Factors Used: CFv = 0.5, CFt = 0.40, CFm =0.9
- Total Correction Factor = 0.18

*** GeoTest does not recommend utilizing an infiltration rate greater than 10 inches per hour without first verifying with an in-situ field infiltration test.**

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 two soil samples collected from the explorations shown in Table 3. A summary of the laboratory test results is presented in Table 3 below.

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

Test Pit ID	Sample Depth (ft)	Soil Type	Cation Exchange Capacity (meq/100 grams)	Organic Content (%)	pH
TP-1	0.5	Topsoil	13.6	5.36	5.7
TP-2	2.0	Weathered Marysville Sand	6.4	2.07	6.2

Suitability for on-site pollutant treatment is determined in accordance with SSC-6 of the Manual. 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 3, the near-surface topsoil and Marysville Sand in the upper 2 feet of the site is expected to be suitable for the treatment of stormwater without amendment.

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 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 preliminary report for the exclusive use of the Walid Bazara and their design consultants for specific application to the design of the proposed short plat development located at 12508 45th Drive NE 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.

This report is intended to be a preliminary evaluation of the subject property. Thus, additional studies outside of the current scope of work will likely be needed once preliminary design concepts are known.

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 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 and Wall Drain Section
	Figure 4	Soil Classification System and Key
	Figure 5	Log of Test Pits
	Figure 6	Grain Size Test Data
	Attachment	NW Agricultural Consultants Test Results
	Attachment	Report Limitations and Guidelines for Its Use (4 pages)

REFERENCES

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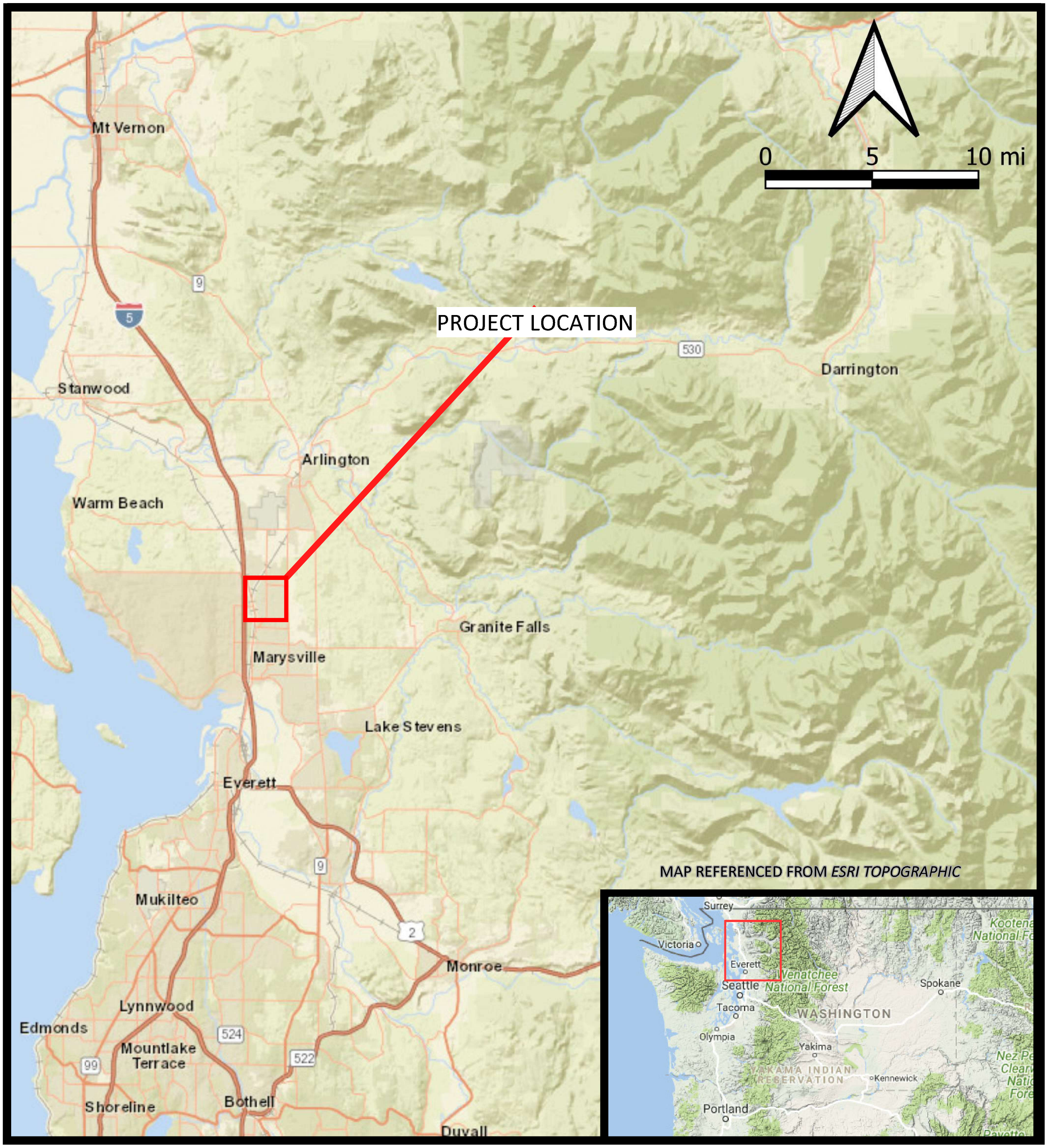


GEOTEST

Date: 3-30-2023 | By: CM | Scale: As Shown

Project 23-0200

VICINITY MAP

BAZARA SHORT PLAT

12508 45TH DRIVE NE

MARYSVILLE, WA 98271

Figure 1

TP-# = Approximate Test Pit Location

N

Notes:

1) Parcel shapefile sourced from *Snohomish County PDS Map Portal*
2) Project parcel area outlined in RED
3) Map image created using *QGIS 3.22.6.*

GEOTEST

Date: 3-30-2023	By: CM	Scale: As Shown	Project 23-0200

SITE AND EXPLORATION PLAN

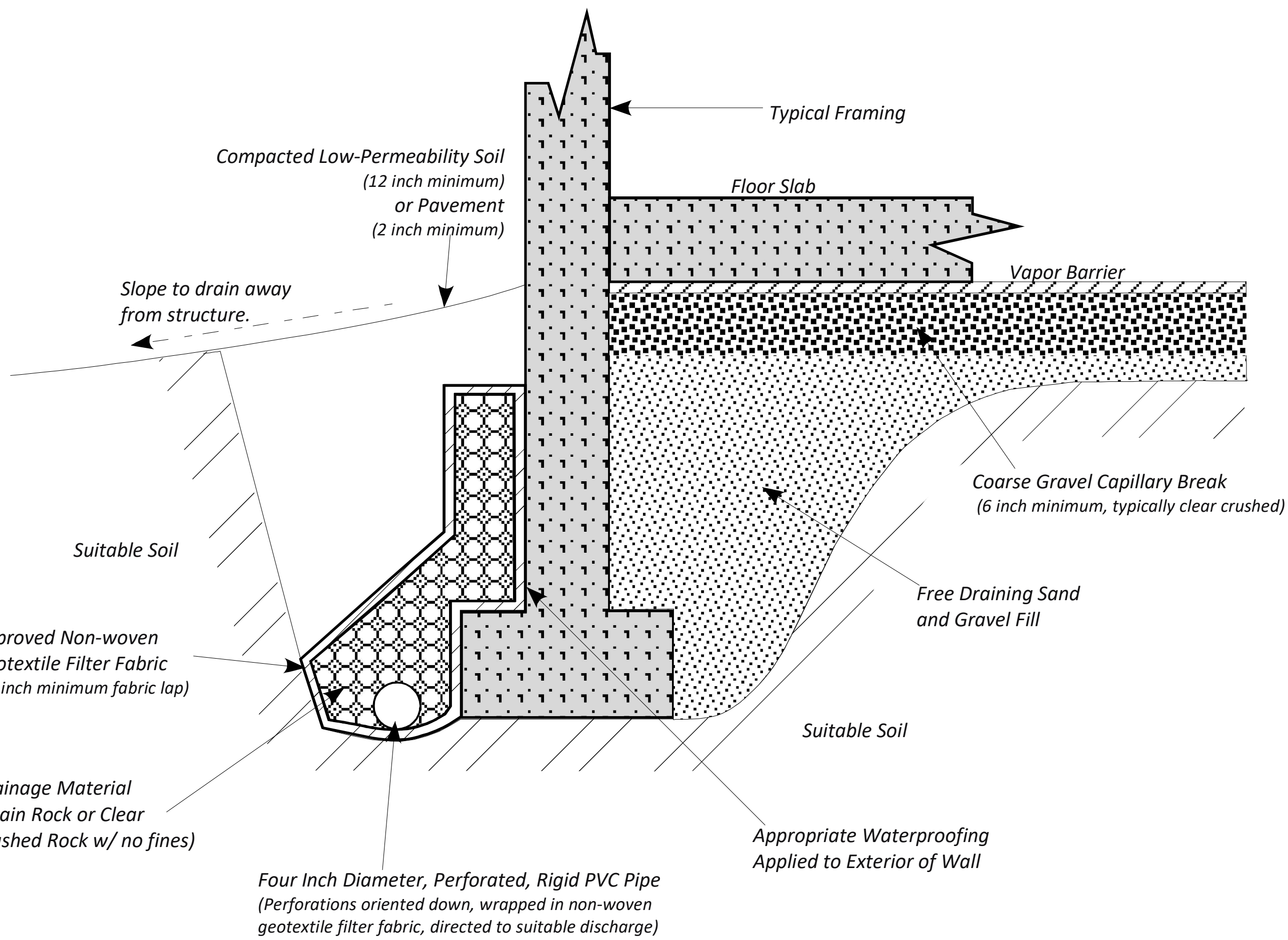
BAZARA SHORT PLAT

12508 45TH DRIVE NE

MARYSVILLE, WA 98271

Figure 2

CONCEPTUAL 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 International Building Code or local 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	Date: 4-6-2023	By: CM	Scale: None	Project 23-0200
	CONCEPTUAL FOOTING & WALL DRAIN SECTION **BAZARA SHORT PLAT** **12508 45TH DRIVE 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

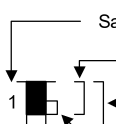
Notes: 1. Soil descriptions are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, as outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the *Standard Test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



Sample Identification Number
Recovery Depth Interval
Sample Depth Interval
Portion of Sample Retained for Archive or Analysis

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

Bazara Short Plat
12508 45th Drive NE
Marysville, WA 98271

Soil Classification System and Key

Figure 4

TP-1

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): 82 Excavated By: Cascade Excavation/CM	
0–1	1	d			SM	Loose, dark brown, moist, silty SAND with trace gravel and numerous roots and grass (Topsoil)	Groundwater not encountered.
1–3	2	d	W = 9 GS		SM	Loose to medium dense, orange-brown, moist, slightly silty, gravelly SAND, occasional roots (Weathered Marysville Sand)	
3–8.3	3	d			SP	Medium dense, tan, moist, poorly graded SAND with trace gravel (Marysville Sand)	
	4	d	W = 8 GS				
						Color transitions to gray and increase gravel content	
	5	d					

Test Pit Completed 03/30/23
Total Depth of Test Pit = 8.3 ft.

TP-2

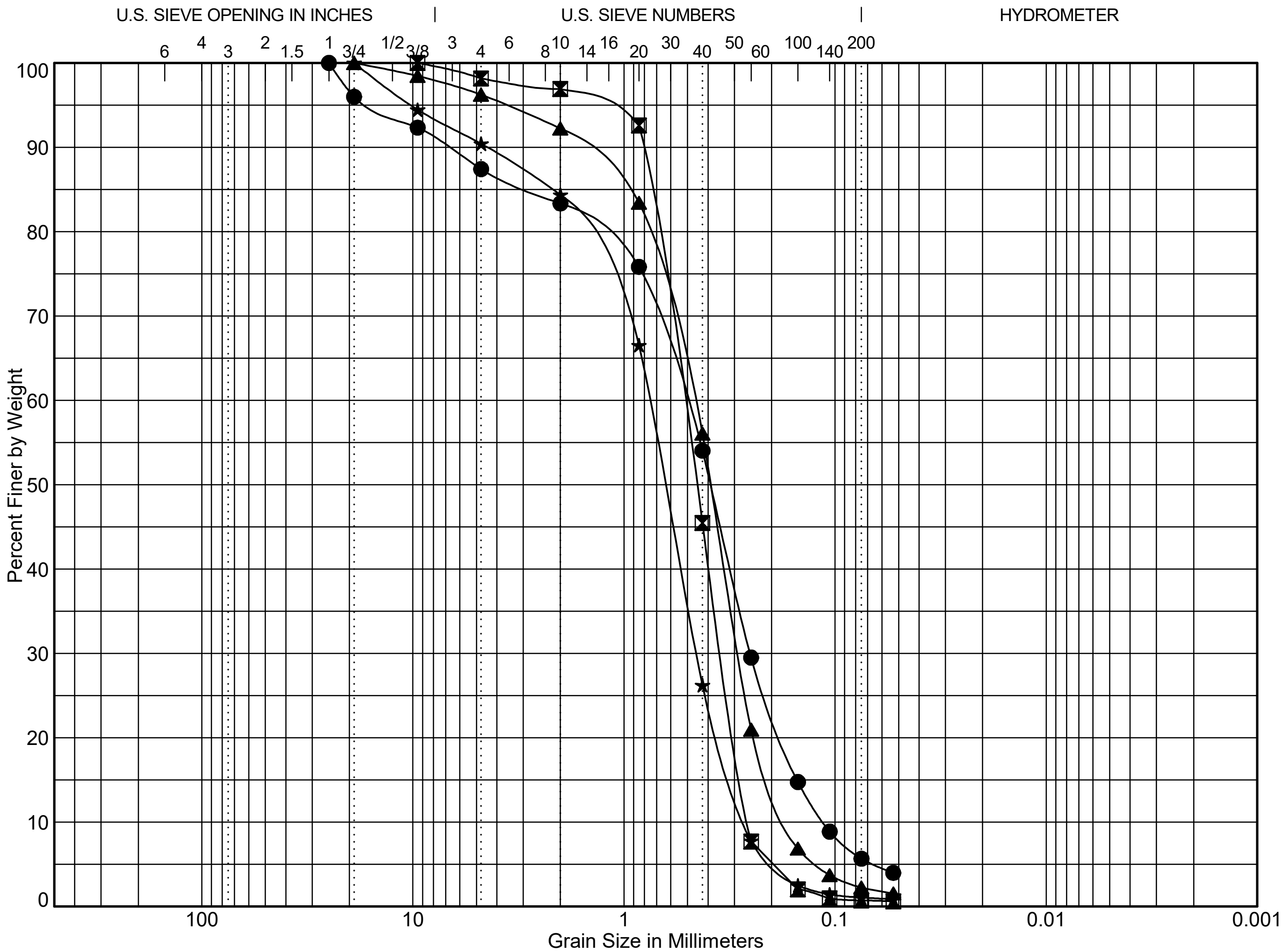
SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 82 Excavated By: Cascade Excavation/CM	
0–1	6	d			SM	Loose, dark brown, moist, silty SAND with trace gravel and numerous roots and grass (Topsoil)	Groundwater not encountered.
1–3	7	d			SM	Loose to medium dense, orange-brown, moist, silty SAND, occasional roots (Weathered Marysville Sand)	
3–4.5	8	d	W = 9 GS		SP	Medium dense, tan, moist, poorly graded SAND with trace gravel (Marysville Sand)	
4.5–7	9	d			SP	Medium dense, gray, moist, poorly graded SAND with trace gravel (Marysville Sand)	
7–8.3	10	d	W = 8 GS		SP	Medium dense, brown, moist, poorly graded SAND with gravel (Marysville Sand)	

Test Pit Completed 03/30/23
Total Depth of Test Pit = 8.3 ft.

Notes: Approximate Elevations Obtained from Snohomish County PDS Map Portal

GEOTEST

Bazara Short Plat 12508 45th Drive NE Marysville, WA 98271	Log of Test Pits	Figure 5



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Point	Depth	Classification	LL	PL	PI	C_c	C_u
● TP-1	2.0	SLIGHTLY SILTY, GRAVELLY SAND (SM)				1.10	4.53
⊠ TP-1	6.0	POORLY GRADED SAND with TRACE GRAVEL (SP)				0.86	2.04
▲ TP-2	4.0	POORLY GRADED SAND with TRACE GRAVEL (SP)				1.04	2.79
★ TP-2	8.0	POORLY GRADED SAND with GRAVEL (SP)				1.02	2.85

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	2.0	6.838	0.514	0.39	0.253	0.113	4.0	8.6	4.1	29.3	48.4	5.7
⊠ TP-1	6.0	0.818	0.526	0.454	0.342	0.258	0.0	1.8	1.3	51.4	44.7	0.7
▲ TP-2	4.0	1.609	0.47	0.388	0.287	0.168	0.0	3.8	4.0	36.2	53.8	2.2
★ TP-2	8.0	4.468	0.76	0.64	0.453	0.267	0.0	9.6	6.1	58.1	25.2	1.1

$C_c = D_{30}^2/(D_{60} * D_{10})$ To be well graded: $1 < C_c < 3$ and

$C_u = D_{60}/D_{10}$ $C_u > 4$ for GW or $C_u > 6$ for SW

GEOTEST

Bazara Short Plat
12508 45th Drive NE
Marysville, WA 98271

Grain Size Test Data

Figure
6

Northwest Agricultural Consultants

2545 W Falls Avenue
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: 63106-1-1
Date: April 3, 2023
Project No: 23-0200
Project Name: Bazara Short Plat

Sample ID	pH	Organic Matter	Cation Exchange Capacity
TP-1 @ 0.5’	5.7	5.36%	13.6 meq/100g
TP-2 @ 2.5’	6.2	2.07%	6.4 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.

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

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.

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

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.

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