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December 13, 2018
Project No. 18-0787

Coast Construction Group
328 N. Olympic Avenue
Arlington, WA 98223

Attn.: Mr. Trevor Gaskin

Re: Geotechnical Engineering Report
Proposed 7C's Swim Facility
SW Corner of North Creek Drive and Dumas Road
Mill Creek, WA 98012
(Parcel No. 28053100203700)

Dear Mr. Gaskin:

As requested, GeoTest Services, Inc. (GTS) is pleased to submit this report summarizing the results of our geotechnical evaluation for the proposed 7C's Swim Facility to be constructed at the above referenced address in Mill Creek, Washington (see *Vicinity Map*, Figure 1). This report has been prepared in general accordance with the terms and conditions established in our services agreement dated October 11, 2018 and authorized by Mr. Gaskin.

PURPOSE AND SCOPE OF SERVICES

The purpose of this evaluation is to establish general subsurface conditions beneath the site from which conclusions and recommendations for foundation design can be formulated. Specifically, our scope of services includes the following tasks:

- Explore soil and groundwater conditions underlying the site by advancing five test pits to approximate depths of 6.5 to 9 feet below ground surface (BGS).
- Perform laboratory testing on representative samples in order to classify and evaluate the engineering characteristics of the soils encountered. In addition, estimate long-term infiltration rates (if feasible) and determine stormwater treatment potential.
- Provide a written report containing a site plan showing pertinent existing site features and the approximate locations of explorations, a description of surface and subsurface conditions, and exploration logs. The findings and recommendations presented in the report pertain to site preparation and earthwork including approximate stripping depths, reuse of on-site soil, placement and compaction of fill, wet weather earthwork, foundation recommendations, estimates of settlement, foundation and site drainage, soil parameters for lateral load resistance, temporary and permanent slopes, and pavement sections.

PROJECT DESCRIPTION

The irregular-shaped, approximately 4.6-acre parcel is located at the southwest corner of North Creek Drive and Dumas Road in Mill Creek, Washington. GTS was provided with a preliminary site plan of the proposed development. TerraVista NW Consulting Engineers prepared this drawing, which was undated. Based on this drawing and discussions with Ms. Kathy Demoors and Mr. Trevor Gaskin of Coast Construction Group, GTS understands that a new swim facility will be constructed on the southern portion of the subject property. The proposed building will have an approximate footprint of 100 feet by 100 feet. Access to the development will be via a new driveway entrance at the southwest corner of the parcel. Asphalt parking and driveways will surround the proposed building. Preliminary information regarding the proposed building was not available at the time that this report was written. GTS anticipates that the new building will be wood-framed and utilize shallow conventional foundations and slabs-on-grade, with the exception of the swimming pool that would be below grade. The depth and dimensions of the proposed swimming pool was not provided to GTS.

Stormwater infiltration facilities are also proposed for this project if feasible. The type and configuration of proposed facilities was not determined at the time that this report was written.

GTS understands that the proposed development will be limited to the southern portion of the property parallel to the southern property line. As of the writing of this report, GTS understands that no decision has been made as to the development of the remainder of the parcel. Thus, it should be understood that the recommendations presented in this report are only applicable to the proposed pool building and asphalt drive paths.

SITE CONDITIONS

This section presents the general surface and subsurface conditions observed at the project site at the time of the field investigation. Interpretations of the site conditions are based on the results of our review of available information, site reconnaissance, subsurface explorations, and laboratory testing.

Surface Conditions

As previously mentioned in the *Project Description* section of this report, the subject property is located at the southwest corner of North Creek Drive and Dumas Road in Mill Creek, Washington. The subject parcel is the shape of a three-sided polygon. Two sides make a right angle, and the northwestern edge of the parcel borders North Creek Drive. Vegetation is dense across the entirety of the site, and no surface water was observed at the time of visit. The topography across the site varies so that the highest part of the parcel is generally in its center with an elevation of approximately 430 feet. The elevation drops in all directions from the center of the parcel at a gentle to moderate rate. Along the western property line, the ground slopes to the west at an approximate 2.5H: 1V to 3H: 1V inclination over approximately 10 to 15 feet of vertical relief. It appears that the slope was created as a result of the construction of North Creek Drive. A moderate slope approximately 10 feet in height with an approximately 20 percent inclination is situated near the midpoint of the southern property line. The eastern portion of the property contains a wetland with an approximate 110-foot buffer, based on a review of a previous site plan prepared by TerraVista NW.

Bordering the subject property to the south is a maintenance yard that is owned by the City of Mill Creek.

Photo 1 – SW corner of parcel, looking NE into the site. Taken during a reconnaissance visit on September 13, 2018.

Subsurface Soil Conditions

Subsurface conditions were explored by advancing five exploratory test pits (TP-1 through TP-5) on November 15, 2018. The explorations were advanced to depths of between 8.0 and 9.0 feet below ground surface (BGS) using a track-mounted excavator. All excavations were terminated at or near the maximum reach of the equipment. The approximate locations of the explorations are shown on the *Site and Exploration Plan (*Figure 2).

The test pits generally encountered approximately 4 to 14 inches of forest duff/topsoil directly underlain by approximately 1 to 2 feet of native, loose to medium-dense, well-graded gravel with sand and varying amounts of organic material (possible weathered till). Underlying the loose to medium-dense, near-surface native soils was very dense, gray, poorly-graded sand with gravel and silt (glacial till). The very dense till was encountered to the maximum explored depth of each exploration.

Photo 2 shows the soil stratigraphy observed in TP-5, which was representative of other Test Pits on site. See the attached *Test Pit Logs* (Figures 5 through 7) and *Grain Size Analysis* (Figures 8 and 9) for more information regarding the approximate locations of the exploration test pits and subsurface soil conditions encountered.

Photo 2 – A view of TP-5. View facing south. Photo taken on November 15, 2018.

General Geologic Conditions

Geologic information for the project site was obtained from the *Geologic map of the Everett 7.5 minute quadrangle, Snohomish County, Washington* (Minard, 1985) published by the U.S. Geological Survey. According to the referenced map, near surface soils in the vicinity of the project site consist of Glacial Till (Qvt). The till generally consists of a nonsorted mixture of clay, silt, sand, pebbles, cobbles, and boulders. It is a compact lodgment till and is often locally referred to as Vashon till or hardpan. Native soils encountered during our subsurface exploration were generally consistent with the mapped till deposits is generally consistent with published geological information.

Groundwater Seepage

At the time of the GTS site visit on November 15, 2018, no groundwater seepage was detected in any of the explorations. In addition, no distinctly mottled or gleyed horizons were encountered within the test pit explorations.

Perched groundwater typically develops when granular or more permeable soil (weathered glacial till) is underlain by more dense or less permeable soil (glacial till). The depositional pattern of these soils is such that looser or more granular soils allow water to pass through the till, only to be restricted once groundwater encounters denser or siltier soils at depth. Perched groundwater conditions were not observed on-site at the time of exploration, but these conditions typically develop in the wet season or after extended periods of rainfall.

The groundwater conditions reported in the exploration logs are for the specific locations and dates indicated, and are not necessarily indicative of other locations and/or times. Groundwater levels are variable and will fluctuate depending on local subsurface conditions, season, precipitation, and changes in land use both on and off-site.

GEOLOGIC HAZARD AREAS

Chapter 18.08 of the Mill Creek Municipal Code addresses Environmentally Critical Areas within the City. The City defines Geologically Hazardous Areas to include erosion hazards, landslide hazards, and seismic hazards. Each of these as they apply to this project is discussed further in the following section.

Erosion Hazard Areas

The City defines Erosion Hazard areas as "lands or areas underlain by soils identified by the U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) as having 'severe' or 'very severe' erosion hazards." Based on the Web Soil Survey for Snohomish County, Washington, the proposed development area is underlain by Everett very gravelly sandy loam (0 to 8 percent slopes). Areas underlain by these soils on slopes that are over 15 percent in inclination are defined as Erosion Hazards by the City.

The following recommendations are intended to limit the development of potential risks including excessive erosion and near-surface soil instability:

- All clearing and grading activities for the proposed development will need to incorporate Best Management Practices (BMPs) for erosion control in compliance with current City of Mill Creek codes and standards.
- GTS recommends that appropriate silt fencing be incorporated into the construction plan for erosion control.
- Removal of vegetation or trees without proper mitigation may increase the risk of failure of the surficial soils on the slope during periods of wet weather. No additional changes to existing slope vegetation are planned as a part of the proposed construction, other than normal maintenance and pruning.
- Organic waste or other debris should not be dumped onto the face of site slopes. These materials can retain water, smother the existing native vegetation, and cause instability on the slope face.
- Proper drainage controls have a significant effect on erosion. Collected site drainage should be directed to an appropriate discharge location. No water should be allowed to flow uncontrolled over the top of a steep slope.
- All areas disturbed by construction practices should be vegetated or otherwise protected to the limit the potential for erosion as soon as practical during and after construction. Areas requiring immediate protection from the effects of erosion should be covered with either plastic, mulch, or erosion control blankets.

In addition to the preceding recommendations, typical erosion control measures during construction will be required. These measures can include a rocked construction entrance or downslope silt fencing, depending on the regulations of the City of Mill Creek. No other mitigations are required to address erosion hazards on the property.

Landslide Hazard Areas

Landslide Hazard Areas in the City of Mill Creek include slopes that are over 40 percent inclination with at least 10 feet of vertical relief and areas meeting all three of the following criteria: Slopes over 15 percent, hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock, and wet season springs or groundwater seepage.

The slope along the western property line appears to have an approximate inclination of 2.5H: 1V to 3H: 1V over approximately 10 to 15 feet of vertical relief. This slope appears to have been created as a result of previous grading for North Creek Drive. Thus, this slope would not be considered as a Landslide Hazard Area. Another potential steep slope is situated adjacent to the southeast corner of the proposed building. Although this slope appears to be over 15 percent inclination and is underlain by permeable soils over glacial till, GTS did not observe any wet season springs or groundwater seepage in the explorations. It would not appear that this slope is a Landslide Hazard, and thus it is GTS's opinion that no mitigations are required to address landslide hazards on the property.

Seismic Hazard Areas

The City defines Seismic Hazard Areas are areas subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, soil liquefaction, lateral spreading, or surface faulting. 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 very low liquefaction susceptibility area. 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. Though no known faults are mapped in the vicinity of the site, the Pacific Northwest is prone very large regional seismic events with a mean recurrence interval of approximately 475 years. Conventional construction techniques in the area do not typically include mitigation for liquefaction hazards based on the mapped site rating or the type of anticipated construction.

Due to the presence of very dense glacial till soils underlying the subject property, it does not appear that the property is located within a Seismic Hazard Area. No other mitigations are required to address seismic hazards on the property.

CONCLUSIONS AND RECOMMENDATIONS

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

The test pits generally exposed 4 to 14 inches of forest duff/topsoil and approximately 1 to 2 feet of loose to medium-dense native soils (weathered till with variable amounts of organics) overlying dense to very dense glacial till. GTS recommends that the topsoil and loose fill soils (if present) be removed from the building footprint down to the native, weathered or unweathered glacial till soils. The proposed building can then be constructed with conventional continuous or individual spread foundations bearing directly on firm and unyielding native soil, or on compacted structural fill placed atop firm and unyielding native soil. Dense, unweathered soils encountered at depth are unlikely to require much preparation. Please note that the weathered till that was observed in our explorations contained varying amounts of organics. If foundations are to be supported on the near-surface weathered till, the foundation subgrades should be free of organics and then compacted to a firm and unyielding condition with a smooth-drum roller, vibratory hoe-pack, or other appropriate piece of construction equipment. Further recommendations regarding the placement and compaction of structural fill can be found in the *Structural Fill and Compaction* section of this report.

Perched groundwater was not observed within any of the test pit explorations performed on November 15, 2018. Although no perched groundwater was observed, the native soils are glacially consolidated. GTS would expect perched water to be found during wet weather months. Therefore, it appears that the native soils are not suitable for the conventional infiltration of stormwater.

Site Preparation and Earthwork

The portions of the site to be occupied by the proposed building foundations, slab areas, and pavement, hardscape, and walkways should be prepared by removing existing forest duff, topsoil, organic material and loose/soft, upper portions of the subgrade soils. All proposed building foundations, slab areas, pavement, hardscape, and walkways may be placed on native, non-organic, weathered or unweathered glacial till soil, or existing firm and unyielding fill material after removal of any soft or medium dense soil, and organic soil.

GTS anticipates approximately 1 to 1.5 feet of surface stripping to reach suitable weathered glacial till soils, and approximately 2 to 3.5 feet of stripping to reach unweathered glacial till soils, in most locations. After site stripping has occurred, the exposed subgrade under all areas to be occupied by soil-supported floor slabs, spread or continuous foundations, pavement or new sidewalk areas should be evaluated to confirm a firm and unyielding condition and proof rolled with a loaded dump truck, large self-propelled vibrating roller, hoe-pack, or similar piece of equipment applicable to the size of the excavation.

Soils disturbed during excavation should be recompacted prior to placement of structural fill or foundation elements. Recompaction of the near-surface soils does not reduce or eliminate the need for overexcavation, where required, of near-surface loose soils or fill material below foundation elements. The purpose of recompacting and proof rolling near-surface soils is to identify possible loose or soft soil deposits and recompact, if feasible, the soil disturbed during site excavation activities.

Proof rolling should be carefully observed by qualified geotechnical personnel. Areas exhibiting significant deflection, pumping, or over-saturation cannot be readily compacted and 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 wet conditions, qualified geotechnical personnel should observe subgrade conditions to determine if proof rolling is feasible.

Structural Fill and Compaction

Structural fill used to obtain final elevations for footings and soil-supported floor slabs must be properly placed and compacted. 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 unsuitable for reuse as structural fill and should be properly disposed off-site or placed in non-structural areas.

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

Reuse of On-site Soil

Near-surface, non-organic, native soils are suitable for reuse as structural fill when placed at optimum moisture contents as determined by ASTM D1557, and if allowed for in the project plans and specifications. The weathered and unweathered glacial till soils contain high percentages of fines and should be considered moisture-sensitive. Reuse of the unweathered glacial till soils may be considerably more difficult to use at or near perched groundwater elevations (if present) and during the wet weather season (typically October through May).

If using on-site materials, the contractor and owner should be prepared to manage over optimum moisture content soils. The moisture content of the site soils may be very difficult to control during periods of wet weather, and as such is not recommended.

Imported Structural Fill

GTS recommends that imported structural fill consist of clean, well-graded sandy gravel, gravelly sand, or other approved naturally occurring granular material (pit run) or a well-graded crushed rock. GTS recommends that structural fill for dry weather construction meet Washington State Department of Transportation (WSDOT) Standard Specification 9-03.14(2) for "Select Borrow" with the added requirement that 100 percent pass a 4-inch-square sieve. Soil containing more than about 5 percent fines (that portion passing the U.S. No. 200 sieve) cannot consistently be compacted to a dense, non-yielding condition when the water content is greater than optimum.

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

Backfill and Compaction

Structural fill should be placed in horizontal lifts approximately 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. GTS recommends that compaction be tested periodically throughout the fill placement.

Wet Weather Earthwork

Earthwork taking place during the wet weather months or during extended periods of heavy precipitation can be difficult to perform when working with fine-grained soils such as glacial till. If construction is carried out during wet weather, GTS recommends that structural fill consist of imported, clean, well-graded sand or sand and gravel as described in the *Imported Structural Fill* section of this report. If earthwork is to be performed in wet weather or under 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 shaking from a moderate to major earthquake. Consequently, moderate levels of 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 2015 International Building Code, the native soil that underlie the site within the upper 100 feet are classified as Site Class D, according to 2010 ASCE -7 Standard – Table 20.3-1, Site Class Definitions. The corresponding values for calculating a design response spectrum for the assumed soil profile type are considered appropriate for the site.

Please reference the following values for seismic structural design purposes:

Conterminous 48 States – 2015 International Building Code
Zip Code 98012
Central Latitude = 47.879722, Central Longitude = -122.219740

<u>Short Period (0.2 sec) Spectral Acceleration</u>

Maximum Considered Earthquake (MCE) Value of S_s = 1.407 (g)
Site Response Coefficient, F_a = 1.000 (Site Class D)
Adjusted spectral response acceleration for Site Class D, $S_{MS} = S_s \times F_a$ = 1.407 (g)
Design spectral response acceleration for Site Class D, $S_{DS} = 2/3 \times SM_s$ = 0.938 (g)

<u>One Second Period (1 sec) Spectral Acceleration</u>

Maximum Considered Earthquake (MCE) Value of $S_1 = 0.547$ (g)
Site Response Coefficient, $F_v = 1.500$ (Site Class D)
Adjusted spectral response acceleration for Site Class D, $S_{M1} = S_1 \times F_v = 0.820$ (g)
Design spectral response acceleration for Site Class D, $S_{D1} = 2/3 \times SM_1 = 0.547$(g)

Foundation Support

Foundation support for the proposed improvements may be provided by continuous and individual spread footings founded directly on firm and unyielding, native, weathered or unweathered glacial till soils, or on compacted structural fill placed over these competent, native soils. GTS 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, GTS recommends that existing topsoil and fill (if present) be removed from beneath the building foundation areas down to the native soils. Dense, unweathered soils are unlikely to require much preparation. Please note that the weathered till that was observed in our explorations contained varying amounts of organics. If foundations are to be supported on the near-surface weathered till, the foundation subgrades should be free of organics and then compacted to a firm and unyielding condition with a smooth-drum roller, vibratory hoe-pack, or other appropriate piece of construction equipment. Once suitable bearing conditions have been confirmed, then foundations can bear directly on native soils or on properly compacted structural fill.

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 and individual spread footings founded directly on firm and unyielding native soil, or on compacted structural fill placed atop these soils, may be proportioned using a net allowable soil bearing pressure of 2,500 pounds per square foot (psf) for compacted structural fill over weathered glacial till. The weathered glacial till was generally encountered approximately 1 to 1.5 feet BGS in the explorations. If the footings bear directly on unweathered glacial till encountered approximately 2 to 3.5 feet BGS in the explorations, a net allowable soil bearing pressure of 3,000 psf can be used.

The 'net allowable bearing pressure' refers to the pressure that can be imposed on the soil at foundation level resulting from the total of all dead plus live loads, exclusive of the weight of the footing or any backfill placed above the footing. 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, GTS estimates the total settlement of building foundations to be less than one inch, and differential settlement between two adjacent load-bearing components supported on competent soil to be less than about one half the total settlement. The soil response to applied stresses caused by building and other loads is expected to be predominantly elastic in nature, with most of the settlement occurring during construction as loads are applied.

Floor Support

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

GTS recommends that interior concrete slab-on-grade floors be underlain with a minimum 6 inch layer of clean, compacted, free-draining gravel with 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. If desired, additional protection against water intrusion below the slab could include a slab underdrain system to collect and direct water towards an approved discharge point.

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.

The American Concrete Institute (ACI) guidelines suggest that the slab may either be poured directly on the vapor barrier or on a granular curing layer placed over the vapor barrier depending on construction conditions. GTS recommends that the architect or structural engineer specify if a curing layer should be used. If moisture control within the building is critical, GTS recommends that the vapor barrier be observed by a representative of GTS to confirm that openings have been properly sealed. Use of a curing layer is recommended during drier months of the year and/or when limited rain is expected during the slab-on-grade construction process. If the slab is constructed during the wet season and exposed to rain after construction, GTS does not recommend the use of curing layer as excessive moisture emissions through the slab may occur.

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.

Resistance to Lateral Loads

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

GTS 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. 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. To account for uniform surcharge pressures, a uniformly distributed lateral pressure should be added to the lateral soil pressures. This uniform pressure should be equal to 35 percent of the vertical surcharge pressure for yielding walls and 50 percent for nonyielding walls. GTS also recommends that a seismic surcharge pressure of 12H be included where H is the wall height in feet. 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 1.5. In order to calculate this passive resistance, GTS presumes 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, and drained conditions will prevent the buildup of hydrostatic pressure in the compacted fill. In design computations, the upper 12 inches of passive resistance should be omitted if the soil is not covered by floor slabs or pavement. If future plans call for the removal of the soil providing resistance, the passive resistance should be disregarded. 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.

An allowable coefficient of base friction of 0.35 for structural fill, applied to vertical dead loads only, may be used between the base of the footing and the underlying imported granular structural fill and/or suitable native deposits. If passive and frictional resistance are applied 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. GTS does not recommend increasing the coefficient of friction to resist seismic or wind loads.

Foundation and Site Drainage

To reduce the potential for groundwater and surface water to seep into interior spaces, GTS recommends that an exterior footing drain system be constructed around the perimeter of new building foundations as shown in the *Typical Footing Drain Section* (Figure 3). The drain should consist of a minimum 4-inch diameter perforated pipe, surrounded by a minimum 12 inches of filtering media. The pipe should be sloped to carry discharge to an approved collection system. The filtering media may consist of open-graded drain rock wrapped by a nonwoven geotextile fabric such as Mirafi 140N (or equivalent) or 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 by weight passing the U.S. Standard No. 200 sieve (based on a wet sieve analysis of that portion passing the U.S. Standard No. 4 sieve). The invert of the footing drain pipe should be placed slightly below the elevation of the footing or 12 inches below the adjacent floor slab grade, whichever is deeper, so that water will not seep through walls or floor slabs. The drain system should include cleanouts to allow for periodic maintenance and inspection.

As the subject property is underlain by glacial till, water that collects under the slab may not be able to drain. Additional protection against water intrusion below the slab could include a slab underdrain system to collect and direct water, if present, toward an approved discharge point. Passive drainage and adequate site planning could also help mitigate the potential for water to collect under the slab.

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.

GTS understands that a swimming pool will be incorporated as part of the proposed development. Water could potentially collect below the swimming pool, as these elements would be placed below existing site grades and in soils that are considered low permeability. Where appropriate, GTS recommends that the swimming pool have adequate water stops and waterproofing to resist the intrusion of water.

Additional measures such as gravity drains or sumps may also need to be incorporated into the drainage design for these elements. Although gravity drains are preferred, these drains may not be feasible due to the planned depth of the proposed swimming pool. Multiple sumps would likely be needed if water is present behind pool walls. As glacial till will not drain, water that makes its way behind the pool will remain there unless it is removed. The pool designer's recommendations should be followed if such a situation arises.

GTS recommends that additional information regarding pool size and depth be provided for our review in order to determine risk of damage due to hydrostatic forces acting on the pool. GTS is available to work with the project team to evaluate what mitigations may be required to reduce these risks.

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 will expose medium-dense to very dense to dense weathered or unweathered glacial till.

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

The native glacial till soil is generally dense to very dense and is not expected to drain efficiently. Utility trench backfill is likely to be more permeable than the native soils. As such, up-gradient utility trenches have the potential to route subsurface sources of water towards new construction. GTS recommends that low-permeability trench dams and water stops be considered should utility trenches be installed up-gradient of any planned structures. Prior to implementing these mitigations, a review of the trench depth and gradients should be performed to determine if these mitigations should be included in the final design.

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

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.

Temporary and Permanent Slopes

The contractor is responsible for construction slope configurations and maintenance of safe working conditions, including temporary excavation stability, as this party is able to monitor the construction activities and has direct control over the means and methods of construction. 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 in depth should be shored or sloped in accordance with Safety Standards for Construction Work, WAC 296-155-66403.

Temporary unsupported excavations in the native soils encountered at the project site are classified as a Type B soil according to WAC 296-155-66403 and may be sloped as steep as 1H: 1V (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.

If permanent cut or fill slopes are used for this project, GTS recommends that these slopes be designed for inclinations of 2H: 1V or flatter. If used for this project, slopes for detention ponds should be designed for inclinations of 3H: 1V or flatter. All permanent cut slopes should be vegetated or otherwise protected to limit the potential for erosion as soon as practical after construction. Permanent slopes requiring immediate protection from the effects of erosion should be covered with either mulch or erosion control netting/blankets. Areas requiring permanent stabilization should be seeded with an approved grass seed mixture, or hydroseeded with an approved seed-mulch-fertilizer mixture.

Pavement Subgrade Preparation

Selection of a pavement section is typically a choice relative to higher initial cost and lower long term maintenance fees or lower initial cost and more frequent maintenance fees. For this reason, GTS recommends 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.

Flexible Pavement Sections

GTS 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].

Areas that will be accessed by more heavily loaded vehicles, semi and garbage trucks, etc., such as the main drive paths, will require a thicker asphalt section and should be designed using a paving section consisting 4 inches of Class ½-inch HMA asphalt surfacing above 8 inches of CSBC meeting criteria set forth in the Washington State Department of Transportation (WSDOT) Standard Specification 9-03.9[3].

GTS 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.

Concrete Sidewalks and Hardscapes

We anticipate that Portland cement concrete (PCC) will be used for walkways and hardscapes. We recommend a concrete sidewalk and hardscape section consisting of 4 inches of PCC surfacing above a minimum of 4 inches of CSTC. It is assumed that sidewalks and hardscape sections will be placed over a firm and unyielding subgrade as previously addressed herein.

Stormwater Infiltration Potential

Based upon an evaluation of the data collected during this investigation, it is our opinion that subsurface conditions are generally unsuitable for the onsite infiltration of stormwater. GTS observed native soils on-site consisting of very dense, glacially compacted soils. Glacially consolidated till soils as found on site within two feet of the surface are considered a restrictive layer by the 2012 Washington State Department of Ecology *Stormwater Management Manual for Western Washington* (amended December 2014). We recommend that the design team consider connecting the new building and site stormwater facilities to the existing municipal storm system to properly convey collected stormwater to a suitable disposal area.

Stormwater mitigation utilizing Low Impact Development (LID) methods may be considered on-site. GTS is available to discuss the potential for partial infiltration and/or LID facilities.

Stormwater Pollutant Treatment

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

Cation Exchange Capacity and Organic Content Testing

Two composite samples were collected during our subsurface explorations for pollutant treatment purposes. Cation exchange capacity (CEC) and organic content (LOI) tests were performed by Northwest Agricultural Consultants. Laboratory test results are presented in Table 1.

TABLE 1
Cation Exchange Capacity, Organic Content, and pH Laboratory Test Results

Test Pit ID	Sample Depth (ft)	Geologic Unit	Cation Exchange Capacity (meq/100 grams)	Organic Content (%)	pH
TP-1	1.0	Topsoil	9.0	3.54	5.2
TP-2	1.5	Weathered Till	4.2	1.59	5.5
TP-3	0.5	Topsoil	13.3	6.15	5.2
TP-5	3.0	Weathered Till	7.9	2.90	5.4

Based on the results listed in Table 1, the fine-grained, near-surface topsoil and weathered till appear to be suitable for on-site pollutant treatment purposes based on the 2012 *Stormwater Management Manual for Western Washington* (amended December 2014). The Manual also states that cation exchange capacity must be greater than 5.0 meq/100 grams for treatment purposes. Low rates of infiltration can be expected if the on-site soils are amended due to their high silt contents.

Geotechnical Consultation and Construction Monitoring

GTS recommends that we be involved in the project review process. The purpose of the review is to verify that the recommendations presented in this report have been properly interpreted and incorporated in the design and specifications.

GTS recommends that geotechnical construction monitoring services be provided. These services should include observation by GTS personnel during structural fill placement, compaction activities and subgrade preparation operations to confirm that design subgrade conditions are obtained beneath the proposed building. We also recommend that periodic field density testing 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 contained within the report. In the event that subsurface conditions differ from those anticipated before the start of construction, GeoTest Services, Inc. would be pleased to provide revised recommendations appropriate to the conditions revealed during construction.

GTS is also 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, and structural steel. These services are supported by our fully accredited materials testing laboratory.

USE OF THIS REPORT

GeoTest Services, Inc. has prepared this report for the exclusive use of Coast Construction Group, and its design consultants for specific application to the design of the proposed 7C's Swim Facility to be constructed at North Creek Drive and Dumas Road in Mill Creek, Washington. Use of this report by others or for another project is at the user's sole risk. Within the limitations of scope, schedule, and budget, our services have been conducted in accordance with generally accepted practices of the geotechnical engineering profession; no other warranty, either expressed 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 subsurface conditions at other locations and times. The analyses, conclusions, and recommendations contained in this report are based on site conditions to the limited depth of our explorations at the time of our exploration program, a brief geological reconnaissance of the area, and review of published geological information for the site. GTS assumes that the explorations are representative of the subsurface conditions throughout the site during the preparation of our recommendations. If variations in subsurface conditions are encountered during construction, GTS should be notified to review the recommendations of this report, and revise if necessary. 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, GTS recommends 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.

GTS appreciates the opportunity to provide geotechnical services on this project and looks forward to assisting you during the construction phase. If you have any questions regarding the information contained in this report, or if we may be of further service, please contact the undersigned.

Respectfully Submitted,
GeoTest Services, Inc.

GERRY D. BAUTISTA
STATE OF WASHINGTON
51531
REGISTERED
PROFESSIONAL ENGINEER

12/13/2018

Erin N. Belsvik, E.I.T.
Project Engineer

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

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 5-8	Test Pit Logs
	Figure 9-10	Grain Size Analysis
	(1 page)	Cation Exchange Capacity, pH and Organic Content Results
	(3 pages)	GeoTest – Report Limitations and Guidelines for its Use

References:

Minard, J.P., 1985, *Geologic map of the Everett 7.5-minute quadrangle, Snohomish County, Washington.* U.S. Geological Survey Miscellaneous Field Studies Map MF-1748, 1 sheet, scale 1:24,000.

Mill Creek (Washington) Municipal Code (Section 18.06), 2018.

Snohomish County Planning and Development Services Map Portal, Snohomish County (Washington).

Washington State Department of Ecology, *Stormwater Management Manual for Western Washington, 2012 (amended December 2014)*.

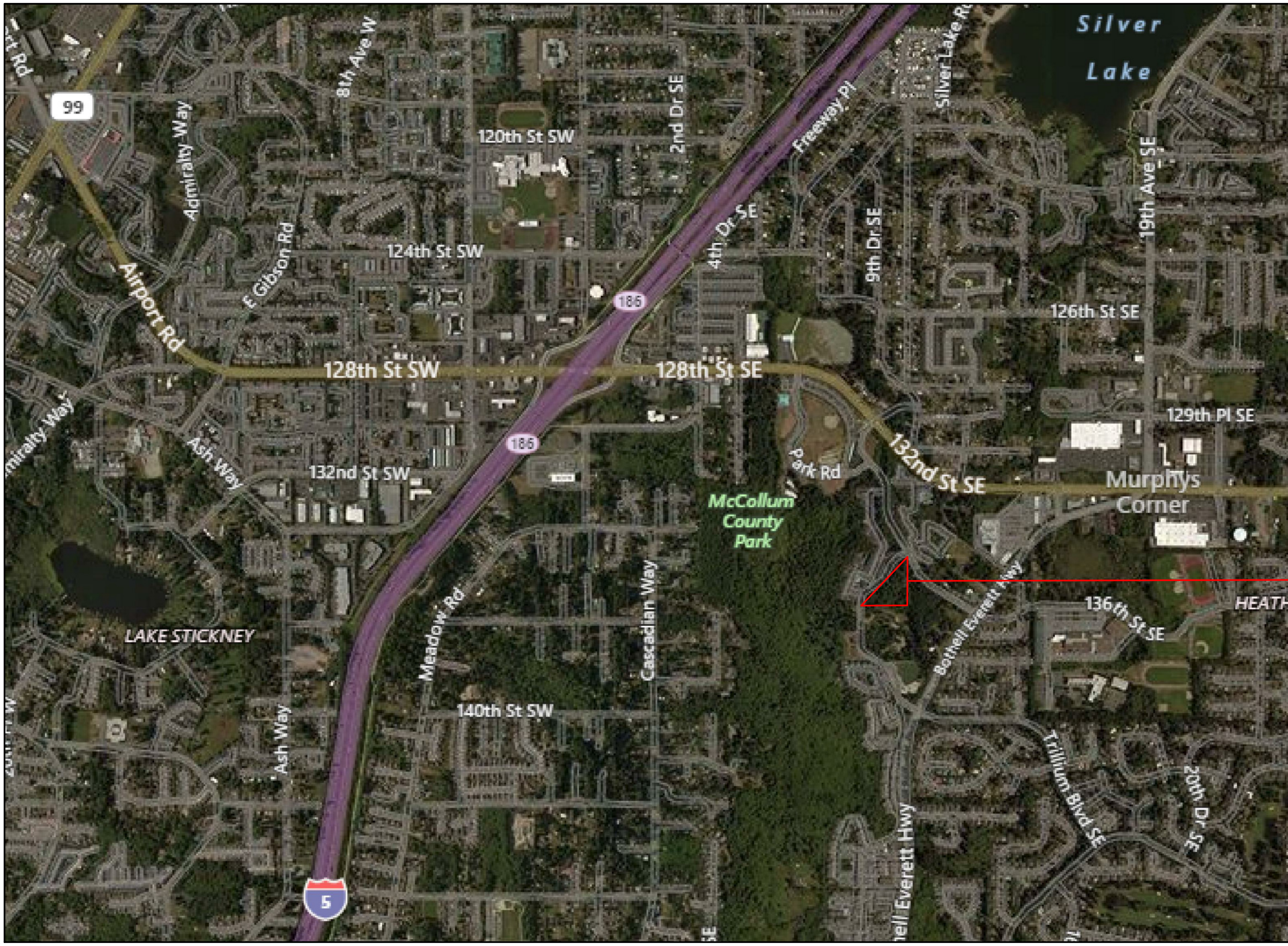
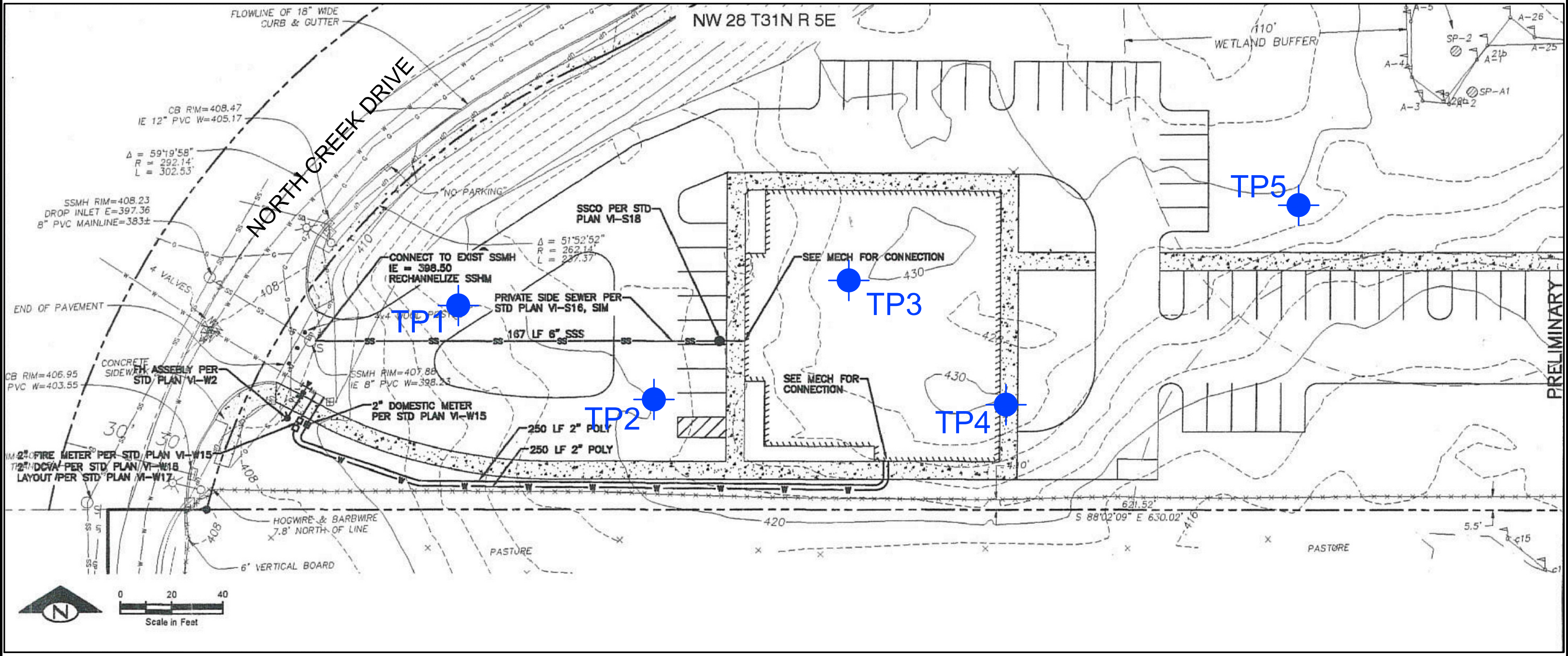


IMAGE REFERENCED FROM BING MAPS

FIGURE NO. GTS-1	GeoTest Services Inc.	7C's SWIM SCHOOL SWC of NORTH CREEK DRIVE & DUMAS ROAD MILL CREEK, WASHINGTON 98223	VICINITY MAP
GTS JOB NO: 18-0787			

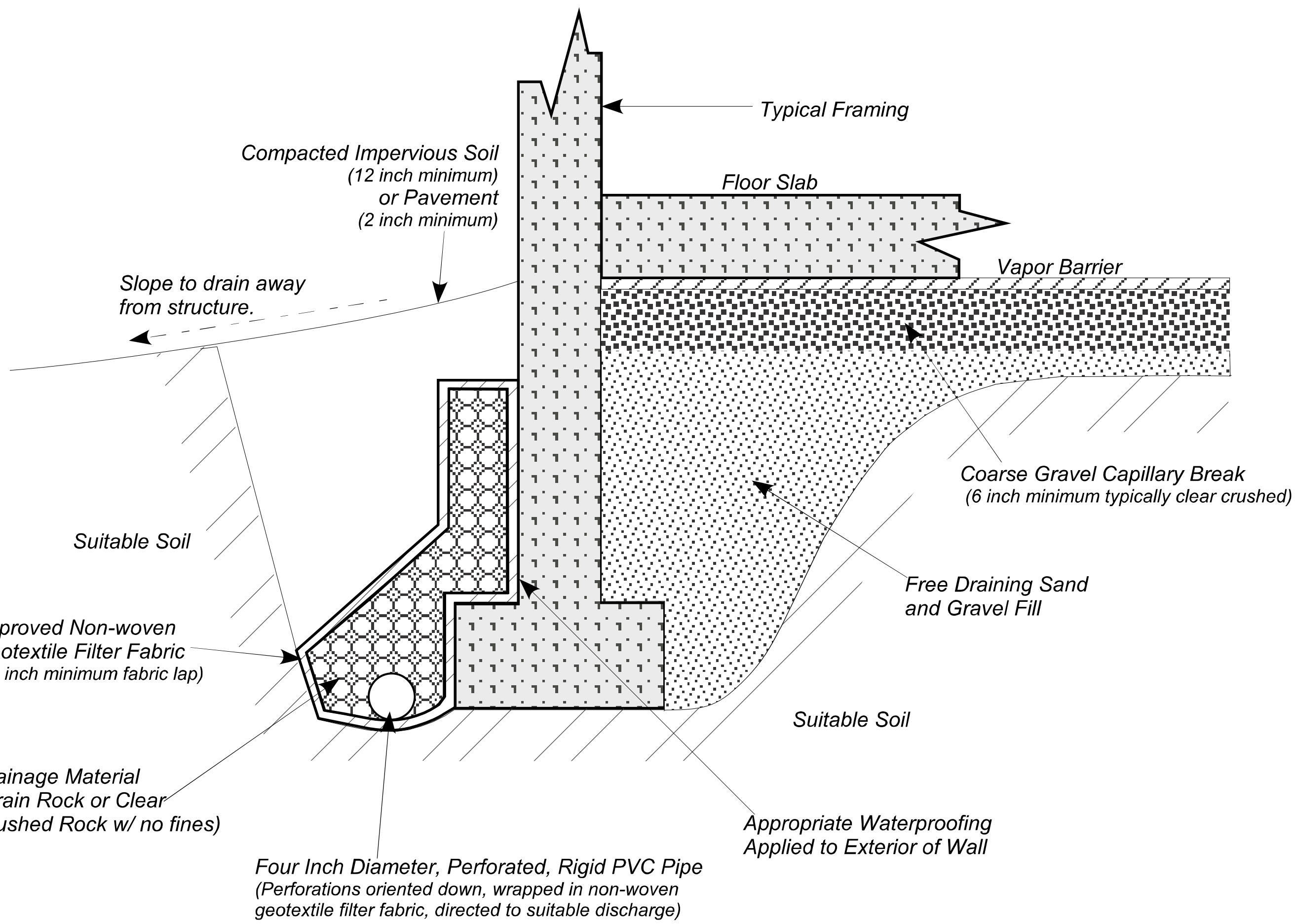


TP# - APPROXIMATE TEST PIT LOCATION

SITE PLAN REFERENCED FROM TERRAVISTA NW CONSULTING ENGINEERS
SCALE AND ORIENTATION AS SHOWN

FIGURE NO. GTS-2	GeoTest Services Inc.	7C's SWIM SCHOOL SWC of NORTH CREEK DRIVE & DUMAS ROAD MILL CREEK, WASHINGTON 98223	SITE AND EXPLORATION PLAN
GTS JOB NO: 18-0787			

SHALLOW FOOTINGS WITH INTERIOR SLAB-ON-GRADE



Notes:

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 monolithic footing and slab configuration

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Date: 11-30-18	By: EB	Scale: None	Project 18-0787

TYPICAL FOOTING & WALL DRAIN SECTION
7C's SWIM SCHOOL
SWC OF NORTH CREEK DRIVE & DUMAS ROAD
MILL CREEK, WASHINGTON 98223

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

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): 418 Excavated By: Coast Construction Group/Erin Belsvik	
0					WD	Loose, dark brown, moist to wet, sandy, primarily organic material (Forest Duff).	
	S1	d			GW	Loose to medium dense, brown, moist, well-graded GRAVEL with SAND and organics (Possible Weathered Till).	Groundwater not encountered.
2	S2	d	W = 7 GS		GW		
					GP-GM	Rootlets extend to 2.0 feet Very dense, grey, damp to moist, poorly graded GRAVEL with sand and silt (Glacial Till).	
4							
	S3	d					
6							
8	S4	d	W = 7 GS				

Test Pit Completed 11/15/18
Total Depth of Test Pit = 8.5 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): 420 Excavated By: Coast Construction Group/Erin Belsvik	
0					WD	Loose, dark brown, moist to wet, sandy, primarily organic material (Forest Duff).	
					SP	Loose to medium dense, brown, moist, well-graded SAND, with gravel and organics (Possible Weathered Till).	Groundwater not encountered.
2	S5	d					
	S6	d	W = 3 GS		SP-SM	Rootlets extend to 2.5 feet Very dense, grey, damp to moist, poorly graded SAND with gravel and silt (Glacial Till).	
4							
6	S7	d					
8	S8	d	W = 7 GS				

Test Pit Completed 11/15/18
Total Depth of Test Pit = 8.5 ft.

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

TP-3

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): 430 Excavated By: Coast Construction Group/Erin Belsvik	
0	S9	d			WD	Loose, dark brown, moist to wet, sandy, primarily organic material (Forest Duff).	Groundwater not encountered.
					GW	Loose to medium dense, brown, moist, well-graded GRAVEL, with sand with organics (Possible Weathered Till).	
2–4	S10	d			SP-SM	Very dense, grey, damp to moist, poorly graded SAND with gravel and silt (Glacial Till).	
6	S11	d	W = 6 GS				
8							

Test Pit Completed 11/15/18
Total Depth of Test Pit = 8.0 ft.

TP-4

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): 430 Excavated By: Coast Construction Group/Erin Belsvik	
0					WD	Loose, dark brown, moist to wet, sandy, primarily organic material (Forest Duff).	Groundwater not encountered.
2	S12		W = 8 GS		GW	Loose to medium dense, brown, moist, well-graded GRAVEL, with sand with organics (Possible Weathered Till).	
4	S13		W = 8 GS		SP-SM	Very dense, grey, damp to moist, poorly graded SAND with gravel and silt (Glacial Till).	
6–8	S14						
8	S15						

Test Pit Completed 11/15/18
Total Depth of Test Pit = 8.5 ft.

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

18-0787 12/13/18 X:\0-PROJECTS GEO\00000-PROJECTS 2018-GEO\FULL GEO EVALUATIONS\COAST GROUP CONSTRUCTION - 18-0787 - 7CS SWIM SCHOOL\GINT\GINT 18-0787.GPJ TEST PIT LOG

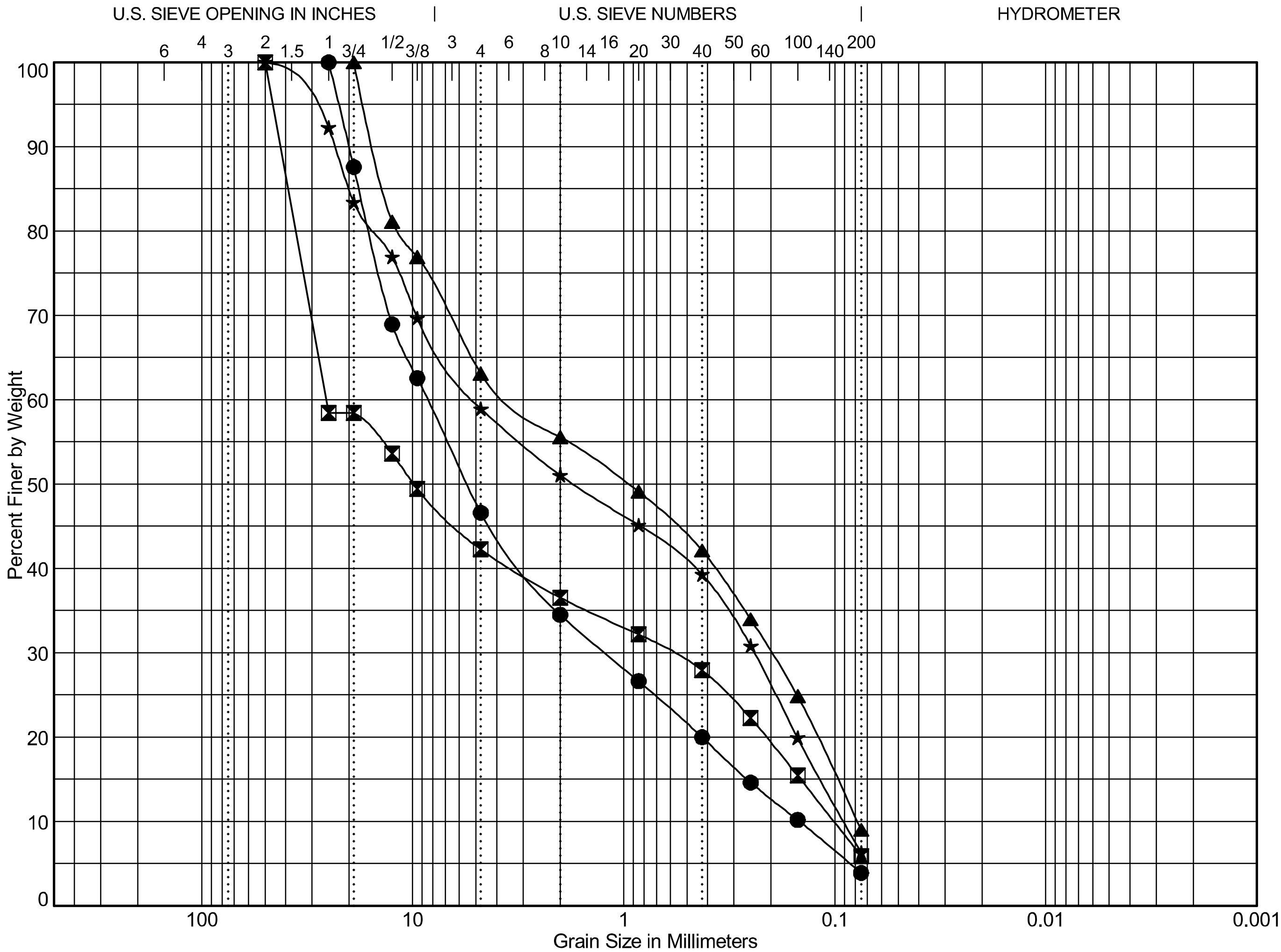
TP-5

SAMPLE DATA				SOIL PROFILE		GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 428 Excavated By: Coast Construction Group/Erin Belsvik	
0				WD	Loose, dark brown, moist to wet, sandy, primarily organic material (Forest Duff).	Groundwater not encountered.
				GW	Loose to medium dense, brown, moist, well-graded GRAVEL, with sand with organics (Possible Weathered Till).	
2						
	S16	d				
4	S17	d		SP-SM	Very dense, grey, dry, poorly graded SAND with gravel and silt (Glacial Till).	
6	S18	d	W = 7 GS			
8						
	S19	d				
10						
12						

Test Pit Completed 11/15/18
Total Depth of Test Pit = 9.0 ft.

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

GEOTEST	7C's Swim School Mill Creek, Washington	Log of Test Pits	Figure 7 (3 of 3)



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

	Point	Depth	Classification	LL	PL	PI	C_c	C_u
●	TP-1	2.5	WELL-GRADED GRAVEL with SAND (GW)				1.20	57.78
⧗	TP-1	7.5	POORLY GRADED GRAVEL with SAND and SILT (GP-GM)				0.14	254.37
▲	TP-2	3.0	POORLY GRADED SAND with GRAVEL and SILT (SP-SM)				0.15	42.50
★	TP-2	8.0	POORLY GRADED SAND with GRAVEL and SILT (SP-SM)				0.13	56.28

	Point	Depth	D_{100}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
●	TP-1	2.5	25	8.499	5.506	1.226	0.147	12.4	41.0	12.1	14.5	16.1	3.9
⧗	TP-1	7.5	50	25.667	9.856	0.596	0.101	41.6	16.2	5.7	8.6	22.0	5.9
▲	TP-2	3.0	19	3.329	0.958	0.2	0.078	0.0	36.9	7.5	13.4	33.1	9.0
★	TP-2	8.0	50	5.09	1.718	0.24	0.09	16.6	24.5	7.9	11.7	33.0	6.3

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

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

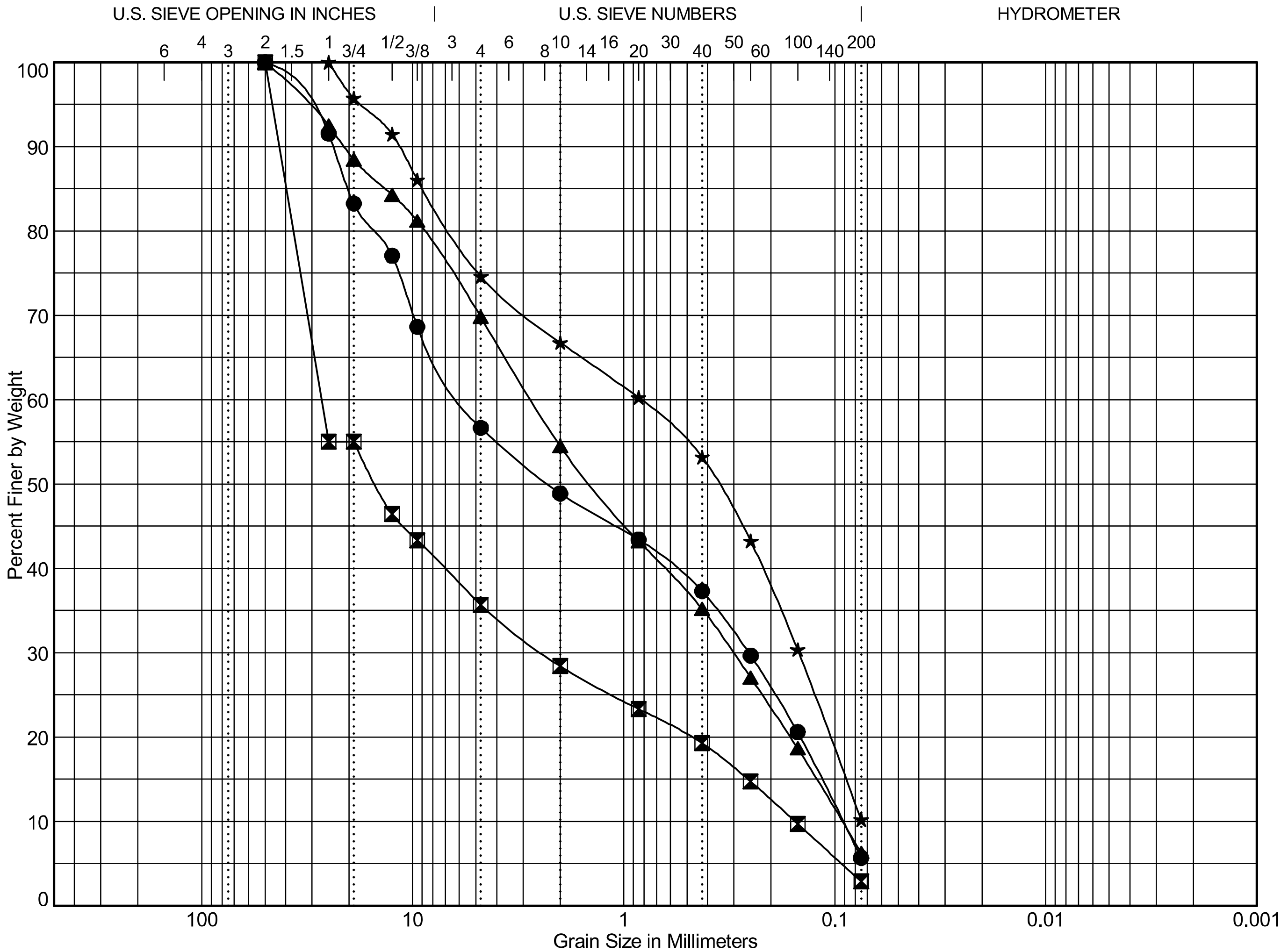
To be well graded: $1 < C_c < 3$ and $C_u > 4$ for GW or $C_u > 6$ for SW

GEOTEST

7C's Swim School
Mill Creek, Washington

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	6.5	POORLY-GRADED SAND with GRAVEL and SILT (SP-SM)				0.12	62.86
⧗	TP-4	2.0	WELL-GRADED GRAVEL with SAND (GW)				1.40	175.29
▲	TP-4	4.0	POORLY-GRADED SAND with GRAVEL and SILT (SP-SM)				0.36	29.61
★	TP-5	6.0	POORLY-GRADED SAND with GRAVEL and SILT (SP-SM)				0.36	11.12

	Point	Depth	D_{100}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
●	TP-3	6.5	50	5.759	2.263	0.256	0.092	16.7	26.6	7.8	11.6	31.6	5.7
⧗	TP-4	2.0	50	27.001	14.883	2.415	0.154	45.0	19.3	7.3	9.1	16.4	2.9
▲	TP-4	4.0	50	2.731	1.422	0.303	0.092	11.5	18.7	15.3	19.3	28.9	6.3
★	TP-5	6.0	25	0.828	0.358	0.148		4.2	21.1	7.8	13.6	43.0	10.2

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

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

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

GEOTEST

7C's Swim School
Mill Creek, Washington

Grain Size Test Data

Figure 9

18-0787 11/27/18 X:\0-PROJECTS GEO\00000-PROJECTS 2018-GEO\FULL GEO EVALUATIONS\COAST GROUP CONSTRUCTION - 18-0787 - 7CS SWIM SCHOOL\GINT\GINT 18-0787.GPJ GRAIN SIZE W/STATS

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Report: 46758-1
Date: November 19, 2018
Project No: 18-0787
Project Name: 7C's Swim School

Sample ID	pH	Organic Matter	Cation Exchange Capacity
TP-1 @ 1.0'	5.2	3.54%	9.0 meq/100g
TP-2 @ 1.5'	5.5	1.59%	4.2 meq/100g
TP-3 @ 0.5'	5.2	6.15%	13.3 meq/100g
TP-5 @ 3.0'	5.4	2.90%	7.9 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.

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.*

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

Subsurface Conditions Can Change

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

Most Geotechnical and Geologic Findings are Professional Opinions

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

A Report's Recommendations are *Not* Final

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

A Geotechnical Engineering or Geologic Report may be Subject to Misinterpretation

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

Do not Redraw the Exploration Logs

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

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In that letter, consider advising the contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the GeoTest and/or to conduct

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additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. In addition, it is recommended that a contingency for unanticipated conditions be included in your project budget and schedule.

Read Responsibility Provisions Closely

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

Environmental Concerns Are Not Covered in this Geotechnical or Geologic Report

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

Obtain Professional Assistance to Deal with Biological Pollutants

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

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