Geotechnical Engineering Services

St. Charles Borromeo Parish – Office Addition
7712 South 12th Street
Tacoma, Washington

for
St. Charles Borromeo Parish

September 1, 2023

GeoEngineers
Earth Science + Technology

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1101 South Fawcett Avenue, Suite 200
Tacoma, Washington 98402
253.383.4940

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Tacoma, Washington

File No. 3161-005-01

September 1, 2023

Prepared for:

St. Charles Borromeo Parish
7712 South 12th Street
Tacoma, Washington 98465

Attention: Father Michael J. McDermott, Pastor

Prepared by:

GeoEngineers, Inc.
1101 South Fawcett Avenue, Suite 200
Tacoma, Washington 98402
253.383.4940

Clinton J. Lindgren, PE
Geotechnical Engineer

Dennis (D.J.) Thompson, PE
Associate Geotechnical Engineer

DENNIS JOHN THOMPSON
STATE OF WASHINGTON
38397
REGISTERED
PROFESSIONAL ENGINEER

9/1/23

CJL:DJT:leh

Table of Contents

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION AND PROJECT UNDERSTANDING

This report presents the results of our geotechnical engineering services completed for the St. Charles Borromeo Parish – Office Addition project. The project site is located at 7112 South 12th Street in Tacoma, Washington as shown on the Vicinity Map, Figure 1. Our understanding of the project is based on our communications with the project team and review of Schematic Design Drawings prepared by MBA Architects dated June 1, 2023, Sheet 5 of a topographic survey prepared by Sitts & Hill Engineers, Inc. dated July 14, 2015, and our experience in the area. GeoEngineers previously completed geotechnical consultation and construction support regarding subgrade preparation, structural fill placement, and compaction in the northern parking lot area, just northeast of the current project site, in 2022.

The proposed project consists of construction of an addition, which will consist of a new structure located north of the existing parish hall, office, and school building. An alleyway, designated on the reviewed site plan as "Parish Street", will separate the new structure from the parish hall, office, and school building to the south. We understand that the addition will consist of a two-story structure with a basement and is anticipated to be supported by shallow foundations. Other anticipated improvements could include hardscaping, utilities, and stormwater management. It is our understanding that stormwater facilities at the site will be designed in accordance with the 2021 City of Tacoma Stormwater Management Manual (SWMM).

2.0 SCOPE OF SERVICES

The purpose of our services is to complete subsurface explorations (drilled borings) to develop an understanding of soil and groundwater conditions at the site and use as a basis to provide geotechnical recommendations related to civil and structural design to support project planning, design, and construction. Our services have been provided in general accordance with our proposal for the project dated June 6, 2023 and signed on June 8, 2023 and can be reviewed for further details.

3.0 SITE CONDITIONS

3.1. Surface Conditions

The overall property is currently developed with the St. Charles Borromeo Catholic Sanctuary facility and associated parking areas and is generally bounded by South 12th Street to the north, residential properties to the east and south, and South Meyers Street to the west. The proposed development area (site) is located in the northern approximately third of the overall property, adjacent to the north side of facility's parish hall, office, and school building. The site is currently developed with relatively level asphalt-paved parking lot and driveway areas. Existing elevations at the site are between about Elevation (EL) 365 feet and EL 368 feet based on aerial imagery. Elevations included herein are referenced to the North American Vertical Datum of 1988 (NAVD 88) and should be considered approximate.

3.2. Literature Review

3.2.1. Geologic Maps

Our understanding of the site geology is based on review of the "Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington" (Schuster, et al. 2015). The reviewed map indicates the site is underlain by glacial till. Glacial till is described as a highly compact mixture of sand, gravel, silt, and clay, sometimes referred to as “hardpan”. Till soils were deposited below glacial ice and have been glacially overridden (glacially consolidated); densities typically range from dense to very dense, although the upper few feet of these deposits can be weathered and medium dense. Till deposits typically provide high bearing resistance and low infiltration potential. Glacial deposits in the area can contain cobbles and boulders dispersed throughout.

3.2.2. Seismic Assessments

We reviewed the “Washington 2019-2021 School Seismic Safety Project Site Class Assessment” published by the Washington Geologic Survey. The report includes geophysical testing data and seismic site class assessments for school campuses across the state. We reviewed the study for DeLong Elementary, which is located about 1.6 miles east of the site. According to the study, DeLong Elementary (and the project site) is underlain by glacial till. The Delong Elementary site is classified as seismic Site Class C according to geophysical testing completed for the study.

3.3. Subsurface Conditions

3.3.1. Explorations

We explored subsurface conditions at the site by advancing four borings (B-1 through B-4) in the project area to nominal depths of about 20 feet below existing ground surface (bgs). The boring locations were targeted to the approximate corners of the proposed addition structure. Approximate locations of the borings and surrounding site features are shown on the attached Site Plan, Figure 2. A detailed description of our subsurface exploration program, including summary exploration logs and laboratory testing results are provided in Appendix A.

3.3.2. Soil Conditions

Surface conditions at the borings typically consisted of a pavement section comprised of about 2.5 to 3 inches of asphalt concrete underlain by a few inches of pavement base consisting of sand with silt and gravel. Underlying the pavement section, we observed what we interpret to be two soil units present in areas of the site: fill and glacial till.

3.3.2.1. Fill

We observed what we interpret to be fill material below the pavement section in all four borings. Our interpretation of fill was based on observations of soil type, layering between explorations, debris encountered and/or relative density of the soil. Fill typically consisted of very loose to loose silty sand with gravel and occasional organic matter, consisting of charcoal fragments. Fill was observed extending to depths between about 5¼ and 7½ feet bgs (EL 362.75 feet to EL 357.5 feet).

3.3.2.2. Glacial Till

Below the fill material, we observed what we interpret to be native glacial till. Glacial till consisted of medium dense to very dense silty sand with gravel. In general, the upper approximately 2½ to 4 feet of glacial till soils were observed to be weathered and medium dense. Below this weathered zone, about 7½ to 10 feet bgs (EL 360.5 feet to EL 355 feet), glacial till was relatively undisturbed and was dense to very dense. All four borings were terminated in very dense glacial till at nominal depths of about 20 feet bgs.

3.3.3. Groundwater Conditions

Groundwater, seepage and/or wet soils were not observed in our explorations. Soil coloring and oxidation staining were intermittently observed (as noted in the logs), which may indicate the presence and fluctuation of groundwater at various times of the year, such as perched groundwater. Explorations were completed on July 26, 2023, which is within the typical dry season for the area.

Based on our observations and experience in the project area, we anticipate that the static groundwater table is well below the depths of our explorations and currently envisioned site excavations. Although not directly observed in our borings, we anticipate perched groundwater could be present at various times throughout the year. Perched groundwater is dependent on infiltration of surface water that slows or terminates atop underlying less permeable layers (e.g., loose fill over glacial till). Rainfall amounts, irrigation activities, site grading, underground utilities and other factors can also affect the quantity, location, and depth of perched groundwater. We anticipate perched groundwater will generally be most prevalent during the wet season, typically October through May in western Washington, and is most likely to accumulate near the top of the glacial till.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1. Primary Geotechnical Considerations

Based on our project understanding, the explorations performed for this study, and our experience, it is our opinion the proposed improvements can be designed and constructed generally as envisioned with regard to geotechnical considerations. A summary of key geotechnical considerations is provided below and should be used in conjunction with the complete recommendations presented further in this report.

- Seismic Site Class C is appropriate for the site; recommended seismic design parameters are provided. It is our opinion that the risk of liquefaction at the site is low.
- The proposed structure(s) can be supported using shallow foundations and slabs-on-grade. Due to variable density and organics observed within the fill, modifications to foundation bearing surfaces are recommended. In general, a minimum of 2 feet of overexcavation and replacement with structural fill is recommended below all foundations, except, where dense glacial till is encountered. Dense glacial till was typically encountered at about 5 to 7 feet below surrounding site grade. We provide additional discussion in the "Shallow Foundations" section below.
- We recommend project plans include provisions to remove of a minimum of 2 feet of the existing fill where present below the building slab. This material should be replaced with an imported granular structural fill material. Modifications to this could be considered in the field during construction, at the time of subgrade preparation.
- Where new design features, loads or excavations are within a distance equal to 20 feet from the existing parish hall, office, school building, and other existing site structures on site, additional review considering undermining of foundations and/or overloading of adjacent structures should be completed by project engineers, prior to final design and construction.
- Existing site soils generally contain a significant quantity of fine-grained particles (material passing the U.S. No. 200 sieve). These soils will be difficult or impossible to work with when wet and will become easily disturbed if exposed to wet weather.

- For general planning purposes, we recommended site soils not be considered for re-use as a structural fill. Other purposes may be applicable.
- Additional provisions and budget allowance for site protection measures will be required if earthwork construction is completed during the wetter times of year.
- Variable silty fill material and relatively shallow glacially consolidated deposits encountered in the explorations are relatively impermeable. Because of this, we do not anticipate that stormwater infiltration would not be very practical and would typically be considered infeasible.

4.2. Seismic Design Considerations

4.2.1. Seismic Design Parameters

In accordance with the 2018 International Building Code (IBC), we determined seismic design parameters using procedures presented in American Society of Civil Engineers (ASCE) 7-16. Based on explorations completed for this study and our understanding of local geology, we anticipate soils below our explorations and extending to depths of 100 feet bgs consist of dense to very dense glacially consolidated soils. Reviewed geophysical testing at a nearby site with similar soil indicates Site Class C. Recommended seismic design parameters are provided in Table 1 below.

TABLE 1. SEISMIC DESIGN CRITERIA

2018 IBC (ASCE 7-16) Parameters[1]	Value
Site Class	C
Mapped MCE_R Spectral Response Acceleration at Short Period, S_s (g)	1.39
Mapped MCE_R Spectral Response Acceleration at 1-second period, S_1 (g)	0.48
Short Period Site Coefficient, F_a	1.2
Long Period Site Coefficient, F_v	1.5
Design Spectral Acceleration at 0.2-second period, S_{DS} (g)	1.11
Design Spectral Acceleration at 1.0-second period, S_{D1} (g)	0.48
Site Modified Peak Ground Acceleration, PGA_M (g)	0.60

Notes:

[1] Parameters developed based on latitude 47.249222 and longitude -122.533171

4.2.2. Liquefaction

Liquefaction refers to a condition where vibration or shaking of the ground, usually from earthquake forces, results in development of excess pore pressures in loose, saturated soils and subsequent loss of strength. In general, soils that are susceptible to liquefaction include loose to medium dense sands to silty sands that are below the water table. Structures, such as buildings, supported on liquefied soils may suffer loss of bearing capacity, foundation settlement and/or lateral movement that can be damaging to the buildings.

We reviewed the "Liquefaction Susceptibility Map of Pierce County, Washington" (Palmer et al. 2004) and the Washington State Department of Natural Resources (DNR) Interactive Natural Hazards Map. According to the maps, the site has "very low" potential for liquefaction. Based on the reviewed resources and the soil and groundwater conditions observed in our explorations, it is our opinion the potential for liquefaction at the site is low.

4.2.3. Lateral Spreading Potential

Lateral spreading related to seismic activity typically involves lateral displacement of large, surficial blocks of non-liquefied soil when a layer of underlying soil loses strength during seismic shaking. Lateral spreading usually develops in areas where sloping ground or large grade changes (including retaining walls) are present. Based on our understanding of the subsurface conditions, liquefaction risk, current site topography and the proposed improvements and site grading, it is our opinion the risk of lateral spreading is low.

4.2.4. Surface Rupture Potential

According to the DNR Geologic Portal (accessed August 1, 2023), the nearest mapped seismogenic feature is about 0.3 miles southwest of the project site. However, based on our understanding of local geology, bedrock in the project area is covered by several hundred feet of glacial soil. Therefore, it is our opinion that the risk for surface rupture at this site is low.

4.3. Shallow Foundations

4.3.1. General

Based on our explorations and understanding of the proposed improvements, we anticipate the new structure can be supported on shallow foundations and slabs-on-grade. We understand that the bottom of footings could range from a few feet (near-grade portions of the new structure) to several feet (basement portions of the structure) below existing grade. As previously discussed, we observed existing fill material extending to depths between about 5¼ and 7½ feet bgs (EL 362.75 feet to EL 357.5 feet) underlain by glacial till; we anticipate that footings could extend to either material depending on the final foundation plan (i.e., basement location, depth of footings, etc.).

Due to the variability in density of and occasional organics observed within the existing fill, we recommend foundations for the proposed structures not bear directly on existing fill. We recommend a minimum 2-foot overexcavation and replacement of existing fill below foundations as discussed below.

4.3.2. Bearing Surface Preparation

Our specific bearing surface preparation recommendations are as follows:

- If more than 2 feet of existing fill is present at foundation subgrade elevation, existing fill should be overexcavated at least 2 feet below footings and replaced with compacted select granular structural fill. Structural fill should extend at least 2 feet laterally beyond the edges of the footings and be compacted to at least 95 percent of the maximum dry density (MDD) of the material.
- If less than 2 feet of existing fill is present at foundation subgrade elevation, existing fill should be overexcavated to expose underlying glacial till and replaced with compacted structural fill. The presence of glacial till at the foundation subgrade should be observed and confirmed by GeoEngineers. Where practical, structural fill extending to glacial till should extend laterally beyond the edge of the footings a distance equal to the thickness of the fill or 2 feet, whichever is less. Structural fill should be compacted to at least 95 percent of the MDD of the material.
- If glacial till is present at foundation subgrade elevation, we do not anticipate overexcavation will be required.

Foundation excavations should be performed using a smooth-edged bucket to limit bearing disturbance. Roots, organic material, and/or deleterious material should be completely removed from below proposed foundation areas. Regardless of the soil unit exposed, the bearing surface should be compacted as necessary to a firm, unyielding condition during bearing surface preparation and/or prior to placement of structural fill. If structural fill is placed below foundations as either replacement of overexcavated soils or to establish a bearing pad, we recommend the structural fill extend laterally beyond the foundation perimeter a distance equal to the depth of structural fill (measured from the base of the footing), or 2 feet, whichever is less.

Foundation bearing surfaces should not be exposed to standing water. If water is present in the excavation, it must be removed before placing formwork and reinforcing steel. Where subgrade protection is needed, a 6-inch-thick layer of crushed rock or a 3- to 4-inch-thick layer of lean-mix concrete could be considered at the base of excavations. This will also limit disturbance to bearing surfaces from construction traffic.

Prepared foundation bearing surfaces should be evaluated by a member of our firm prior to placement of subgrade protection, formwork, or reinforcing steel to verify that the bearing surface has been prepared in accordance with our recommendations or to provide recommendations for remediating unsuitable bearing soils.

4.3.3. Minimum Dimensions

Exterior foundations should be established at least 18 inches below the lowest adjacent grade. Interior footings can be founded a minimum of 12 inches below the top of the floor slab. Isolated spread footings should have a minimum width of 24 inches. Continuous spread footings for walls should be at least 18 inches wide. Actual footing widths must also consider allowable soil bearing pressure for the design loads, as described below.

4.3.4. Allowable Soil Bearing Pressure

Shallow foundations bearing on a minimum of 2 feet of compacted structural fill overlying proof-compacted existing fill may be designed using an allowable soil bearing pressure of 2,500 pounds per square foot (psf). Shallow foundations bearing on structural fill extending to glacial till or directly on glacial till (typically encountered about 5¼ feet to feet 7½ bgs, EL 362.75 feet to EL 357.5 feet) may be designed using an allowable soil bearing pressure of 4,000 psf. The presence of glacial till at the base of foundation excavations should be observed and confirmed during construction.

These bearing pressures apply to the total of dead and long-term live loads and may be increased by one-third when considering total loads, including earthquake or wind loads. These are net bearing pressures. The weight of the foundation and overlying backfill can be ignored in calculating foundation sizes.

The actual bearing resistance will depend, in part, on the depth and size of the footings and the condition of the foundation bearing surface soils. Higher bearing capacity values than presented may be achieved on a case-by-case basis. We can consider possible increases to the recommended bearing pressures if specific elements such as foundation size, loads, depth and construction methods are known.

4.3.5. Foundation Settlement Estimates

Disturbed soil must be removed from the base of foundation excavations and the bearing surface should be prepared as recommended. Provided these measures are taken, we estimate the total static settlement of shallow foundations will be on the order of 1 inch or less. Differential settlements could be on the order of ¼ to ½ inch between similarly loaded isolated column footings or over a distance of about 50 feet along continuous wall footing. These settlements should occur rapidly, essentially as loads are applied. Settlements could be greater than estimated if disturbed or saturated soil conditions are present below foundations.

These estimates are based on footings proportioned using the recommended allowable bearing pressure provided above, and maximum considered loading of about 5,000 pounds per lineal foot or 40,000 pounds per column. We should be notified if foundation loads exceed those presented above so we can review overall foundation sizes, loads, and revise our settlement estimates, if necessary.

4.3.6. Lateral Resistance

The ability of the soil to resist lateral loads is a function of frictional resistance, which can develop on the base of footings and slabs and passive resistance, which can develop on the face of below-grade elements of the structure as these elements tend to move into the soil.

For cast-in-place footings founded in accordance with the recommendations presented above, the allowable frictional resistance on the base of the footing may be computed using a coefficient of friction of 0.40 applied to the vertical dead-load forces. The allowable passive resistance on the face of the footing or other embedded foundation elements may be computed using an equivalent fluid density of 275 pounds per cubic foot (pcf) for undisturbed existing site soils or structural fill extending out from the face of the foundation element a distance at least equal to 2½ times the depth of the element. These values include a factor of safety of about 1.5.

The passive earth pressure and friction components may be combined, provided that the passive component does not exceed two-thirds of the total. The passive earth pressure value is based on the assumptions that the adjacent grade is level, and that groundwater remains below the base of the footing throughout the year. The top foot of soil should be neglected when calculating passive lateral earth pressure unless the area adjacent to the foundation is covered with pavement or a slab-on-grade.

4.3.7. Footing Drains

Based on our interpretation of the regional groundwater table, groundwater conditions observed in our explorations and anticipated bearing surface depths, it is our opinion footing drains are not necessary to maintain bearing support. However, we still recommend perimeter footing drains be incorporated at the base of the exterior footings and around the building. Our recommendation is based on the potential for near-surface seepage to occur during wetter times of the year or from irrigation/landscaping activities as observed soil conditions contain are relatively impermeable, potentially causing below grade pooling of water. Perimeter footing drains will also assist in maintaining drier conditions around the structures and for long-term maintenance and management of near-surface water seeping in and around the structures.

In most cases, civil design provides adequate drainage design sections, typically comprised of perforated pipes, clean gravel and wrapped in a geotextile. We expect the majority of standard civil design sections for foundation drains will be adequate for these purposes, and as such, prefer to not provide a specific recommendation. We can review and/or would be happy to provide specific recommendations for design of foundation drains and additional assistance, if requested.

4.3.8. Considerations for Nearby Structures

Based on our review of current project plans, the new structure will be located about 20 feet offset (north) of the existing parish hall, office, and school building. Based on this offset, we do not anticipate that the load influence from the new structure will affect the existing adjacent building.

It is possible to locate new structures closer to existing foundations; however, this would have to be considered on a case-by-case basis and would require additional analysis. We recommend we review foundation plans, including near final design layouts, to evaluate potential load influence effects on adjacent structures.

Further considerations with regards to excavation near and below adjacent structures may also require evaluation as to not undermine existing structures and for worker safety.

4.4. Slab-on-Grade

4.4.1. Modulus of Subgrade Reaction (Slabs-on-Grade)

Slab-on-grade floors should bear on existing site soils or on structural fill extending to these soils and should be prepared as recommended in the "Subgrade Preparation" and/or "Area Fills and Pavement Bases" sections of this report. We recommend that slab subgrades be observed by a member of our firm during construction. Disturbed areas should be compacted, if possible, or removed and replaced with compacted structural fill. In all cases, the exposed soil should be compacted to a uniformly firm and unyielding condition.

A modulus of subgrade reaction of 200 pounds per cubic inch (pci) may be used for structural design of slabs-on-grade, provided that the bearing surface has been prepared as recommended and consists of thoroughly compacted existing site soil or structural fill extending to such soil. This value is for a 1-foot by 1-foot square plate. The modulus of subgrade reaction for a foundation varies based on its minimum width and is computed according to the following equation:

$$k_s = k_{s1}[(B+1)/2B]^2$$

Where k_s is the computed modulus of subgrade reaction, k_{s1} is the modulus of subgrade reaction for a 1- foot by 1-foot square plate, and B is the minimum width or lateral dimension of the mat or slab.

4.4.2. Capillary Break and Underslab Drainage

We recommend the slab-on-grade floors be underlain by a minimum 6-inch-thick capillary break layer consisting of clean sand and gravel, crushed rock, or washed rock. The capillary break material should contain less than 3 percent fines material based on the minus ¾-inch sieve size fraction. Washington State Department of Transportation (WSDOT) Specification 9-03.9 (Aggregates for Ballast and Crushed Surfacing; i.e., crushed surfacing base course [CSBC]) can also be considered for use as a capillary break material.

Based on our understanding of soil and groundwater conditions at the site and proposed construction, it is our opinion an underslab drain system is not necessary. If dry slabs are required (e.g., where adhesives are used to anchor carpet or tile to slab), a waterproof liner may be placed as a vapor barrier below the slab.

4.4.3. Settlement Estimate

We estimate long-term static settlements for slabs constructed as recommended will be less than about ¾ inch for a floor load of up to 200 psf. We estimate differential settlement of floor slabs will be ½ inch or less over a span of 50 feet.

4.5. Retaining Walls and Below-Grade Structures

4.5.1. Design Parameters

We recommend the following lateral earth pressures be used for design of conventional retaining walls and below-grade structures. Our design pressures assume that the ground surface around the retaining structures will be level or near level and that retained soil will consist of compacted structural fill. Drainage systems must be included in the design in accordance with the recommendations presented in the "Wall Drainage" section below. If drainage systems are not feasible, we should be contacted to provide the appropriate undrained lateral soil pressures.

- Active soil pressure may be estimated using an equivalent fluid density of 36 pcf for the drained condition.
- At-rest soil pressure may be estimated using an equivalent fluid density of 58 pcf for the drained condition.
- For seismic considerations, a uniform lateral pressure of 14*H psf (where H is the height of the retaining structure or the depth of a structure below ground surface) should be added to the lateral earth pressure.
- We recommend surcharge effects be considered if surcharge loads are applied closer than one-half of the retaining structure height from the wall face. We can review and provide recommended surcharge loads on a case-by-case basis.

The active soil pressure condition assumes the wall is free to move laterally 0.001 H, where H is the wall height. The at-rest condition is applicable where walls are restrained from movement. The above recommended lateral soil pressures do not include the effects of sloping backfill surfaces or surcharge loads, except as described.

Retaining wall or below-grade structure foundation bearing surfaces should be prepared following the "Bearing Surface Preparation" section of this report. Provided bearing surfaces are prepared as recommended, retaining wall or below-grade structure foundations may be designed using the allowable soil bearing pressure and lateral resistance values presented above for structure foundation design. We estimate settlement of retaining structures will be similar to the values previously presented for structure foundations.

4.5.2. Wall Drainage

The retaining walls or below-grade structures are designed using drained parameters, so a drainage system behind the structure must be constructed to collect water and prevent the buildup of hydrostatic pressure against the structure. We recommend the drainage system include a zone of free-draining backfill a minimum of 18 inches in width against the back of the wall. The drainage material should consist of coarse sand and gravel containing less than 5 percent fines by weight based on the fraction of material passing the ¾-inch sieve. A perforated, rigid, smooth-walled drainpipe with a minimum diameter of 4 inches should be placed along the base of the structure within the free-draining backfill and extend for the entire wall length. The drainpipe should be metal or rigid polyvinyl chloride (PVC) pipe and be sloped to drain by gravity. Discharge should be routed to appropriate discharge areas and to reduce erosion potential. Cleanouts should be provided to allow routine maintenance. We recommend roof downspouts or other types of drainage systems not be connected to retaining wall drainage systems.

Other systems may also be considered, where appropriate and as approved by the project engineer. Weep holes and other through-wall drainage systems may be considered. Typically, the minimum 18 inches we recommend as a drainage zone can be reduced to about 12 inches with the use of a woven geotextile fabric that is placed between the natural soil cut and the drainage zone for separation purposes. There are also other products, such as waffle-type plastic drain board systems that can be used to reduce the required width of the drainage zone.

4.6. Infiltration Feasibility Assessment

We understand that stormwater facilities at the sites, if planned, will be designed in accordance with the 2021 City of Tacoma *Stormwater Management Manual* (SWMM). Because the site is underlain by variable silty fill material and/or glacial till at relatively shallow depths, infiltration facilities would likely need to be designed using the infiltration rate of these soils, which is typically very low (on the order of 0.05 to 0.1 inches per hour based on our experience in similar soils). In our opinion, on-site infiltration should be considered practically infeasible.

If infiltration facilities are included at this site, they should include overflows that are tightlined to alternative discharge locations. Additional testing, analysis, and reporting will be required to establish the final design infiltration rate if infiltration is planned. We would recommend that at least one pilot infiltration test (PIT) be performed at each proposed facility location. We can assist with performing PITs, and associated analysis and reporting, if requested.

4.7. Site Development and Earthwork

4.7.1. General

We anticipate site development and earthwork will include minor grading, excavating, and establishing subgrades for bearing surfaces and below-grade structures, utility installation, hardscaping, and placing and compacting fill and backfill materials. We expect site grading and earthwork can be accomplished with conventional earthmoving equipment. However, glacial till can be encountered in a very dense condition and take some effort during excavation. The earthwork contractor should be prepared to encounter dense soils conditions, especially in relatively deeper site excavations. The following sections provide specific recommendations for site development and earthwork.

4.7.2. Clearing and Stripping

Based on our understanding of the proposed improvements, which are in existing pavement areas, we anticipate clearing and stripping depths will be negligible. However, structural elements of existing buildings and pavements should be demolished and removed from within the footprint of the new improvements. If currently vegetated areas of the site are included in the proposed improvements, we anticipate clearing and stripping depths will be variable and could range from about 4 to 12 inches, although we did not directly explore these areas.

During demolition and stripping operations, excessive disturbance of surficial soils can occur, especially if occurring during and/or left exposed to wet conditions. Disturbed soils may require additional remediation during final site grading and construction.

Cobbles and boulders can be present in the glacial till soils in the vicinity. As such, the contractor should be prepared to remove cobbles and boulders during grading or excavation. Boulders may be removed from the site or used in landscape areas. Voids caused by boulder removal should be backfilled with compacted structural fill.

4.7.3. Temporary Excavations and Cut Slopes

Based on explorations and our experience with other projects in similar soil conditions, we anticipate that shallow excavations could experience minor caving. Excavations deeper than 4 feet should be shored or laid back at a stable slope if workers are required to enter. Shoring and temporary slope inclinations must conform to the provisions of Title 296 Washington Administrative Code (WAC), Part N, “Excavation, Trenching and Shoring.” Regardless of the soil type encountered in the excavation shoring, trench boxes or sloped sidewalls will be required under Washington Industrial Safety and Health Act (WISHA) if excavations are deeper than 4 feet. We recommend contract documents specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety and providing shoring, as required, to protect personnel and structures.

In general, we recommend that for planning purposes all temporary cut slopes be inclined no steeper than about 1½H:1V (horizontal to vertical). Steeper temporary cut slopes are possible for cuts into relatively undisturbed glacial till materials similar to those observed at this site; however, this should be evaluated on a case-by-case basis. Our guidelines assume all surface loads are kept at a minimum distance of at least one-half the depth of the cut away from the top of the slope and that seepage is not present on the slope face. Flatter cut slopes will be necessary where seepage occurs or if surface surcharge loads are anticipated. Temporary covering with heavy plastic sheeting should be used to protect these slopes during periods of wet weather.

4.7.4. Permanent Cut and Fill Slopes

We recommend permanent slopes be constructed at a maximum inclination of 2H:1V to manage erosion. Where 2H:1V permanent slopes are not feasible, protective facings and/or retaining structures should be considered.

To achieve uniform compaction, we recommend fill slopes be overbuilt and subsequently cut back to expose well-compacted fill. Fill placement on existing slopes steeper than 5H:1V should be benched into the slope face. The configuration of benches depends on the equipment being used and the inclination of the existing slope. Bench excavations should be level and extend into the slope face at least half the width of the compaction equipment used.

Exposed areas should be re-vegetated as soon as practical to reduce surface erosion and sloughing. Temporary protection should be used until permanent protection is established.

4.7.5. Groundwater Handling Considerations

Based on observed soil and groundwater conditions in our explorations it is our opinion static groundwater levels will not rise above the bottom of our explorations, which extended as deep as 20 feet bgs

(Elevation 344 feet). Although not directly encountered in our completed borings, we anticipate perched groundwater could be present at various times throughout the year (see "Groundwater Conditions" section of this report for additional discussion). We anticipate shallow perched groundwater can be handled adequately with sumps, pumps, and/or diversion ditches, as necessary. Groundwater handling needs will typically be lower during the summer and early fall months. Ultimately, we recommend that the contractor performing the work be made responsible for controlling and collecting groundwater encountered.

4.7.6. Surface Drainage

Surface water from roof downspouts, driveways and landscape areas should be collected and controlled. Curbs or other appropriate measures such as sloping pavements, sidewalks and landscape areas should be used to direct surface flow away from buildings, erosion sensitive areas and from behind retaining structures. Roof and catchment drains should not be connected to wall or foundation drains.

4.7.7. Subgrade Preparation

Subgrades that will support structures, slabs-on-grade, and hardscape areas should be thoroughly compacted to a uniformly firm and unyielding condition on completion of stripping and before placing structural fill. We recommend that subgrades for these areas be evaluated to identify areas of yielding or soft soil. Probing with a steel probe rod or proof-rolling with a heavy piece of wheeled construction equipment are appropriate methods of evaluation.

If soft or otherwise unsuitable subgrade areas are revealed during evaluation that cannot be compacted to a stable and uniformly firm condition, we recommend that: (1) the unsuitable soils be scarified (e.g., with a ripper or farmer's disc), aerated and recompacted, if practical; or (2) the unsuitable soils be removed and replaced with compacted structural fill, as needed.

4.7.8. Subgrade Protection and Wet Weather Considerations

The wet weather season generally begins in October and continues through May in western Washington; however, periods of wet weather can occur during any month of the year. Soils encountered in our explorations generally contained a significant quantity of fines and will be extremely susceptible to disturbance during periods of wet weather. On-site soils will become easily disturbed and become difficult to manage when wet. Project budget or provisions for some export and import material may be necessary if earthwork is conducted during the wetter times of the year (see "Fill Materials" section for additional discussion).

If earthwork is scheduled during the wet weather months, we offer the following recommendations:

- Measures should be implemented to remove or eliminate the accumulation of surface water from work areas. The ground surface in and around the work area should be sloped so that surface water is directed away and graded so that areas of ponded water do not develop. Measures should be taken by the contractor to prevent surface water from collecting in excavations and trenches.
- Earthwork activities should not take place during periods of heavy precipitation.
- Slopes with exposed soils should be covered with plastic sheeting.
- The contractor should take necessary measures to prevent on-site soils and other soils to be used as fill from becoming wet or unstable. These measures may include the use of plastic sheeting, sumps with pumps and grading. The site soils should not be left uncompacted and exposed to moisture.

Sealing exposed soils by rolling with a smooth-drum roller prior to periods of precipitation will help reduce the extent to which these soils become wet or unstable.

- Construction traffic should be restricted to specific areas of the site, preferably areas that are surfaced with working pad materials not susceptible to wet weather disturbance.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practical.

4.8. Fill Materials

4.8.1. On-Site Soils

Soils encountered in the explorations typically consisted of silty sand with variable gravel content. Summary logs, soil descriptions and results of our laboratory testing are included in Appendix A. Laboratory testing results of our explorations indicate fines content up to about 30 percent. In our experience, soil containing more than about 5 to 10 percent fines becomes more sensitive to changes in moisture, will become difficult to compact when just a few percent above the optimum moisture content (OMC), and will become easily disturbed when wet.

In general, we do not recommend relying on the use of on-site materials as structural fill. For general planning purposes, and alternative review, if desired, we recommend site soils only be considered for re-use as structural fill if earthwork is planned in the drier summer months. If earthwork will occur in the winter, we recommend project planning include provisions for all import of structural fill materials and export and/or re-distribution.

4.8.2. Structural Fill

The workability of material for use as structural fill will depend on the gradation and moisture content of the soil. Material used for structural fill should be free of debris, organic contaminants, and rock fragments larger than 6 inches. For most applications, structural fill consisting of material similar to "Select Borrow" or "Gravel Borrow" as described in Section 9-03.14 of the WSDOT Standard Specifications will be appropriate.

Weather and site conditions should be considered when determining the type of import fill materials purchased and brought to the site for use as structural fill. If earthwork activities are scheduled during the wet weather months or during prolonged periods of wet weather, we recommend that washed crushed rock or select granular fill, as described below, be used for structural fill.

If prolonged dry weather prevails during the earthwork phase of construction, materials with a somewhat higher fines content may be acceptable.

4.8.3. Select Granular Fill

Select granular fill should consist of well-graded sand and gravel or crushed rock with a maximum particle size of 6 inches and less than 5 percent fines by weight based on the minus ¾-inch fraction. Organic matter, debris or other deleterious material should not be present. In our opinion, material with gradation characteristics similar to WSDOT Specification 9-03.9 (Aggregates for Ballast and Crushed Surfacing), or 9-03.14 (Borrow) is suitable for use as select granular fill, provided that the fines content is less than 5 percent (based on the minus ¾-inch fraction) and the maximum particle size does not exceed 6 inches.

4.9. Fill Placement and Compaction

4.9.1. General

To obtain proper compaction, fill and backfill soil should be compacted near the OMC and in uniform horizontal lifts. Lift thickness and compaction procedures will depend on the moisture content and gradation characteristics of the soil and the type of equipment used. The maximum allowable moisture content varies with the soil gradation and should be evaluated during construction. Generally, 8- to 12-inch loose lifts are appropriate for steel-drum vibratory roller compaction equipment. Compaction should be achieved by mechanical means. During fill and backfill placement, sufficient testing of in-place density should be conducted to check that adequate compaction is being achieved.

4.9.2. Area Fills and Pavement Bases

Fill placed to raise site grades and materials under pavements and structural areas should be placed on subgrades prepared as previously recommended. Fill material placed below structures and footings should be compacted to at least 95 percent of the theoretical MDD per ASTM International (ASTM) D 1557. Fill material placed less than 2 feet below subgrades for driveways and gravel-surfaced areas should be compacted to at least 95 percent of the MDD. Fill placed deeper than 2 feet below subgrade in these areas should be compacted to at least 90 percent of the MDD. Fill material placed in landscaping areas should be compacted to a firm condition that will support construction equipment, as necessary, typically around 85 to 90 percent of the MDD.

4.9.3. Backfill Behind Retaining Walls and Below-Grade Structures

Backfill behind retaining walls or below-grade structures should be compacted to between 90 and 92 percent of the MDD. Overcompaction of fill placed directly behind retaining walls or below-grade structures should be avoided. We recommend use of hand-operated compaction equipment and maximum 6-inch loose lift thickness when compacting fill within about 3 to 5 feet behind retaining walls or below-grade structures.

4.10. Pavement Recommendations

4.10.1. General

We anticipate that new pavements for the proposed improvements could include parking areas and driveways. Our recommended pavement sections provided below are based on our explorations and experience in the area. We understand asphalt concrete pavement (ACP) is planned for the proposed improvements.

The recommended pavement sections below may not be adequate for heavy construction traffic loads such as those imposed by concrete transit mixers, dump trucks or cranes. Additional pavement thickness may be necessary to prevent pavement damage during construction. An asphalt-treated base (ATB) section can also be used during construction to protect partially constructed pavement sections and pavement subgrades. The recommended sections assume final improvements surrounding the pavement areas will be designed and constructed such that stormwater or excess irrigation water from landscape areas does not accumulate below the pavement section or pond on pavement surfaces. If pavements in parking areas slope inward (toward the center of the parking area) full depth curbs or other measures should be used to prevent water from entering and ponding on the subgrade and within the base section.

4.10.2. Construction Considerations

Existing pavements, hardscaping or other structural elements should be removed prior to placement of new pavement sections. Pavement subgrade should be prepared to a uniformly firm, dense, and unyielding condition as previously described. CSBC and subbase should be moisture conditioned to near optimum moisture content and compacted to at least 95 percent of the MDD (ASTM D 1557).

CSBC should conform to applicable sections of 4-04 and 9-03.9(3) of the WSDOT Standard Specifications. Hot mix asphalt should conform to applicable sections of 5-04, 9-02 and 9-03 of the WSDOT Standard Specifications.

Some areas of pavement may exhibit settlement and subsequent cracking over time. Cracks in the pavement will allow water to infiltrate to the underlying base course, which could increase the amount of pavement damage caused by traffic loads. To prolong the effective life of the pavement, cracks should be sealed as soon as possible.

4.10.3. Asphalt Concrete Pavement Design

4.10.3.1. Standard-Duty ACP – Automobile Driveways and Parking Areas

- 2 inches of hot mix asphalt, class ½ inch, PG 58-22
- 4 inches of CSBC
- 6 inches of subbase consisting of select granular fill, previously described, to provide a uniform grading surface, to provide pavement support, to maintain drainage, and to provide separation from subgrade soil.
- Subgrade consisting of proof-compacted firm and unyielding conditions, or structural fill prepared in accordance with the "Subgrade Preparation" and "Area Fills and Pavement Bases" sections of this report.

4.10.3.2. Areas Subject to Occasional Heavy Truck Traffic

- 3 inches of hot mix asphalt, class ½ inch, PG 58-22
- 6 inches of CSBC
- 6 inches of subbase consisting of select granular fill, previously described, to provide a uniform grading surface, to provide pavement support, to maintain drainage, and to provide separation from subgrade soil.
- Subgrade consisting of proof-compacted firm and unyielding conditions, or structural fill prepared in accordance with the "Subgrade Preparation" and "Area Fills and Pavement Bases" sections of this report.

4.10.3.3. Temporary Construction Surfacing

A temporary surfacing of ATB can be used to protect partially constructed pavement sections and pavement subgrades during construction. This can provide a relatively clean working surface, prevent construction traffic from damaging final paving surfaces and, in some instances, reduce subgrade repairs required for final paving. A 2-inch-thick section of ATB can be substituted for the upper 2 inches of CSBC in either the light-duty or heavy-duty pavement sections if desired. Prior to placement of the final pavement surface sections, we recommend that any areas of ATB pavement failure be removed, and the subgrade repaired.

If ATB is used and is serviceable when final pavements are constructed, the design asphalt concrete pavement thickness can be placed directly over the ATB.

Cement treatment of subgrades is sometimes used to create construction surfacing or to control soil moisture during wet weather construction. In our opinion cement treatment would not likely be cost effective for creating a wet weatherproof construction surface due to the high fines content in the soil. Cement treatment or cement stabilization would likely only be cost effective as an emergency or contingency action for reducing soil moisture in the on-site material if excavated and re-used as a structural fill. We estimate that it would take a significant amount of cement, likely on the order of 10 percent by weight, to create a firm and stable working surface that could handle wet weather construction. If used as a structural fill, likely on the order of 6 to 8 percent cement by weight would be required.

5.0 LIMITATIONS

We have prepared this report for the St. Charles Borromeo Parish – Office Addition project in Tacoma, Washington. St. Charles Borromeo Parish may distribute copies of this report to their authorized agents and regulatory agencies as may be required for the Project.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices for geotechnical engineering in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our professional knowledge, judgment, and experience. No warranty, express or implied, applies to the services or this report.

Please refer to Appendix B titled “Report Limitations and Guidelines for Use” for additional information pertaining to the use of this report.

FIGURES

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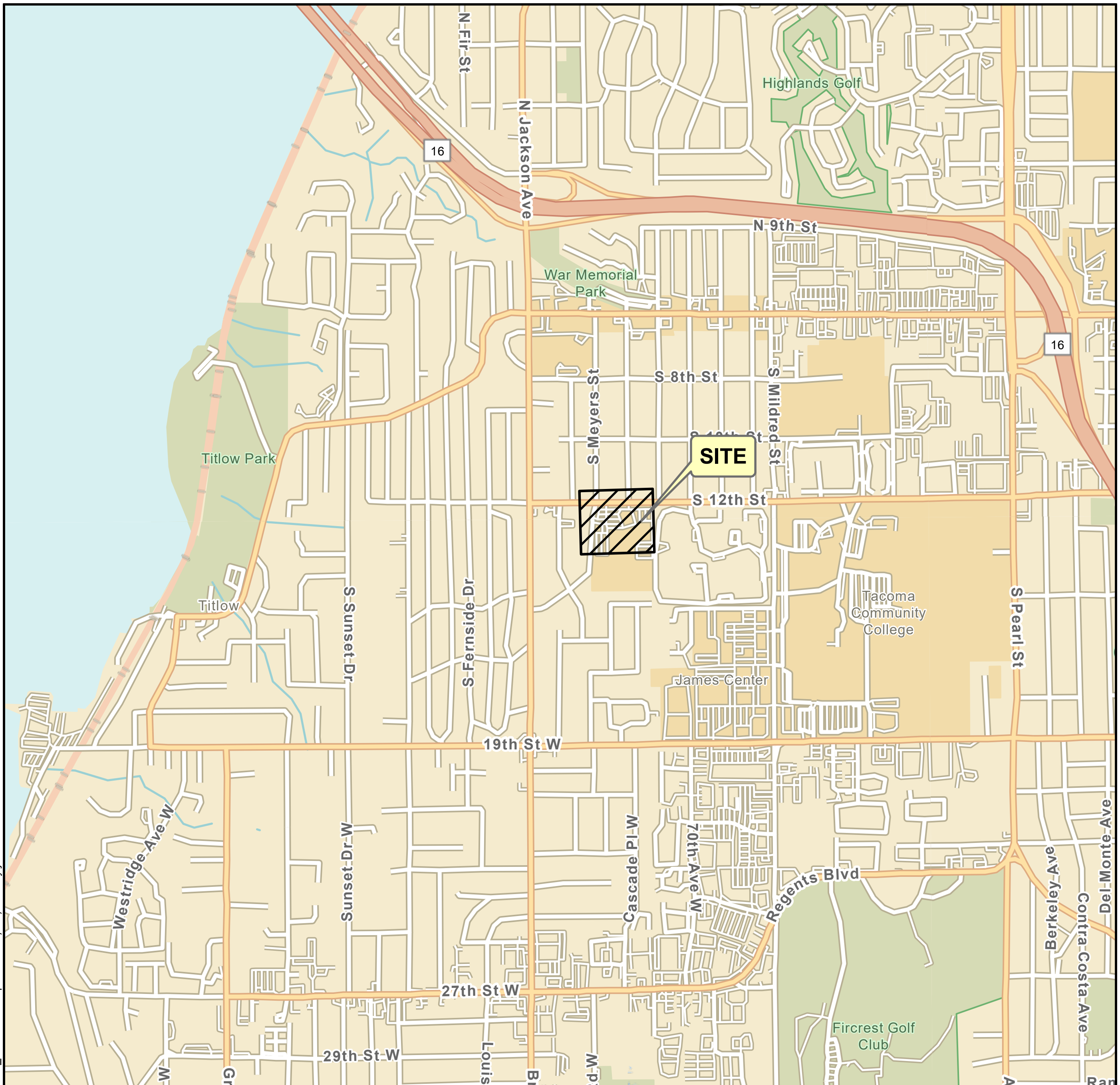

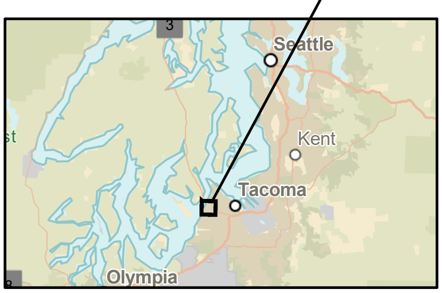

N

0 2,000

Feet

Source(s):
- ESRI

Coordinate System: NAD 1983 UTM Zone 10N

Disclaimer: This figure was created for a specific purpose and project. Any use of this figure for any other project or purpose shall be at the user's sole risk and without liability to GeoEngineers. The locations of features shown may be approximate. GeoEngineers makes no warranty or representation as to the accuracy, completeness, or suitability of the figure, or data contained therein. The file containing this figure is a copy of a master document, the original of which is retained by GeoEngineers and is the official document of record.

Vicinity Map

St. Charles Borromeo Parish - Office Addition
Tacoma, WA

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Figure 1

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Legend

Approximate Site Area

B-1 Boring by GeoEngineers, Inc., 2023

Source: Aerial from Microsoft Bing

Projection: WA State Plane, South Zone, NAD83, US Foot

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N

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Site Plan

St. Charles Borromeo Parish - Office Addition
Tacoma, Washington

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Figure 2

APPENDICES

GEOENGINEERS

APPENDIX A
Subsurface Explorations and Laboratory Testing

APPENDIX A
SUBSURFACE EXPLORATIONS AND LABORATORY TESTING

Subsurface Explorations

Subsurface conditions at the site were explored by advancing four borings on July 26, 2023 at the approximate locations shown in the Site Plan, Figure 2. Locations of the borings were determined using an electronic tablet with global positioning system (GPS) software and should be considered approximate. Exploration locations were constrained to some degree by existing site infrastructure.

The borings were performed using truck-mounted drilling equipment provided and operated by Holocene Drilling, Inc. under subcontract to GeoEngineers. Borings were advanced using hollow-stem auger drilling methods and advanced to depths between approximately 20¾ and 21½ feet below existing site grade (bgs). Borings were backfilled by the driller in accordance with Washington State Department of Ecology requirements. Soil cuttings generated from the borings were placed in metal barrels and hauled off by the driller for off-site disposal.

During the exploration program our field representative continuously monitored the borings, obtained representative soil samples, classified the soils, maintained a detailed log of each exploration, and observed groundwater conditions. Soil samples were obtained from the borings using a 1.4-inch-inside-diameter split-barrel sampler driven into the soil using a 140-pound hammer free-falling a distance of 30 inches. The number of blows required to drive the sampler the last 12 inches or other indicated distance is recorded on the logs as the blow count. Our field representative made sample attempts at 2½- to 5-foot-depth intervals. Samples were retained in sealed plastic bags to prevent moisture loss. The soils were classified visually in general accordance with ASTM International (ASTM) D 2488 and Figure A-1, which includes a Key to the Exploration Logs. Summary logs of the explorations are included as Figures A-2 through A-5.

Laboratory Testing

Soil samples obtained from the explorations were transported to the GeoEngineers' laboratory. Representative soil samples were selected for laboratory tests to evaluate the pertinent geotechnical engineering characteristics of the site soils and to confirm or modify our field classifications. The following sections provide a general description of the tests performed.

Sieve Analysis (SA)

Grain-size distribution analyses were completed on selected samples in general accordance with ASTM Test Method D 6913. This test method covers the quantitative determination of the distribution of particle sizes in soils. Typically, the distribution of particle sizes larger than 75 micrometers (μm) is determined by sieving. Figure A-6 presents the results of our sieve analyses.

Moisture Content (MC)

Oven dried samples were used to estimate the percentage of water (on a mass basis) in the soil, in general accordance with ASTM Test Method D 2216. Test results are presented on the exploration logs at the respective sample depths.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

Sampler Symbol Descriptions

- 2.4-inch I.D. split barrel / Dames & Moore (D&M)
- Standard Penetration Test (SPT)
- Shelby tube
- Piston
- Direct-Push
- Bulk or grab
- Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

ADDITIONAL MATERIAL SYMBOLS

GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point lead test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
UU	Unconsolidated undrained triaxial compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

GeoEngineers

Figure A-1

Drilled	Start 7/26/2023	End 7/26/2023	Total Depth (ft)	20.75	Logged By LSP Checked By CJL	Driller Holocene Drilling Inc.	Drilling Method	Hollow-stem Auger

Surface Elevation (ft) Vertical Datum	366 NAVD88	Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Foremost Mobile B-58 Truck
Easting (X) Northing (Y)	1135457 705210	System Datum	South NAD83 (feet)	Groundwater not observed at time of exploration	

Notes:

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							AC	Approximately 2½ inches of asphalt concrete			
365								SP-SM	Approximately 4 inches of brownish gray fine to medium sand with silt and gravel (pavement base)			
								SM	Brown silty fine sand with gravel and occasional organics (charcoal) (very loose, moist) (fill)			
		X	9	3		1 MC				13		
	5								Grades to gray-brown, loose			
360		X	16	29		2A 2B 2C						
								SM	Gray silty fine to medium sand with gravel (medium dense, moist) (glacial till)			
		X	18	28		3 SA				8	31	
									Grades to with occasional iron oxide staining			
355	10	X	12	50/6"		4						Intermittent drill chatter starting at approximately 10 feet below ground surface (bgs) to bottom of boring
									Grades to very dense			
350	15	X	17	72/11"		5						Increased silt content
	20	X	9	50/3"		6						

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Aerial Imagery.

Log of Boring B-1

GeoEngineers

Project: St. Charles Borromeo Parish Office Addition
Project Location: Tacoma, Washington
Project Number: 3161-005-01

Figure A-2
Sheet 1 of 1

Drilled	Start 7/26/2023	End 7/26/2023	Total Depth (ft) 20.75	Logged By LSP	Checked By CJL	Driller Holocene Drilling Inc.	Drilling Method Hollow-stem Auger

Surface Elevation (ft) / Vertical Datum	365 / NAVD88	Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop
Drilling Equipment	Foremost Mobile B-58 Truck		
Easting (X) / Northing (Y)	1135577 / 705202	System Datum	South NAD83 (feet)
Groundwater not observed at time of exploration			

Notes:

Elevation (feet)	Depth (feet)	Recovered (in)	Blows/foot	Sample Name / Testing	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
365	0				AC	Approximately 2½ inches of asphalt concrete			
					SP-SM	Approximately 3 inches of brownish gray fine to medium sand with silt and gravel (pavement base)			
					SM	Brown silty fine to medium sand with gravel and occasional organics (charcoal) (loose, moist) (fill)			
		17	7	1					
360	5	12	3	2 MC		Grades to very loose	17		
		18	20	3 MC	SM	Gray with iron oxide staining silty fine to medium sand with occasional gravel (medium dense, moist) (glacial till)	6		Intermittent drill chatter starting at approximately 7.5 feet bgs to bottom of boring
355	10	14	39	4		Grades to dense			
						Grades to very dense			
350	15	18	60	5					Increased in silt content, occasional near wet seams
345	20	9	50/4"	6					Rock in sampler shoe

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Aerial Imagery.

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Log of Boring B-2

GeoEngineers

Project: St. Charles Borromeo Parish Office Addition
Project Location: Tacoma, Washington
Project Number: 3161-005-01

Figure A-3
Sheet 1 of 1

Drilled	Start 7/26/2023	End 7/26/2023	Total Depth (ft) 21.5	Logged By LSP / Checked By CJL	Driller Holocene Drilling Inc.	Drilling Method Hollow-stem Auger

Surface Elevation (ft) 368 / Vertical Datum NAVD88	Hammer Data: Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment: Foremost Mobile B-58 Truck
Easting (X) 1135457 / Northing (Y) 705171	System South / Datum NAD83 (feet)	Groundwater not observed at time of exploration

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							AC	Approximately 3 inches of asphalt concrete			
								SP-SM	Approximately 4 inches of brownish gray fine to medium sand with silt and gravel (pavement base)			
								SM	Brown silty fine sand with gravel (very loose, moist) (fill)			
365			9	2		1						
	5		15	22/9"		2 MC		SM	Gray with occasional iron oxide staining silty fine to medium sand with gravel (medium dense, moist) (glacial till)	9		Drill rig hammer issues, sampler only driven 9 inches
360			18	80/12"		3 MC			Grades to very dense	6		
	10		18	71		4			Grades to fine sand			Intermittent drill chatter starting at approximately 10 feet bgs to bottom of boring
355												
	15		18	55		5 MC						
350												
	20		6	43		6			Grades to dense			

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Aerial Imagery.

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Log of Boring B-3

GeoEngineers

Project: St. Charles Borromeo Parish Office Addition
Project Location: Tacoma, Washington
Project Number: 3161-005-01

Drilled	Start 7/26/2023	End 7/26/2023	Total Depth (ft)	21.5	Logged By LSP Checked By CJL	Driller	Holocene Drilling Inc.	Drilling Method	Hollow-stem Auger

Surface Elevation (ft) Vertical Datum	367 NAVD88	Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	Foremost Mobile B-58 Truck
Easting (X) Northing (Y)	1135576 705167	System Datum	South NAD83 (feet)	Groundwater not observed at time of exploration	

Notes:

Elevation (feet)	Depth (feet)	FIELD DATA: Recovered (in)	FIELD DATA: Blows/foot	FIELD DATA: Sample Name / Testing	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				AC	Approximately 3 inches of asphalt concrete			
					SP-SM	Approximately 4 inches of brownish gray fine to medium sand with silt and gravel (pavement base)			
365					SM	Brown silty fine sand with gravel with occasional organics (charcoal) (very loose, moist) (fill)			
		3	4	1					
	5	5 10	0 1	2 2A SA			13	27	Sample 2A obtained with California sampler
360									
		16	22	3 MC	SM	Gray silty fine to medium sand with gravel and occasional iron oxide staining (medium dense, moist) (glacial till)	7		Intermittent drill chatter starting at approximately 7.5 feet bgs to bottom of boring
	10	17	53	4		Grades to very dense			
355									
	15	18	51	5					
350									
	20	18	66	6					

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Aerial Imagery.

Log of Boring B-4

GEOENGINEERS

Project: St. Charles Borromeo Parish Office Addition
Project Location: Tacoma, Washington
Project Number: 3161-005-01

Figure A-5
Sheet 1 of 1

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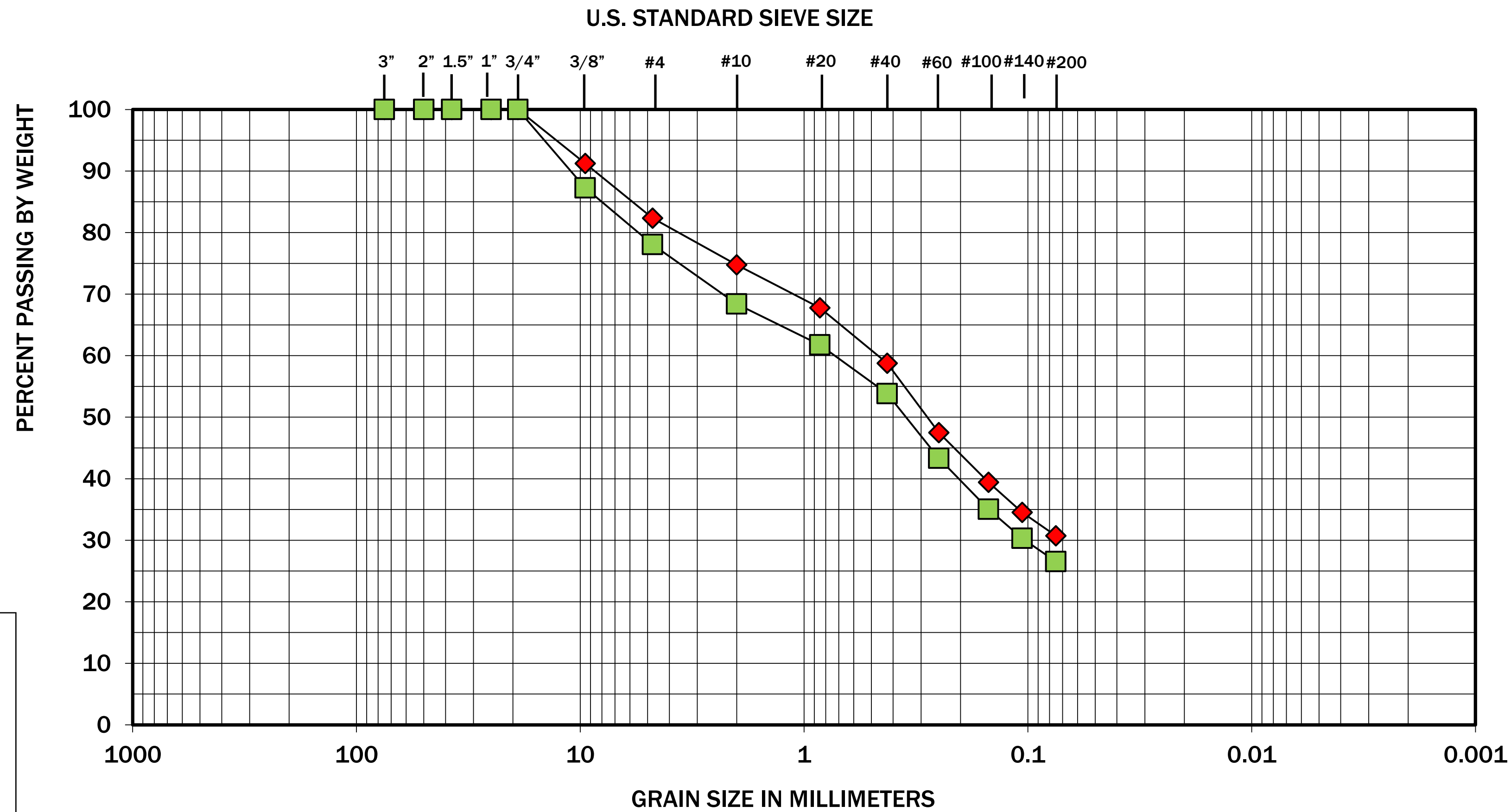

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆ (red diamond)	B-1	7.5	8	Silty sand with gravel (SM)
■ (green square)	B-4	5	13	Silty sand with gravel (SM)

AASHTO ACCREDITED

Note: This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations, or generated by separate operations or processes.

The grain size analysis results were obtained in general accordance with ASTM D6913. GeoEngineers 17425 NE Union Hill Road Ste 250, Redmond, WA 98052

GeoEngineers

St. Charles Borromeo Parish – Office Addition
Tacoma, Washington

Sieve Analysis Results

Figure A-6

APPENDIX B
Report Limitations and Guidelines for Use

APPENDIX B
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to our services, GeoEngineers includes the following explanatory "limitations" provisions in its reports. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical Services are Performed for Specific Purposes, Persons and Projects

This report has been prepared for St. Charles Borromeo Parish and for the Project(s) specifically identified in the report. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures its services to meet the specific needs of its clients. No party other than the party to whom this report is addressed may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the Project, and its schedule and budget, our services have been executed in accordance with proposal dated June 6, 2023 (executed June 8, 2023) and generally accepted geotechnical practices in this area at the time this report was prepared. We do not authorize, and will not be responsible for, the use of this report for any purposes or projects other than those identified in the report.

A Geotechnical Engineering or Geologic Report is based on a Unique Set of Project-Specific Factors

This report has been prepared for the St. Charles Borromeo Parish – Office Addition project in Tacoma, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it 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.

For example, changes that can affect the applicability of this report include those that affect:

- The function of the proposed structure;

[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

- Elevation, configuration, location, orientation or weight of the proposed structure;
- Composition of the design team; or
- Project ownership.

If changes occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

Environmental Concerns are Not Covered

Unless environmental services were specifically included in our scope of services, this report does not provide any environmental findings, conclusions, or recommendations, including but not limited to, the likelihood of encountering underground storage tanks or regulated contaminants.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we use sources that we reasonably believe to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

Geotechnical and Geologic Findings are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied its professional judgment to render an informed opinion about subsurface conditions at other locations. Actual subsurface conditions may differ, sometimes significantly, from the opinions presented in this report. Our report, conclusions and interpretations are not a warranty of the actual subsurface conditions.

Geotechnical Engineering Report Recommendations are Not Final

We have developed the following recommendations based on data gathered from subsurface investigation(s). These investigations sample just a small percentage of a site to create a snapshot of the subsurface conditions elsewhere on the site. Such sampling on its own cannot provide a complete and accurate view of subsurface conditions for the entire site. Therefore, the recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for the recommendations in this report if we do not perform construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective means of managing the risks associated with unanticipated conditions. If another party performs field observation and confirms our expectations, the other party must take full responsibility for both the observations and recommendations. Please note, however, that another party would lack our project-specific knowledge and resources.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable, but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help reduce the risk of problems associated with unanticipated subsurface conditions, GeoEngineers recommends giving contractors the complete geotechnical engineering or geologic report, including these "Report Limitations and Guidelines for Use." When providing the report, you should preface it with a clearly written letter of transmittal that:

- Advises contractors that the report was not prepared for purposes of bid development and that its accuracy is limited; and
- Encourages contractors to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.