Geotechnical Engineering Services

Sunnyside Village Cohousing Development
Marysville, Washington

for

Sunnyside Village Cohousing
c/o Urban Evolution, LLC

December 23, 2020

GeoEngineers
Earth Science + Technology

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File No. 24145-001-00

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1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services for use in design of the proposed Sunnyside Village Cohousing project located in Marysville, Washington. The proposed project site is shown relative to surrounding physical features in the Vicinity Map, Figure 1, and the Site Plan, Figure 2.

1.1. Project Description

We understand that the 4.75-acre property located at 3121 66th Avenue NE is being planned to be developed with 30 to 34 cottages, each of which will be around 700 to 1,200 square feet in size. The existing house on the property will remain and be used as the common house for the community. We also understand the project team is in the process of changing the layout design of the community.

The cottages are planned to be supported on conventional shallow spread foundations and there will be no below-grade structures as part of the development. Associated improvements for the project consist of sidewalks/hardscape, parking stalls and access drive lanes, landscaping and community gardens, and new underground utility construction.

1.2. Purpose and Scope

The purpose of our geotechnical services is to evaluate soil and groundwater conditions as a basis for developing geotechnical design criteria for the proposed development. Field explorations and laboratory testing were performed to identify and evaluate subsurface conditions at the site to develop engineering recommendations for use in design of the project. Our services were completed in general accordance with our proposal dated September 30, 2019.

2.0 FIELD EXPLORATIONS AND LABORATORY TESTING

2.1. Field Explorations

Subsurface conditions were evaluated through a field exploration program that consisted of excavating and sampling 11 test pits and completing one hand auger. The test pits and hand auger were completed on January 27, 2020. The test pits were completed using a rubber-tired backhoe subcontracted to GeoEngineers. The hand auger was completed using a 3-inch-diameter manually operated hand auger. The approximate locations of the explorations are shown on Figure 2.

The test pits, designated TP-1 through TP-11, were completed to depths ranging from 3 to 6.5 feet below the existing ground surface. The hand auger, designated HA-1, was completed to a depth of 2.5 feet below the existing ground surface before practical refusal was met. Locations of the explorations were determined in the field by using a hand-held global positioning system (GPS) unit. Elevations at the exploration locations were interpolated from the site survey developed by Metron and Associates in November 2019. The respective ground surface elevations are shown on the exploration logs in Appendix A. Appendix A includes logs of the test pits and hand auger (Figures A-2 through A-13) and details of the subsurface explorations performed.

2.2. Laboratory Testing

Soil samples obtained from the explorations were transported to GeoEngineers' laboratory and evaluated to confirm or modify field classifications, as well as to evaluate engineering properties of the soil. Representative samples were selected for laboratory testing consisting of moisture content and fines content (material passing the U.S. No. 200 sieve). The tests were performed in general accordance with test methods of the American Society for Testing and Materials (ASTM) and other applicable procedures. A description of the laboratory testing and the test results are presented in Appendix B.

3.0 SITE CONDITIONS

3.1. Surface Conditions

The site is generally rectangular in shape and is bounded by 66th Avenue NE and a stormwater detention pond to the north, and existing properties to the east, south and west. The site is currently occupied by a single-story family house (to be used as the community house), detached one car garage and an associated storage shed. All of these structures are situated near the middle of the site. Two small gardens are located on the west and north sides of the site. A small "A-Frame" structure covered in plastic is present directly west of the northern garden. Various other amenities such as an old swing set structure, picnic tables, play-frame structures, etc. are located around the site.

Site grades slope down gently to the south, from approximate Elevation 112 feet at the north end of the site to approximately Elevation 99 feet at the south end of the site. A majority of the site is covered in grass, with the exception of the southeast corner of the site where recent clearing work has left exposed soil and blackberry bushes. A large debris pile consisting of cleared trees, logs and vegetation is located in the southeast corner of the site. Small and large coniferous and deciduous trees border the site and surround the single-story family house. Gravel driveways run from the north (off 66th Avenue NE) and west sides of the site and meet near the front of the single car garage. An overhead power line runs from the southeast corner of the site to the garage. An underground waterline follows the east-west running driveway before turning north under the garage and feeding into the house. We also understand a septic system exists east of the existing house.

3.2. Geology

Published geologic information for the project vicinity includes a United States Geological Survey (USGS) map of the Marysville Quadrangle, Snohomish County, Washington (USGS 1985). Mapped soils in the immediate project vicinity consist of glacially consolidated Vashon Till deposits (glacial till). Older alluvium deposits are mapped southeast of the site.

Glacial till is generally a non-sorted, non-stratified mixture of sand, gravel and silt that has been overridden by several thousand feet of ice. It typically has high shear strength, low consolidation and low permeability characteristics in the undisturbed state. It typically develops a "weathered" zone where seasonal groundwater perches on top of the relatively impermeable unweathered till and the perched groundwater occurs as seepage following the site topography.

The older alluvium deposits generally consist of stratified sand and gravel deposited by streams flowing from the uplands to the east. These deposits lie at the bases of the slopes along the east and west sides of the broad Marysville valley.

3.3. Subsurface Conditions

3.3.1. Soil Conditions

Fill associated with past grading activities and native glacial till deposits were encountered below existing grades in the explorations completed at the site. Our observations included the following.

3.3.1.1. Sod and Topsoil

Approximately 1 to 6 inches of sod and topsoil was observed in the explorations completed at the site. The sod and topsoil consist of a matrix of grass, silty soil, roots and organic material.

3.3.1.2. Fill/Weathered Glacial Till Soils

Fill and/or weathered glacial till was observed below the sod and topsoil. These soils generally consist of medium dense to dense/medium stiff to very stiff silty fine to medium sand/sandy silt with varying amounts of gravel and roots with occasional organic matter. The fill and weathered glacial till thickness ranges from approximately 2 to 3.5 feet below existing site grades. These soils may consist of reworked glacially consolidated soils (fill) that were graded during the original site development or weathered glacially consolidated soils, and the distinction between the soils is difficult.

3.3.1.3. Glacial Till

Relatively unweathered glacial till was encountered below the fill and weathered till in all of the test pits completed at the site. The glacial till extended to the depths explored. The relatively unweathered glacial till generally consists of dense to very dense silty sand with variable gravel and cobble content. The transition from the unweathered glacial till and the overlying weathered glacial till is difficult to distinguish in most areas.

Although not encountered in our explorations, boulders are common in glacially consolidated soils and should be anticipated during construction.

3.3.2. Groundwater Conditions

Shallow perched groundwater seepage was encountered in a majority of the explorations completed at the site. Seepage flow rates on the order of 0.5 to 2 gallons per minute (gpm) were noted during excavation activities. The groundwater seepage was generally perched on top of the dense glacial till deposits within the fill and weathered glacial till. The perched groundwater is expected to vary as a function of season, precipitation and other factors.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our subsurface exploration program, geotechnical laboratory testing, analyses and experience on other similar projects, we conclude that the proposed Sunnyside Village Cohousing project can be constructed satisfactorily as planned with respect to geotechnical elements. The primary geotechnical considerations for the project are summarized below:

- The site is classified as Site Class C, in accordance with the 2018 International Building Code (IBC).
- Shallow foundations can be constructed on the glacially consolidated soils. Allowable bearing pressures of 3,000 pounds per square foot (psf) may be used for footings bearing on native undisturbed medium dense to very dense glacial till. An allowable bearing pressure of 3,000 psf may also be used where

imported structural fill is placed below footings, if needed, that extends to the native glacially consolidated soils.

- Conventional slabs-on-grade are considered appropriate and should be underlain by a 4-inch-thick layer of capillary break consisting of clean crushed rock with negligible fines and sand content.
- The on-site soils generally contain a high percentage of fines (silt and clay) ranging from 14 to 34 percent, based on our laboratory tests, and are highly moisture sensitive. Therefore, reuse of on-site soils should only be planned in the normal dry season (June through September).
- We anticipate that long-term design infiltration rates will be less than 0.2 inches per hour within the native glacial till. On-site infiltration testing will be needed if infiltration facilities are planned as part of the project.

These geotechnical considerations are discussed in greater detail, and conclusions and recommendations for the geotechnical aspects of the project are presented in the following report sections.

4.1. Earthquake Engineering

4.1.1. Seismicity

The Puget Sound area is located near the convergent continental boundary known as the Cascadia Subduction Zone (CSZ), which extends from mid-Vancouver Island to Northern California. The CSZ is the zone where the westward advancing North American Plate is overriding the subducting Juan de Fuca Plate. The interaction of these two plates results in two potential seismic source zones: (1) the Benioff source zone and (2) the CSZ interplate source zone. A third seismic source zone, referred to as the shallow crustal source zone, is associated with the north-south compression resulting from northerly movement of the Sierra Nevada block of the North American Plate.

Shallow crustal earthquakes occur within the North American Plate to depths up to 15 miles. Shallow earthquakes in the Puget Sound region are expected to have durations ranging up to 60 seconds. Four magnitude 7 (or greater) known shallow crustal earthquakes have occurred in the last 1,100 years in the Cascadia region; two of these occurred on Vancouver Island and two in Western Washington. The northeast-southwest trending Southern Whidbey Island fault zone is mapped approximately 9 miles southwest of the site.

The Benioff zone is characterized as being capable of generating earthquakes up to magnitude (M) 7.5. The Olympia 1949 (M = 7.1), the Seattle 1965 (M = 6.5) and the Nisqually 2001 (M = 6.8) earthquakes are considered to be Benioff zone earthquakes. The recurrence interval for large earthquakes originating from the Benioff source zone is believed to be shorter than for the shallow crustal and CSZ source zones; on average, damaging Benioff zone earthquakes in Western Washington occur every 30 years or so.

The CSZ is considered as being capable of generating earthquakes of magnitudes 8 to 9. No earthquakes on the CSZ have been instrumentally recorded; however, through the geologic record and historical records of tsunamis in Japan, it is believed that the most recent CSZ event occurred in the year 1700. Recurrence intervals for CSZ interplate earthquakes are thought to be on the order of 400 to 600 years.

4.1.2. Seismic Hazards

We evaluated the site for seismic hazards including liquefaction, lateral spreading and fault rupture. Our evaluation indicates the site does not have liquefiable soils present and therefore, also has little to no risk of liquefaction-induced ground disturbance, including lateral spreading. There are no mapped faults in the immediate vicinity of the site, with the exception of the Southern Whidbey Island fault zone mapped approximately 9 miles southwest of the site. Our opinion is that there is a low risk of fault displacement resulting in ground rupture at the surface.

4.1.3. 2018 IBC Seismic Design Information

We recommend the use of the 2018 IBC parameters listed in Table 1 for soil profile type, short period spectral response acceleration (S_S), 1-second period spectral response acceleration (S_1) and seismic coefficients (F_A and F_V) for the project site.

TABLE 1. 2018 IBC PARAMTERS

2018 IBC Parameter	Recommended Value
Soil Profile Type	C
Mapped MCE_R Spectral Response Acceleration at Short Period, S_s (g)	1.123
Mapped MCE_R Spectral Response Acceleration at 1-second period, S_1 (g)	0.399
Short Period Site Coefficient, F_a	1.2
Long Period Site Coefficient, F_v	1.5

4.2. Shallow Foundations

We recommend that the proposed buildings be supported on shallow spread footings founded on the medium dense to very dense glacial till encountered in our explorations. Shallow spread footings may also be supported on properly compacted structural fill extending down to the medium dense to very dense glacial till. Existing fill and unsuitable weathered glacial soils should be removed from under the planned buildings foundations.

For shallow foundation support, we recommend widths of at least 18 and 24 inches, respectively, for continuous wall and isolated column footings supporting the proposed buildings. The design frost depth in the Puget Sound area is 12 inches; therefore, we recommend that exterior footings for the buildings be founded at least 18 inches below lowest adjacent finished grade. Interior footings should be founded at least 12 inches below bottom of slab or adjacent finished grade.

The following recommendations for the building foundations are based on the subsurface conditions observed in the explorations.

4.2.1. Allowable Bearing Pressures

Unsuitable soils consisting of fill, topsoil and/or highly weathered glacial soils will vary across the site and must be removed from below planned footings. Based on our explorations, these unsuitable soils range from approximately 2 to 3.5 feet below existing site grades. Therefore, depending on the foundation locations and design elevations, up to 2 feet of overexcavation under the footings may be necessary. We recommend the following:

- **Shallow Foundations on Medium Dense Glacial Till:** For foundations extending to and bearing on competent undisturbed medium dense to very dense native glacial till, foundations may be designed using an allowable soil bearing pressure of 3,000 psf for isolated spread footings and continuous footings.
- **Shallow Foundations on Structural Fill:** For foundations bearing on properly placed and compacted structural fill extending down to medium dense to very dense glacial soils, foundations may be designed using an allowable soil bearing pressure of 3,000 psf for isolated spread footings and continuous footings.

The allowable bearing pressures presented above apply to the total dead and long-term live loads and may be increased up to one-third for short-term live loads such as wind or seismic forces.

Overexcavated areas below building foundations should be backfilled with structural fill consisting of imported gravel borrow where 3,000 psf is used. Where structural fill is placed below footings, the fill should extend beyond the edges of the foundations by the depth of the overexcavation.

4.2.2. Settlement

Post-construction settlement of shallow footings supported on native soils or on properly compacted structural fill as recommended above should be limited to less than 1 inch, and differential settlement between comparably loaded column footings or along a 25-foot section of continuous wall footing should be less than ½ inch. We expect most of the footing settlements will occur as loads are applied. Loose or disturbed soils not removed from footing excavations prior to placing concrete will result in additional settlement.

4.2.3. Lateral Resistance

Lateral foundation loads may be resisted by passive resistance on the sides of the footings and by friction on the base of the footings. Frictional resistance may be computed using a coefficient of friction of 0.4 applied to vertical dead-load forces. Passive resistance may be computed using an equivalent fluid density of 350 pounds per cubic foot (pcf). The allowable passive resistance is for horizontal soil conditions in front of the footing and is applicable, provided that the footings are surrounded by structural fill or constructed neat against native glacial soils. The structural fill should be compacted to at least 95 percent of the maximum dry density (MDD) determined in accordance with ASTM D 1557. Passive pressure resistance should be calculated from the bottom of adjacent floor slabs or below a depth of 1 foot, where the adjacent area is unprotected, as appropriate. The allowable frictional resistance and passive resistance values presented above include a factor of safety of about 1.5.

If soils adjacent to footings are disturbed during construction, the disturbed soils must be recompacted, otherwise the lateral passive resistance value must be reduced.

4.2.4. Footing Drains

We recommend perimeter footing drains be installed around the proposed buildings. The perimeter drains should be installed at the base of the exterior footings. The perimeter drains should consist of at least

4-inch-diameter perforated pipe placed on a 4-inch bed of, and surrounded by, 6 inches of drainage material enclosed in a nonwoven geotextile filter fabric such as Mirafi 140N (or approved equivalent). The perimeter drains should be provided with cleanouts. The footing drainpipe should be installed at least 18 inches below the top of the adjacent floor slab. The drainage material should consist of “Gravel Backfill for Drains” per Section 9-03.12(4) of the 2020 Washington State Department of Transportation (WSDOT) Standard Specifications. We recommend the drainpipe consist of either heavy-wall solid pipe (SDR-35 PVC, or equal) or rigid corrugated smooth interior polyethylene pipe (ADS N-12, or equal). We recommend against using flexible tubing for footing drainpipes. The perimeter drains should be sloped to drain by gravity, if practicable, to a suitable discharge point, preferably a storm drain. We recommend the cleanouts be covered and placed in flush mounted utility boxes. Water collected in roof downspout lines must not be routed to the footing drain lines.

4.2.5. Construction Considerations

We recommend that the excavations for the footings be completed with an excavator equipped with a smooth-edge bucket to minimize subgrade disturbance. Immediately prior to placing concrete, all debris and loose soils that accumulated in the footing excavations during forming and steel placement must be removed. Debris or loose soils not removed from the footing excavations will result in increased settlement.

If wet weather construction is planned, we recommend that all footing subgrades be protected using a lean concrete mud mat or 2-inch layer of clean crushed gravel. The mud mat or gravel layer should be placed the same day that the footing subgrade is excavated and approved for foundation support.

4.3. Slab-on-Grade Floors

4.3.1. Subgrade Preparation

We recommend that concrete slabs-on-grade be constructed on a gravel layer to provide uniform support and drainage, and to act as a capillary break. We expect that slab-on-grade floors can be supported on: (1) medium dense to very dense native glacial soils encountered in our explorations, or (2) properly compacted structural fill extending down to these materials, or (3) suitable on-site soils. Prior to placing the gravel layer, the subgrade should be proof-rolled, as described in Section 4.4. The exposed subgrade should be evaluated during construction and compacted to a firm and unyielding condition, although unsuitable soils should be removed and replaced with structural fill, where needed.

4.3.2. Design Parameters

A 4-inch-thick capillary break layer of 1-inch-minus clean crushed gravel with negligible sand and silt (WSDOT 9-03.1(4)C, Grading No. 67) should be placed to provide uniform support and form a capillary break beneath the slabs. For slabs designed as a beam on an elastic foundation, a modulus of subgrade reaction of 75 pounds per cubic inch (pci) may be used for subgrade soils, prepared as recommended above. This value assumes the slabs are bearing directly on structural fill placed over medium dense to dense native glacial soils and will require evaluation during construction.

If water vapor migration through the slabs is objectionable, the capillary break gravel layer should be covered with heavy plastic sheeting at least 10-mil thick to act as a vapor retarder. This will be desirable where the slabs are in occupied spaces or will be surfaced with tile or will be carpeted. It may also be prudent to apply a sealer to the slab to further retard the migration of moisture through the floor.

The contractor should be made responsible for maintaining the integrity of the vapor barrier during construction. Additional water proofing measures that may be needed should be evaluated during design.

4.4. Earthwork

4.4.1. Excavation Considerations

Planned final site grades may be close to the existing grades. Based on the subsurface soil conditions encountered in our explorations, we expect the soils at the site may be excavated using conventional heavy-duty construction equipment. Dense to very dense glacial till can be difficult to excavate. Glacial deposits in the area commonly contain cobbles and boulders that may be encountered during excavation. Accordingly, the contractor should be prepared to deal with cobbles and boulders.

The fill and native soils contain sufficient fines (material passing the U.S. Standard No. 200 sieve) to be highly moisture-sensitive and susceptible to disturbance, especially when wet. Ideally, earthwork should be undertaken during extended periods of dry weather (June through September) when the surficial soils will be less susceptible to disturbance and provide better support for construction equipment. Dry weather construction will help reduce earthwork costs and increase the potential for using the native soils as structural fill.

Trafficability on the site is not expected to be difficult during dry weather conditions. However, the native soils will be susceptible to disturbance from construction equipment during wet weather conditions and pumping and rutting of the exposed soils under equipment loads may occur and could potentially generate significant quantities of mud if not protected.

4.4.2. Clearing and Site Preparation

Construction of the planned buildings and associated site improvements will require demolition of utilities and significant clearing and stripping. We expect that there will be demolition of the existing underground utilities and septic system. Gravel from stripping of the driveway may be reused as backfill, provided it meets the requirements outlined in Section 4.4.5.

Areas to be developed or graded should be cleared of surface and subsurface deleterious matter including debris, shrubs, trees and associated stumps and roots greater than 1-inch diameter. Graded areas should be stripped of organic materials and topsoil. Based on our explorations and site observations, we estimate that stripping depths will be on the order of 2 to 6 inches to remove topsoil within existing landscape and lawn areas. Greater stripping depths will be needed in more densely vegetated areas and where large tree root systems exist.

The stripped organic soils can be stockpiled and used later for landscaping purposes or may be spread over disturbed areas following completion of grading. If spread out, the organic strippings should be placed in a layer less than 1-foot thick, should not be placed on slopes greater than 3H:1V (horizontal:vertical) and should be track-rolled to a uniformly compacted condition. Materials that cannot be used for landscaping or protection of disturbed areas should be removed from the project site.

4.4.3. Abandoning Utilities

The following recommendations apply to abandoning underground utility pipes at the site prior to vertical construction:

- All utility pipes greater than or equal to 8 inches in diameter and located below building areas may be left in place, provided they are fully grouted.
- All utilities less than 8 inches in diameter and located beneath building areas may be left in place, provided that they are capped and/or plugged with grout.
- Utility structures should be removed, and associated pipes capped/plugged to prevent the movement of groundwater.
- Utility pipes encountered outside of building areas during redevelopment activities should be plugged, capped, or removed to prevent movement of groundwater.

Abandoned utility lines under proposed buildings should be identified during construction and the existing trench backfill should be removed and replaced as follows:

- Utility pipes and existing trench backfill located below planned foundations should be removed entirely and be replaced with structural fill or lean concrete.
- Utility pipes and existing trench backfill located below planned floor slabs should be removed and recompacted to a depth of 3 feet below the bottom of the slab. The excavations should be backfilled with structural fill compacted to at least 95 percent of the MDD per ASTM D 1557 for floor slab areas and foundations designed for a maximum allowable bearing pressure of 3,000 psf.

4.4.4. Earthwork Subgrade Preparation

Prior to placing new fills, pavement base course materials or gravel below on-grade floor slabs, subgrade areas should be proof-rolled to locate any soft or pumping soils. Prior to proof-rolling, all unsuitable soils should be removed from below building footprints and new hardscape areas. Proof-rolling can be completed using a piece of heavy tire-mounted equipment, such as a loaded dump truck. During wet weather, the exposed subgrade areas should be probed to determine the extent of soft soils. If soft or pumping soils are observed, they should be removed and replaced with structural fill.

After completing the proof-rolling, the subgrade areas should be recompacted to a firm and unyielding condition, if possible. The degree of compaction that can be achieved will depend on when the construction is performed. If the work is performed during dry weather conditions, we recommend that all subgrade areas be recompacted to at least 95 percent of the MDD in accordance with the ASTM D 1557 test procedure (modified proctor). If the work is performed during wet weather conditions, it may not be possible to recompact the subgrade to 95 percent of the MDD. In this case, we recommend that the subgrade be compacted to the extent possible without causing undue weaving or pumping of the subgrade soils.

Subgrade disturbance or deterioration could occur if the subgrade is wet and cannot be dried. If the subgrade deteriorates during proof-rolling or compaction, it may become necessary to modify the proof-rolling or compaction criteria or methods.

4.4.4.1. Subgrade Protection

Site soils contain significant fines content (silt/clay) and will be highly sensitive and susceptible to moisture and equipment loads. Once stripping activities are complete, the exposed subgrade soils can deteriorate rapidly in wet weather and under equipment loads.

The contractor should take necessary measures to prevent site subgrade soils from becoming disturbed or unstable. Construction traffic during the wet season should be restricted to specific areas of the site, preferably areas that are protected with a thick gravel layer and are not susceptible to wet weather disturbance.

Protecting the existing soils with a thin layer of crushed rock will not be adequate during the wet season and the subgrade will still deteriorate under equipment loads. The contractor may also consider leaving subgrade areas about 12 inches higher in elevation until subgrade preparation work is ready in order to protect subgrade soils from deterioration.

4.4.5. Structural Fill

All fill, whether existing on-site soils or imported soil, that will support floor slabs, pavement areas or foundations, or be placed in utility trenches are classified as structural fill and should generally meet the criteria for structural fill presented below. The suitability of soil for use as structural fill depends on its gradation and moisture content.

4.4.5.1. Materials

Structural fill material quality varies, depending upon its use, as described below:

- Structural fill placed below foundations, floor slabs or as subbase material below pavement areas should meet the criteria for gravel borrow as described in Section 9-03.14(1) of the 2020 WSDOT Standard Specifications.
- Structural fill placed to raise site grades outside of building areas or to backfill utility trenches should meet the criteria for common borrow as described in Section 9-03.14(3) of the 2020 WSDOT Standard Specifications during dry weather conditions (typically June through September). Common borrow materials are highly moisture sensitive. For wet weather construction (October through May), structural fill placed to raise site grades or in utility trenches should meet the criteria for gravel borrow, as described in Section 9-03.14(1) of the 2020 WSDOT Standard Specifications, except that the fines content (material passing the US No. 200 sieve) should not exceed 5 percent.
- Structural fill placed as crushed surfacing base course (CSBC) below pavements should conform to Section 9 03.9(3) of the 2020 WSDOT Standard Specifications.
- Structural fill placed as capillary break below slabs should consist of 1-inch-minus clean crushed gravel with negligible sand or silt in conformance with Section 9-03.1(4)C, grading No. 67 of the 2020 WSDOT Standard Specifications.

4.4.5.2. Reuse of On-site Soils

Based on the samples collected from our explorations, the moisture content of the native glacial till is typically near the optimum moisture content for compaction. However, the soils are highly moisture sensitive and can be difficult to compact during periods of wet weather or if impacted by groundwater seepage. Therefore, we recommend that they be used as Common Borrow only during periods of extended dry weather from June through September. Soils with significant organic content (above 3 percent) should not be used as structural fill.

The moisture content of the fill soils encountered in our explorations are well above the optimum moisture content for compaction. In addition, the soils contain sufficient organic material and are not suitable for reuse as structural fill.

4.4.6. Fill Placement and Compaction Criteria

Structural fill should be mechanically compacted to a firm, non-yielding condition. Structural fill should be placed in loose lifts not exceeding 12 inches in thickness if using heavy compactors and 6 inches if using hand-operated compaction equipment. The actual lift thickness will be dependent on the structural fill material used and the type and size of compaction equipment. Each lift should be moisture-conditioned to within 2 percent of the optimum moisture content and compacted to the specified density before placing subsequent lifts. Compaction of all structural fill at the site should be in accordance with the ASTM D 1557 (modified proctor) test method. Structural fill should be compacted to the following criteria:

1. Structural fill placed below floor slabs and foundations, and against foundations, should be compacted to at least 95 percent of the MDD.
2. Structural fill in new pavement and hardscape areas, including utility trench backfill, should be compacted to at least 90 percent of the MDD, except that the upper 2 feet of fill below final subgrade should be compacted to at least 95 percent of the MDD, as shown in the Compaction Criteria for Trench Backfill, Figure 3.
3. Structural fill placed as crushed rock base course below pavements should be compacted to 95 percent of the MDD.
4. Non-structural fill, such as fill placed in landscape areas, should be compacted to at least 90 percent of the MDD.

4.4.7. Weather Considerations

The on-site soils and common borrow contain a sufficient percentage of fines (silt and clay) to be highly moisture sensitive. When the moisture content of these soils is more than a few percent above the optimum moisture content, these soils become muddy and unstable, operation of equipment on these soils will be difficult and it will be difficult or impossible to meet the required compaction criteria. Additionally, disturbance of near-surface soils should be expected if earthwork is completed during periods of wet weather. It will be preferable to schedule site preparation and earthwork activities during periods of dry weather when the soils will be less susceptible to disturbance and provide better support for construction equipment.

The wet weather season in the Puget Sound region generally begins in October and continues through May; however, periods of wet weather may occur during any month of the year. The optimum earthwork period for these types of soils is typically June through September. If wet weather earthwork is unavoidable, we recommend the following:

- Structural fill placed during the wet season or during periods of wet weather should consist of imported gravel borrow with less than 5 percent fines (material passing the U.S. No. 200 sieve).
- The ground surface in and around the work area should be sloped so that surface water is directed away from the work area.
- The ground surface should be graded such that areas of ponded water do not develop.

- The contractor should take measures 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 or similar means.
- Measures should be taken to prevent on-site soils and 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 the surficial soils by rolling with a smooth-drum roller prior to periods of precipitation will reduce the extent to which these soils become wet or unstable.
- The contractor should cover all soil stockpiles that will be used as structural fill with plastic sheeting.
- Construction and foot traffic should be restricted to specific areas of the site, preferably areas that are surfaced with 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 practicable.

4.4.8. Utility Trenches

Trench excavation, pipe bedding and trench backfilling should be completed using the general procedures described in the 2020 WSDOT Standard Specifications or other suitable procedures specified by the project civil engineer. The glacial deposits and fill soils encountered at the site are generally of low corrosivity, based on our experience in the Puget Sound area.

Utility trench backfill should consist of structural fill and should be placed in lifts of 12 inches or less (loose thickness) when using heavy compaction equipment or 6 inches or less when using hand-operated equipment, such that adequate compaction can be achieved throughout the lift. Each lift must be compacted prior to placing the subsequent lift. Prior to compaction, the backfill should be moisture-conditioned to within 2 percent of the optimum moisture content, if necessary. The backfill should be compacted in accordance with the criteria discussed above and as shown on Figure 3.

4.4.9. Pavement Subgrade Preparation

We recommend that the subgrade soils in new pavement areas be prepared and evaluated, as described in Sections 4.4.4 and 4.5. In cut areas in medium dense to very dense glacial till, we recommend that the exposed subgrade be proof-rolled. Where existing fill or loose to medium dense native soils exist, we recommend that the upper 12 inches of the existing site soils be compacted to at least 95 percent of the MDD per ASTM D 1557 and then proof-rolled prior to placing pavement section materials. If the subgrade soils are loose or soft, it may be necessary to excavate the soils and replace them with structural fill, gravel borrow or gravel base material. Based on our explorations, the subgrade soils are expected to consist of fill, weathered native soils and relatively unweathered glacial till. Pavement subgrade conditions should be observed and proof-rolled during construction to evaluate the presence of unsuitable subgrade soils and the need for overexcavation.

4.4.10. Excavations

Temporary open cut slopes will likely be used for underground utilities. The stability of open cut slopes is a function of soil type, groundwater seepage, slope inclination, slope height and nearby surface loads.

The use of inadequately designed open cuts could impact the stability of adjacent work areas, existing utilities and endanger personnel.

The contractor performing the work has the primary responsibility for the protection of workers and adjacent improvements. In our opinion, the contractor will be in the best position to observe subsurface conditions continuously throughout the construction process and to respond to variable soil and groundwater conditions. Therefore, the contractor should have the primary responsibility for deciding whether or not to use open cut slopes for much of the excavations rather than some form of temporary excavation support, and for establishing the safe inclination of the cut slope. Acceptable slope inclinations for utilities and ancillary excavations should be determined during construction. Because of the diversity of construction techniques and available shoring systems, the design of temporary shoring is most appropriately left up to the contractor proposing to complete the installation. Temporary cut slopes and shoring must comply with the provisions of Title 296 Washington Administration Code (WAC), Part N, "Excavation, Trenching and Shoring."

4.4.10.1. Temporary Slopes

For planning purposes, temporary unsupported cuts more than 4 feet high may be inclined at 1.5H:1V maximum steepness in the fill and weathered glacial soils. Steeper slopes, up to 1H:1V, are feasible for cuts made in the very dense glacial till. Flatter slopes may be necessary if seepage is present on the face of the cut slopes or if localized sloughing occurs.

The above guidelines assume that surface loads such as traffic, construction equipment, stockpiles or building supplies will be kept away from the top of the cut slopes a sufficient distance so that the stability of the excavation is not affected. We recommend that this distance be at least 5 feet from the top of the cut for temporary cuts made at 1.5H:1V or flatter, and no closer than a distance equal to one half the height of the slope for cuts made at 1H:1V.

Temporary cut slopes should be planned such that they do not encroach on a 1H:1V influence line projected down from the edges of nearby or planned foundation elements.

Water that enters the excavation must be collected and routed away from prepared subgrade areas. We expect that this may be accomplished by installing a system of drainage ditches and sumps along the toe of the cut slopes. Some sloughing and raveling of the cut slopes should be expected. Temporary covering, such as heavy plastic sheeting with appropriate ballast, should be used to protect these slopes during periods of wet weather. Surface water runoff from above cut slopes should be prevented from flowing over the slope face by using berms, drainage ditches, swales or other appropriate methods.

If temporary cut slopes experience excessive sloughing or raveling during construction, it may become necessary to modify the cut slopes to maintain safe working conditions. Slopes experiencing problems can be flattened, regraded to add intermediate slope benches, or additional dewatering can be provided if the poor slope performance is related to groundwater seepage.

4.4.11. Permanent Slopes

We recommend that permanent cut or fill slopes be constructed at inclinations of 2H:1V or flatter. To achieve uniform compaction, we recommend that fill slopes be overbuilt at least 2 feet and subsequently cut back to expose properly compacted fill. Permanent slopes constructed at 3H:1V or flatter provide better conditions for future maintenance.

To reduce erosion, newly constructed slopes should be planted or hydroseeded shortly after completion of grading. Until the vegetation is established, some sloughing and raveling of the slopes should be expected. This may require localized repairs and reseeding. Temporary covering, such as clear heavy plastic sheeting, jute fabric, loose straw or erosion control blankets (such as American Excelsior Curlex 1 or North American Green SC150) could be used to protect the slopes during periods of rainfall.

4.4.12. Sedimentation and Erosion Control

In our opinion, the erosion potential of the on-site soils is low to moderate. Construction activities including stripping and grading will expose soils to the erosion effects of wind and water. The amount and potential impacts of erosion are partly related to the time of year that construction actually occurs. Wet weather construction will increase the amount and extent of erosion and potential sedimentation.

Erosion and sedimentation control measures may be implemented by using a combination of interceptor swales, straw bale barriers, silt fences and straw mulch for temporary erosion protection of exposed soils. All disturbed areas should be finish graded and seeded as soon as practicable to reduce the risk of erosion. Erosion and sedimentation control measures should be installed and maintained in accordance with the requirements of the City of Marysville.

4.5. Pavement Recommendations

4.5.1. Subgrade Preparation

We recommend the subgrade soils in new pavement areas be prepared and evaluated, as described in Section 4.4.4. All new pavement and hardscape areas should be supported on subgrade soils that have been proof-rolled or probed, and approved by the geotechnical engineer. If the exposed subgrade soils are loose or soft, it may be necessary to excavate localized areas and replace them with structural fill or gravel base course. Pavement subgrade conditions should be observed during construction and prior to placing the base course materials in order to evaluate the presence of zones of unsuitable subgrade soils and the need for overexcavation and replacement of these zones.

4.5.2. New Hot-Mix Asphalt Pavement

In light-duty pavement areas (e.g., automobile parking), we recommend a pavement section consisting of at least a 2-inch thickness of ½-inch hot-mix asphalt (HMA) (PG 58-22) per WSDOT Sections 5-04 and 9-03, over a 4-inch thickness of densely compacted crushed rock base course per WSDOT Section 9-03.9(3). In heavy-duty pavement areas (e.g., main access drive), we recommend a pavement section consisting of at least a 3-inch thickness of ½-inch HMA (PG 58-22) over a 6-inch thickness of densely compacted crushed rock base course. The base course should be compacted to at least 95 percent of the MDD (ASTM D 1557). We recommend that a proof-roll of the compacted base course be observed by the geotechnical engineer of record prior to paving. Soft or yielding areas observed during proof-rolling may require overexcavation and replacement with compacted structural fill.

The pavement sections recommended above are based on our experience. Thicker asphalt sections may be needed. based on the City of Marysville requirements or based on actual traffic data.

4.5.3. Asphalt-Treated Base

If pavements are constructed during the wet seasons, consideration may be given to covering the areas to be paved with asphalt-treated base (ATB) for protection. Light-duty pavement areas should be surfaced with at least 3 inches of ATB, and heavy-duty pavement areas should be surfaced with at least 6 inches of ATB. Prior to placement of the final pavement sections, we recommend the ATB surface be evaluated and areas of ATB pavement failure be removed, and the subgrade repaired. If ATB is used and is serviceable when final pavements are constructed, the CSBC can be eliminated, and the design portland cement concrete (PCC) or asphalt concrete pavement thickness can be placed directly over the ATB. The contractor may need to increase the thickness of these recommended ATB sections, based on planned heavy equipment and construction traffic loading.

4.6. Drainage Considerations

The contractor should anticipate shallow perched groundwater conditions may develop and seepage may enter excavations, depending on the time of year construction takes place, especially in the spring and winter months. However, we expect this seepage water can be handled by digging interceptor trenches in the excavations and pumping from sumps. The seepage water if not intercepted and removed from the excavations will make it difficult to place and compact structural fill and may destabilize cut slopes.

All paved and landscaped areas should be graded so surface drainage is directed away from the buildings to appropriate catch basins.

Water collected in roof downspout lines must not discharge into or be routed to the perforated pipes intended for footing or wall drainage.

4.7. Infiltration Considerations

Based on our analysis, it is our opinion that the on-site native glacial soils have a very low infiltration capacity. The majority of the soils across the site are composed of glacially consolidated, dense glacial till with a relatively high fines content, which limits the infiltration capacity. The results of laboratory testing consisting of percent fines tests indicated that the fines content (material passing the U.S. No. 200 sieve) typically ranges from about 14 to 34 percent. Due to the density of the native glacial soils and relatively high fines content, infiltration should be assumed to be very low when designing infiltration systems. We recommend a preliminary long-term design infiltration rate of not more than 0.2 inches per hour be used for design of the infiltration facilities in the native glacial soils.

If infiltration facilities will be used for this project, we recommend that in-situ testing, such as pilot infiltration tests (PIT), be completed in accordance with the governing jurisdictional requirements to more accurately determine the infiltration capacity of the soil.

5.0 RECOMMENDED ADDITIONAL GEOTECHNICAL SERVICES

Throughout this report, recommendations are provided where we consider additional geotechnical services to be appropriate. These additional services are summarized below:

- GeoEngineers should be retained to provide additional recommendations for design of stormwater infiltration facilities, including performing pilot infiltration testing, if infiltration is being considered at the site.
- GeoEngineers should be retained to review the project plans and specifications when complete to confirm that our design recommendations have been implemented as intended.

- During construction, GeoEngineers should observe and evaluate the suitability of foundation subgrades, observe removal of unsuitable soils, evaluate the suitability of floor slab and pavement subgrades, observe installation of subsurface drainage measures including footing drains, observe and test structural backfill including trench backfill, and provide a summary letter of our construction observation services. The purposes of GeoEngineers construction phase services are to confirm that the subsurface conditions are consistent with those observed in the explorations and other reasons described in Appendix C, Report Limitations and Guidelines for Use.

6.0 LIMITATIONS

We have prepared this report for the exclusive use of Sunnyside Village Cohousing, Urban Evolution, and their authorized agents for the planned Sunnyside Village Cohousing project in Marysville, Washington. The data and report should be provided to prospective contractors for the bidding or estimating purposes, but our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

Please refer to Appendix C for additional information pertaining to use of this report.

7.0 REFERENCES

ASCE 7-16, 2016, “Minimum design loads for buildings and other structures.”

International Code Council, “International Building Code,” 2018.

United States Geological Survey map of the Marysville quadrangle, Snohomish County, Washington, 1985.

United States Geological Survey Seismic Design Web Service Documentation accessed via: https://earthquake.usgs.gov/ws/designmaps/

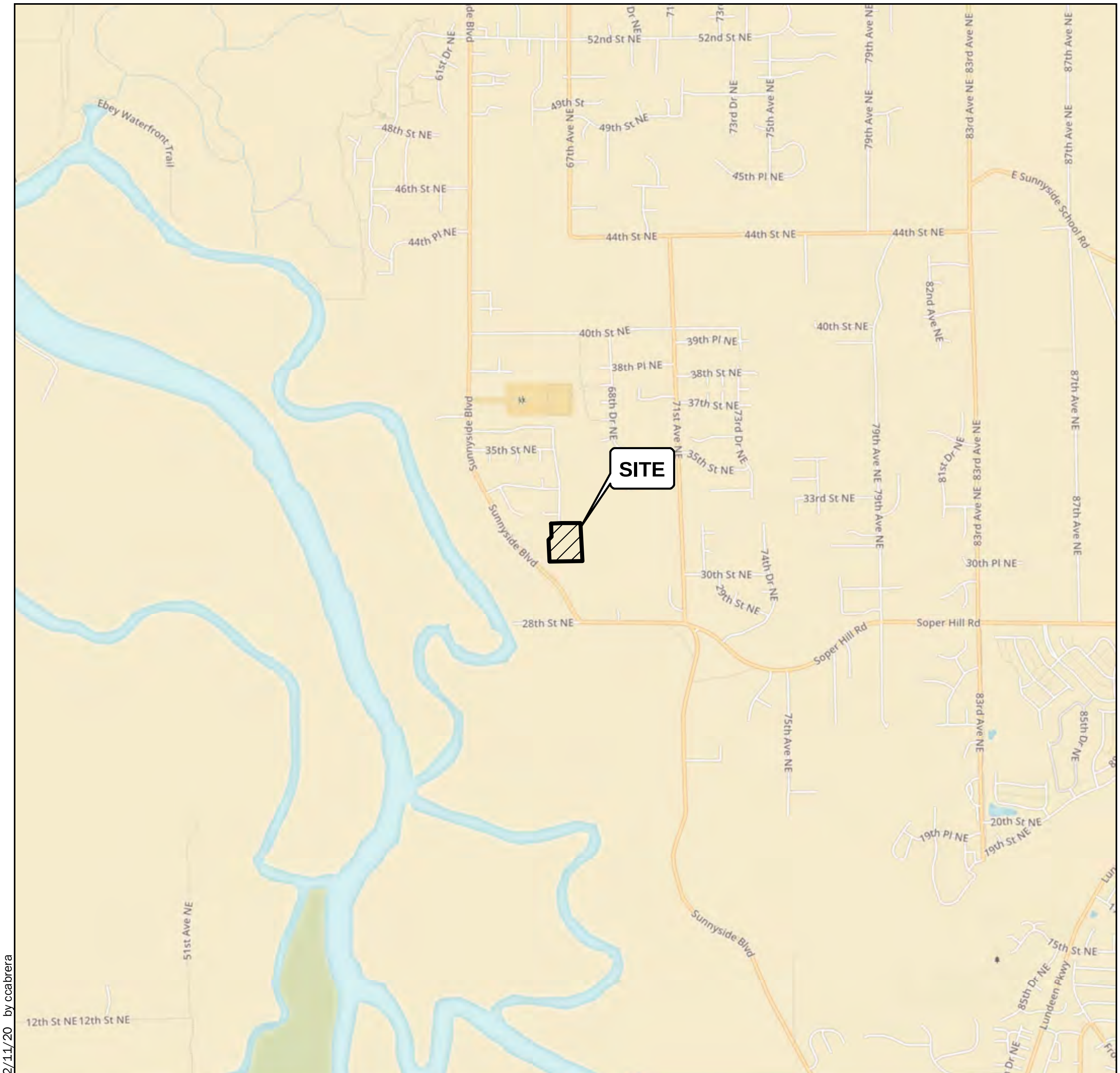
Washington Administration Code, “Title 296, Chapter 296-155, Part N, “Excavation, Trenching and Shoring,” April 2016.

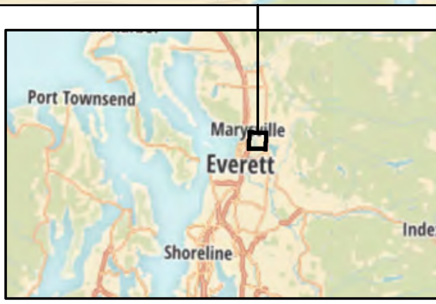
Washington State Department of Ecology, “Stormwater Management in Western Washington, Volume III, Hydrologic Analysis and Flow Control Design/BMPs,” December 2014.

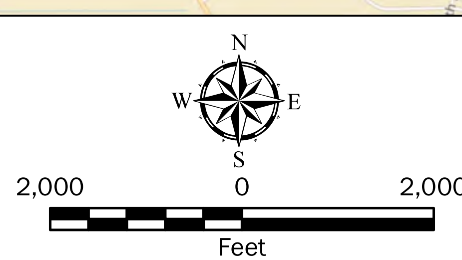
Washington State Department of Transportation, “Standard Specifications for Road, Bridge and Municipal Construction,” 2020.

FIGURES

GeoEngineers







Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 10N

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Vicinity Map

Sunnyside Village Cohousing
Marysville, Washington

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Figure 1

Legend

TP-1 Test Pit by GeoEngineers, Inc., 2020

HA-1 Hand Augur by GeoEngineers, Inc., 2020

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Survey from Metron and Associates dated November 2019.

Projection: NAD83 Washington State Planes, North Zone, US Foot

Site Plan

Sunnyside Village Cohousing
Marysville, Washington

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Figure 2

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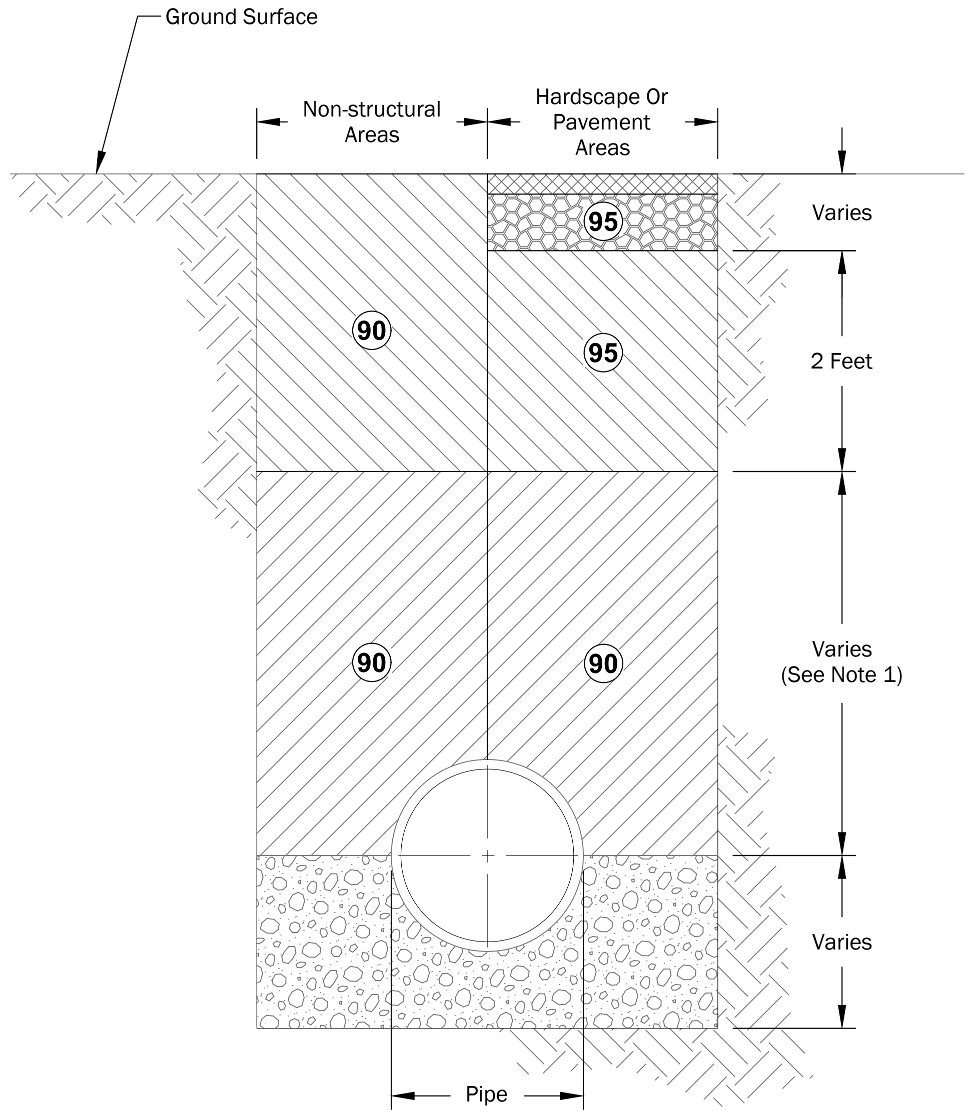

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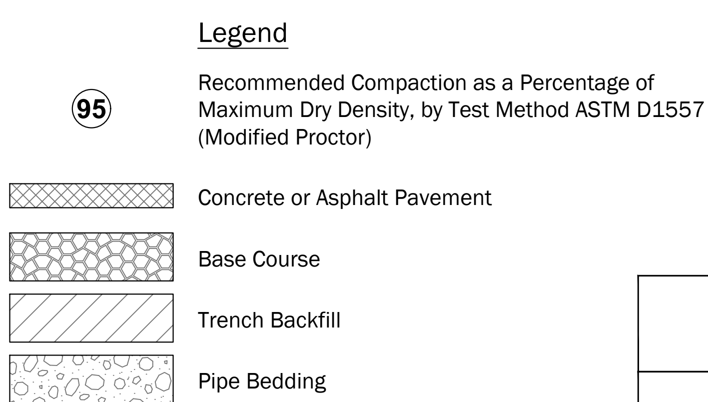

Notes:

1. All backfill under building areas should be compacted to at least 95 percent per ASTM D1557.

Compaction Criteria for Trench Backfill

Sunnyside Village Cohousing
Marysville, Washington

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Figure 3

APPENDICES

APPENDIX A
Field Explorations

APPENDIX A
FIELD EXPLORATIONS

Subsurface soil and groundwater conditions were explored by excavating 11 test pits (TP-1 through TP-11) and completing one hand auger (HA-1) on January 27, 2020. The test pits were completed to depths ranging from 3 to 6.5 feet below existing grades. The hand auger was completed to a depth of 2.5 feet.

Test Pits

The test pits were completed using a rubber tire-mounted Komatsu WB 140 backhoe owned and operated by Kelly's Excavating under subcontract to GeoEngineers. The test pit locations were determined in the field using a hand-held GPS. The approximate test pit locations are shown on Figure 2. The test pits were continuously monitored by a geotechnical engineer from our firm who reviewed and classified the soils encountered, obtained representative soil samples, observed groundwater conditions and prepared a detailed log of each exploration. Disturbed samples of representative soil types were obtained from the excavator bucket at representative depths before probing the bottom of the pit with a ½-inch-diameter steel probe rod to provide a measure of the relative density of granular soils and the relative consistency of cohesive soils. Soils encountered in the test pits were classified in the field in general accordance with ASTM International (ASTM) D 2488, the Standard Practice for Classification of Soils, Visual-Manual Procedure, which is summarized in Figure A-1, Key to Exploration Logs. Logs of the test pits are provided in Figures A-2 through A-12.

Hand Augers

A hand auger was continuously monitored by a geotechnical engineer from our firm who reviewed and classified the soils encountered, obtained representative soil samples and observed groundwater conditions. The hand auger location was determined in the field using a hand-held GPS and the approximate location is shown on Figure 2. The soils encountered were generally sampled at 1-foot vertical intervals with a 3-inch inside-diameter, manually-operated hand auger. Soils encountered were visually classified in general accordance with the classification system described in Figure A-1. A key to the hand auger log symbols is also presented in Figure A-1. A log of the hand auger is presented in Figure A-13.

The exploration logs are based on our interpretation of the field and laboratory data and indicate the various types of soils and groundwater conditions encountered. The logs also indicate the depths at which these soils or their characteristics change, although the change may actually be gradual.

Observations of groundwater conditions were made during the explorations. The groundwater conditions encountered during the explorations are presented on the exploration logs. Groundwater conditions observed during excavations represent a short-term condition and may or may not be representative of the long-term groundwater conditions at the site. Groundwater conditions observed during the explorations should be considered approximate.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	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
- 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

SYMBOLS GRAPH	SYMBOLS LETTER	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 load test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined 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

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Figure A-1

Date Excavated	1/27/2020	Total Depth (ft)	6.5	Logged By	NBD	Excavator	Kelly's Excavating	See "Remarks" section for groundwater observed
				Checked By	YNAN	Equipment	Komatsu WB T40 Backhoe	See "Remarks" section for caving observed

Surface Elevation (ft)	110	Easting (X)	1320218	Coordinate System	WA State Plane North
Vertical Datum	NAVD88	Northing (Y)	376686	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Sample Name / Testing	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
110	0		SOD	2 inches sod			Probe Depth = 3 to 5 inches
		1 / MC	SM	Brown silty fine to medium sand with occasional gravel, small roots (loose to medium dense, moist) (fill)	31		
109	1	2 / %F	SM	Brown silty fine to medium sand with gravel, small roots (loose to medium dense, moist to wet)	36	31	
108	2	3	SM	Brown-gray silty fine to medium sand with gravel and occasional small roots (medium dense to dense, moist to wet) (weathered glacial till)			Moderate groundwater seepage observed at 20 inches, approximately 1 gpm Probe Depth = 3 to 4 inches Probe Depth = 1 to 2 inches
107	3	4	ML	Gray brown sandy silt with gravel and occasional cobbles (very stiff, moist to wet) (glacial till)			Mild to moderate caving observed at 1½ to 2 feet Probe Depth = 1 to 2 inches
106	4	5	SM	Silty fine to coarse sand with gravel (medium dense, moist)			Probe Depth = 2 to 3 inches
105	5						
			SM	Gray silty fine to medium sand with gravel and occasional cobbles (dense, moist)			Probe Depth = 1 to 2 inches
104	6	6 / MC			10		

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-1

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-2
Sheet 1 of 1

Date Excavated	1/27/2020	Total Depth (ft)	4	Logged By	NBD	Excavator	Kelly's Excavating	See "Remarks" section for groundwater observed
				Checked By	YNAN	Equipment	Komatsu WB T40 Backhoe	See "Remarks" section for caving observed

Surface Elevation (ft)	110	Easting (X)	1320397	Coordinate System	WA State Plane North
Vertical Datum	NAVD88	Northing (Y)	376678	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				SOD	2 inches sod			
			1 / MC		ML	Dark brown sandy silt with gravel, small roots (medium stiff to stiff, moist) (fill)	29		Probe Depth = 3 to 4 inches Probe Depth = 4 to 5 inches
109	1		2		SM	Dark brown silty fine to medium sand with occasional gravel, small roots (medium dense, moist to wet)			
108	2								Moderate groundwater seepage observed at 2 and 2½ feet, approximately 1 to 2 gpm; moderate caving observed at 2 to 2½ feet Probe Depth = 3 to 4 inches
107	3		3 / %F		SM	Gray silty fine to medium sand with gravel and occasional cobbles (dense, moist) (glacial till)	11	30	Probe Depth = 1 to 2 inches
106	4								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-2

GEOENGINEERS

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-3
Sheet 1 of 1

Date Excavated	1/27/2020	Total Depth (ft)	3	Logged By	NBD	Excavator	Kelly's Excavating	See "Remarks" section for groundwater observed
				Checked By	YNAN	Equipment	Komatsu WB T40 Backhoe	See "Remarks" section for caving observed

Surface Elevation (ft)	108	Easting (X)	1320282	Coordinate System	WA State Plane North
Vertical Datum	NAVD88	Northing (Y)	376583	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	1 to 2 inches sod			
			1 MC		ML	Dark brown sandy silt, small roots (soft to medium stiff, wet) (fill)	48		Probe Depth = 5 to 7 inches
107	1								Probe Depth = 4 to 5 inches
			2 MC		SM	Brown silty fine to medium sand with gravel, small roots (loose to medium dense, moist to wet)	26		Moderate groundwater seepage observed at 1½ to 2 feet, approximately 1 gpm; moderate caving observed at 1½ to 2 feet
106	2				SM	Gray silty fine to medium sand, moderate oxidation stains (medium dense, moist) (weathered glacial till)			Probe Depth = 2 to 4 inches
			3						
105	3								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-3

GEOENGINEERS

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Date Excavated	1/27/2020	Total Depth (ft)	3.5	Logged By	NBD	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	YNAN	Equipment	Komatsu WB T40 Backhoe	Caving not observed

Surface Elevation (ft)	104	Easting (X)	1320128	Coordinate System	WA State Plane North
Vertical Datum	NAVD88	Northing (Y)	376487	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 inches sod			Probe Depth = 3 to 5 inches
			1		SM	Dark brown silty fine to medium sand, small roots (loose to medium dense, moist) (fill)			
103	1								Probe Depth3 to 5 inches
102	2		2 %F				41	31	Probe Depth = 2 to 3 inches
					SM	Gray silty fine to medium sand with gravel and cobbles (dense, moist) (glacial till)			
101	3		3 MC				10		Probe Depth = 1 to 2 inches; denser soil at 3 feet bgs

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-4

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Date:12/23/20 Path:\\GEOENGINEERS.COM\WAN\PROJECTS\24\24145001\GINT\2414500100.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_TESTPIT_1P_GEOTEC_%F

Date Excavated	1/27/2020	Total Depth (ft)	3.5	Logged By NBD Checked By YNAN	Excavator: Kelly's Excavating Equipment: Komatsu WB T40 Backhoe	See "Remarks" section for groundwater observed See "Remarks" section for caving observed	

Surface Elevation (ft) Vertical Datum	104 NAVD88	Easting (X) Northing (Y)	1320230 376484	Coordinate System Horizontal Datum	WA State Plane North NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 inches sod			Probe Depth = 4 to 5 inches
			1 / MC		SM	Dark brown silty fine to medium sand with occasional gravel, small roots (loose to medium dense, moist to wet) (fill)	41		
103	1								Probe Depth = 3 to 4 inches; Moderate groundwater seepage observed at 1 to 2¼ feet, approximately 1 to 1½ gpm; Slight to moderate caving observed at 1 to 2¼ feet
102	2		2 / MC		SM	Gray silty fine to medium sand with gravel and occasional cobbles (dense to very dense, moist to wet) (glacial till)	26		Probe Depth = 2 to 3 inches
			3 / MC				14		
101	3								Probe Depth = 1 inch

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-5

GEOENGINEERS

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-6
Sheet 1 of 1

Date Excavated	1/27/2020	Total Depth (ft)	3	Logged By	NBD	Excavator	Kelly's Excavating	See "Remarks" section for groundwater observed
				Checked By	YNAN	Equipment	Komatsu WB T40 Backhoe	See "Remarks" section for caving observed

Surface Elevation (ft)	106	Easting (X)	1320403	Coordinate System	WA State Plane North
Vertical Datum	NAVD88	Northing (Y)	376508	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
			1 MC		SM	Dark brown silty fine sand with gravel and cobbles, small roots (loose to medium dense, moist) (fill)	20		Probe Depth = 4 to 5 inches
105	1				ML	Brown sandy silt with occasional gravel, small roots (medium stiff to stiff, moist)			Probe Depth = 4 to 5 inches Moderate groundwater seepage observed at 1½ to 2 feet, approximately 1½ gpm; moderate caving observed at 1½ to 2 feet
104	2		2 3 MC		SM	Gray silty fine to medium sand with occasional gravel (medium dense to dense, moist) (glacial till)	12		Probe Depth = 2 to 3 inches Probe Depth = 1 to 3 inches
103	3								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-6

GEOENGINEERS

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Date Excavated	1/27/2020	Total Depth (ft)	3.25	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe	See "Remarks" section for groundwater observed See "Remarks" section for caving observed

Surface Elevation (ft)	103	Easting (X)	1320505	Coordinate System	WA State Plane North
Vertical Datum	NAVD88	Northing (Y)	376483	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 inches sod			Probe Depth = 3 to 4 inches
			1		ML	Dark brown sandy silt with occasional gravel and cobbles, small roots (stiff, moist) (fill)			
102	1				SM	Brown silty fine to medium sand, small roots (medium dense, moist)			Probe Depth = 3 to 4 inches Slight to moderate groundwater seepage observed at 1 to 2½ feet, approximately 1 gpm; slight to moderate caving observed at 1 to 2½ feet
101	2		2 %F				16	14	Probe Depth = 2 to 3 inches
100	3		3 MC		SM	Gray-brown silty fine to coarse sand with occasional gravel, moderate oxidation staining (medium dense, moist) (weathered glacial till)	14		Probe Depth = 2 to 3 inches

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-7

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Date Excavated	1/27/2020	Total Depth (ft)	4	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe
					See "Remarks" section for groundwater observed See "Remarks" section for caving observed

Surface Elevation (ft) 101 Vertical Datum NAVD88	Easting (X) 1320095 Northing (Y) 376371	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				SOD	1 to 2 inches sod			Probe Depth = 2 to 4 inches
			1 MC		SM	Dark brown silty fine to medium sand with gravel, small roots (medium dense, moist) (fill)	22		
			2 MC		SM	Brown silty fine to medium sand with gravel, occasional small roots (medium dense to dense, moist)	21		
100	1								Probe Depth = 2 to 4 inches
99	2								Probe Depth = 1 to 3 inches Perched groundwater observed at 2 feet
98	3		3		SM	Gray silty fine to medium sand with gravel and cobbles (very dense, moist) (glacial till)			Probe Depth <1 inch
97	4								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-8

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Date Excavated	1/27/2020	Total Depth (ft)	3.75	Logged By NBD Checked By YNAN	Excavator: Kelly's Excavating Equipment: Komatsu WB T40 Backhoe	See "Remarks" section for groundwater observed See "Remarks" section for caving observed

Surface Elevation (ft)	100	Easting (X)	1320253	Coordinate System	WA State Plane North
Vertical Datum	NAVD88	Northing (Y)	376322	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 to 3 inches sod			
			1 MC		ML	Dark brown sandy silt with occasional gravel, small roots (soft to medium stiff, moist) (fill)	49		
99	1				ML	Brown sandy silt, occasional small roots (medium stiff to stiff, wet)			
98	2		2 MC				47		Moderate groundwater seepage observed at 2 to 3 feet, approximately 2 gpm; moderate to severe caving observed at 2 to 3 feet
97	3		3 %F		SM	Gray silty fine to medium sand with occasional gravel, moderate oxidation stains (medium dense to dense, moist) (weathered glacial till)	16	34	

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-9

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-10
Sheet 1 of 1

Date Excavated 1/27/2020	Total Depth (ft) 3.5	Logged By NBD Checked By YNAN	Excavator Kelly's Excavating Equipment Komatsu WB T40 Backhoe	See "Remarks" section for groundwater observed See "Remarks" section for caving observed

Surface Elevation (ft) 101 Vertical Datum NAVD88	Easting (X) 1320358 Northing (Y) 376326	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	2 inches sod			Probe Depth = 3 to 4 inches
			1 / MC		SM	Dark brown silty fine to medium sand with gravel, small roots (medium dense, moist) (fill)	18		
100	1				ML	Brown sandy silt with gravel (stiff, moist to wet)			Probe Depth = 3 to 4 inches
			2 / MC				21		Moderate groundwater seepage observed at 1½ to 2½ feet, approximately 1 to 2 gpm
99	2								Probe Depth = 2 to 4 inches Moderate caving observed at 2 to 2½ feet
			3		SM	Gray silty fine to medium sand with occasional gravel (dense, moist) (glacial till)			
98	3								Probe Depth = 1 to 2 inches

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-10

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Date Excavated	1/27/2020	Total Depth (ft)	3.5	Logged By	NBD	Excavator	Kelly's Excavating	See "Remarks" section for groundwater observed
				Checked By	YNAN	Equipment	Komatsu WB T40 Backhoe	Caving not observed

Surface Elevation (ft)	100	Easting (X)	1320494	Coordinate System	WA State Plane North
Vertical Datum	NAVD88	Northing (Y)	376317	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
			1 MC		ML	Dark brown sandy silt with occasional gravel, small roots (soft to medium stiff, moist) (fill)			Probe Depth = 5 to 8 inches
					ML	Brown sandy silt with gravel, wood debris (medium stiff to stiff, moist)			
99	1		2 MC				44		Probe Depth = 3 to 5 inches Slight groundwater seepage observed at 1 foot, approximately ½ gpm
98	2				SM	Gray silty fine to medium sand with gravel (dense, moist) (glacial till)			Probe Depth = 1 to 2 inches
			3 %F				38		
97	3								

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Test Pit TP-11

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Date Excavated	1/27/2020	Total Depth (ft)	2.5	Logged By	NBD	Excavator	GeoEngineers	Groundwater not observed
				Checked By	YNAN	Equipment	Hand Auger	See "Remarks" section for caving observed

Surface Elevation (ft)	100	Easting (X)	1320162	Coordinate System	WA State Plane North
Vertical Datum	NAVD88	Northing (Y)	376341	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	1 to 2 inches sod			
					ML	Dark brown sandy silt with occasional gravel, small roots (soft, wet) (fill)			
			1						
99	1								
			2						Caving in borehole
98	2								

Practical refusal at 2½ feet bgs

Notes: See Figure A-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Boring HA-1

GeoEngineers

Project: Sunnyside Village Cohousing
Project Location: Marysville, Washington
Project Number: 24145-001-00

Figure A-13
Sheet 1 of 1

APPENDIX B
Laboratory Testing

APPENDIX B
LABORATORY TESTING

Soil samples obtained from the explorations were visually classified in the field and/or in our laboratory using a system based on the Unified Soils Classification System (USCS) and ASTM International (ASTM) classification methods. ASTM test method D 2488 was used to visually classify the soil samples, while ASTM D 2487 was used to classify the soils based on laboratory tests results. These classification procedures are incorporated in the exploration logs shown in Figures A-2 through A-13.

Moisture Content Testing

Moisture content tests were completed in general accordance with ASTM D 2216 for representative samples obtained from the explorations. The results of these tests are presented on the exploration logs in Appendix A at the depths at which the samples were obtained.

Percent Passing the U.S. No. 200 Sieve

Selected samples were "washed" through the U.S. No. 200 mesh sieve to determine the relative percentage of coarse- and fine-grained particles in the soil. The percent passing value represents the percentage by weight of the sample finer than the U.S. No. 200 sieve. These tests were conducted in general accordance with ASTM D 1140, and the results are shown on the exploration logs at the representative sample depths.

APPENDIX C
Report Limitations and Guidelines for Use

APPENDIX C
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 use by Sunnyside Village Cohousing, Urban Evolution, and their authorized agents. 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 our agreement with Sunnyside Village Cohousing 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 Sunnyside Village Cohousing project in Marysville, 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.

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

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

- The function of the proposed structure;
- 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.

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.

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

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.

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, test pit 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.

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