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10. Geotechnical Report

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Real-World Geotechnical Solutions
Investigation • Design • Construction Support

Preliminary Geotechnical Engineering Report

Project Information:	Camas Valley Estates GeoPacific Project No. 21-5741 March 8, 2021
Site Location:	22630 NE 28th Street Camas, Washington 98607 Clark County Property No. 173157000
Client:	Lennar Northwest 11807 NE 99th Street, Suite 1179 Vancouver, Washington 98682 Phone: (360) 258-7889

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1.0 PROJECT INFORMATION

This report presents the results of a geotechnical engineering study conducted by GeoPacific Engineering, Inc. (GeoPacific) for the above-referenced project. The purpose of our investigation was to evaluate subsurface conditions at the site, assess potential geologic hazards at the property, and to provide geotechnical recommendations for site development. This geotechnical study was performed in accordance with GeoPacific Proposal No. P-7651, dated February 19, 2021, and your subsequent authorization of our proposal and *General Conditions for Geotechnical Services*.

2.0 SITE AND PROJECT DESCRIPTION

As indicated on Figures 1 through 3 the subject site is located at 22630 NE 28th Street in Camas, Washington, and consists of Clark County Property No. 173157000. The property is approximately 38.23-acres in size. The site is bordered by NE 28th Street to the south, by Green Mountain to the north, and by existing residential properties to the east, and west. The site latitude and longitude are 45.645846, -122.438997, and the legal description is the NE ¼ of Section 21, T2N, R3E, Willamette Meridian. Topography at the site is relatively level to moderately sloping to the south with site elevations ranging from approximately 318 to 484 feet above mean sea level (amsl). Site gradients range from approximately 0 to 25 percent with the steepest areas being located in the northern portion of the property. An existing home with detached barns and sheds is present in the western-central portion of the property, accessed via a gravel drive located along the western margin of the site extending from NE 28th Street. Vegetation at the site ranges from open grassy areas to areas overgrown with blackberries, and some trees around the margins of the site. The site has been regularly mowed and may have been used for agricultural purposes in the past.

As shown on Figure 3, GeoPacific understands that development at the site will consist of a 116-Lot residential subdivision supporting construction of single-family homes, construction of new public streets, stormwater facilities, and installation of new underground utilities. We anticipate that the homes will be constructed with typical spread foundations and wood framing, with maximum structural loading on column footings and continuous strip footings on the order of 10 to 35 kips, and 2 to 4 kips respectively. We anticipate maximum cuts and fills will be on the order of ten feet.

3.0 REGIONAL GEOLOGIC SETTING AND LANDSLIDE MAPPING

Regionally, the subject site lies within the Willamette Valley/Puget Sound lowland, a broad structural depression situated between the Coast Range on the west and the Cascade Range on the east. A series of discontinuous faults subdivide the Willamette Valley into a mosaic of fault-bounded, structural blocks (Yeats et al., 1996). Uplifted structural blocks form bedrock highlands, while down-warped structural blocks form sedimentary basins. The *Geologic Map of the Lacamas Creek Quadrangle, Clark County, Washington, (*U.S. Department of the Interior, U.S. Geological Survey, 1998, Russell C. Evarts, 2006*)*, indicates that the northern portion of the site located on Green Mountain is underlain by late Miocene to earth Pliocene-aged massive to crudely stratified, pebbly and cobbly conglomerate with sparse to abundant lenses of friable to lithified, arkosic to basaltic sandstone, typically referred to as the Troutdale Formation (Ttfc). The geologic map indicates that the southern portion of the site is underlain by early Pleistocene-aged unconsolidated to semi-consolidated, thick-bedded, pebble to boulder conglomerate with matrix of volcanic lithic to micaceous, quartzo-feldspathic sand (QTc). Clasts are largely comprised of volcanic rocks eroded from the western Cascade Range and the Columbia River Basalt group.

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4.0 REGIONAL SEISMIC SETTING

At least four major fault zones capable of generating damaging earthquakes are thought to exist in the vicinity of the subject site. These include the Lacamas Creek/Sandy River Fault Zone, the Portland Hills Fault Zone, the Gales Creek-Newberg-Mt. Angel Structural Zone, and the Cascadia Subduction Zone.

4.1 Lacamas Creek / Sandy River Fault Zone

The Lacamas Creek Fault intersects the northeast trending Sandy River Fault north of Camas, Washington at Lacamas Lake, approximately 1 mile south of the subject site. The fault trace lies approximately 0.25 miles west of the site. The Lacamas Creek Fault extends northwest to southeast, intersecting the northeast, southwest trending Sandy River Fault. According to the USGS Earthquake Hazards Program the fault has been mapped as a normal fault with down-to-the-southwest displacement and has also been described as a steeply northeast or southwest-dipping, oblique, right-lateral, slip-fault. The trace of the Lacamas Lake fault is marked by the very linear lower reach of Lacamas Creek. No fault scarps on Quaternary surficial deposits have been described. The Lacamas Lake fault offsets Pliocene-aged sedimentary conglomerates generally identified as the Troutdale formation, and Pliocene to Pleistocene aged basalts generally identified as the Boring Lava formation. Recent seismic reflection data across the probable trace of the fault under the Columbia River yielded no unequivocal evidence of displacement underlying the Missoula flood deposits, however, recorded mild seismic activity during the recent past indicates this area may be potentially seismogenic.

4.2 Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that include the central Portland Hills Fault, the western Oatfield Fault, and the eastern East Bank Fault. These faults occur in a northwest-trending zone that varies in width between 3.5 and 5.0 miles. The combined three faults reportedly vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years) sediment (Madin, 1990). The Portland Hills Fault occurs along the Willamette River at the base of the Portland Hills, and is located approximately 15 miles southwest of the site. The Oatfield Fault occurs along the western side of the Portland Hills, and is located approximately 17 miles southwest of the site. The East Bank Fault occurs along the eastern margin of the Willamette River, and is located approximately 12. miles southwest of the site. The accuracy of the fault mapping is stated to be within 500 meters (Wong, et al., 2000).

According to the USGS Earthquake Hazards Program, the fault was originally mapped as a down-to-the-northeast normal fault, but has also been mapped as part of a regional-scale zone of right-lateral, oblique slip faults, and as a steep escarpment caused by asymmetrical folding above a south-west dipping, blind thrust fault. The Portland Hills fault offsets Miocene Columbia River Basalts, and Miocene to Pliocene sedimentary rocks of the Troutdale Formation. No fault scarps on surficial Quaternary deposits have been described along the fault trace, and the fault is mapped as buried by the Pleistocene aged Missoula flood deposits. No historical seismicity is correlated with the mapped portion of the Portland Hills Fault Zone, but in 1991 a M3.5 earthquake occurred on a NW-trending shear plane located 1.3 miles east of the fault (Yelin, 1992). Although there is no definitive evidence of recent activity, the Portland Hills Fault Zone is assumed to be potentially active (Geomatrix Consultants, 1995).

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4.3 Gales Creek-Newberg-Mt. Angel Structural Zone

The Gales Creek-Newberg-Mt. Angel Structural Zone is a 50-mile-long zone of discontinuous, NW-trending faults that lies about 35 miles southwest of the subject site. These faults are recognized in the subsurface by vertical separation of the Columbia River Basalt and offset seismic reflectors in the overlying basin sediment (Yeats et al., 1996; Werner et al., 1992). A geologic reconnaissance and photogeologic analysis study conducted for the Scoggins Dam site in the Tualatin Basin revealed no evidence of deformed geomorphic surfaces along the structural zone (Unruh et al., 1994). No seismicity has been recorded on the Gales Creek Fault or Newberg Fault (the fault closest to the subject site); however, these faults are considered to be potentially active because they may connect with the seismically active Mount Angel Fault and the rupture plane of the 1993 M5.6 Scotts Mills earthquake (Werner et al. 1992; Geomatrix Consultants, 1995).

According to the USGS Earthquake Hazards Program, the Mount Angel fault is mapped as a high-angle, reverse-oblique fault, which offsets Miocene rocks of the Columbia River Basalts, and Miocene and Pliocene sedimentary rocks. The fault appears to have controlled emplacement of the Frenchman Spring Member of the Wanapum Basalts, and thus must have a history that predates the Miocene age of these rocks. No unequivocal evidence of deformation of Quaternary deposits has been described, but a thick sequence of sediments deposited by the Missoula floods covers much of the southern part of the fault trace.

4.4 Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year (Goldfinger et al., 1996). A growing body of geologic evidence suggests that prehistoric subduction zone earthquakes have occurred (Atwater, 1992; Carver, 1992; Peterson et al., 1993; Geomatrix Consultants, 1995). This evidence includes: (1) buried tidal marshes recording episodic, sudden subsidence along the coast of northern California, Oregon, and Washington, (2) burial of subsided tidal marshes by tsunami wave deposits, (3) paleoliquefaction features, and (4) geodetic uplift patterns on the Oregon coast. Radiocarbon dates on buried tidal marshes indicate a recurrence interval for major subduction zone earthquakes of 250 to 650 years with the last event occurring 300 years ago (Atwater, 1992; Carver, 1992; Peterson et al., 1993; Geomatrix Consultants, 1995). The inferred seismogenic portion of the plate interface lies approximately along the Oregon Coast at depths of between 20 and 40 kilometers below the surface.

5.0 FIELD EXPLORATION AND SUBSURFACE CONDITIONS

Our subsurface explorations for this report were conducted on March 2, 2021. A total of ten test pits (TP-1 through TP-10) were excavated at the site using a New Holland 11-88, rubber-tracked excavator to a maximum depth of 13 feet bgs. Explorations were conducted under the full-time observation of a GeoPacific geologist. During the explorations pertinent information including soil sample depths, stratigraphy, soil engineering characteristics, and groundwater occurrence was recorded. Soils were classified in accordance with the Unified Soil Classification System (USCS). Soil samples obtained from the explorations were placed in relatively air-tight plastic bags. At the completion of each test, the test pits were loosely backfilled with onsite soils. The approximate locations of the explorations are indicated on Figures 2 and 3.

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It should be noted that exploration locations were located in the field by pacing or taping distances from apparent property corners and other site features shown on the plans provided. As such, the locations of the explorations should be considered approximate. Summary exploration logs are attached. The stratigraphic contacts shown on the individual test pit logs represent the approximate boundaries between soil types. The actual transitions may be more gradual. The soil and groundwater conditions depicted are only for the specific dates and locations reported, and therefore, are not necessarily representative of other locations and times. Soil and groundwater conditions encountered in the explorations are summarized below.

5.1 Soil Descriptions

Topsoil: Vegetation at the site typically consists of grassy vegetation and blackberry growth. Sparse trees are present along the property margins. The topsoil horizon typically ranged from approximately 6 to 8 inches in grassy areas, and up to 14 inches where blackberries are present, consisting of dark brown or red brown, organic, Lean CLAY (OL-CL), containing fine roots. The depth of organic soils will increase where trees are present.

Lean CLAY (CL): Below the topsoil within our test pits, soils typically consisted of light brown, brown, or red brown, medium stiff to stiff, very moist to wet, low to moderately plastic, Lean CLAY (CL) containing varying degrees of subrounded gravel to cobble-sized rock. The soil type was found to be present in varying thicknesses and extending to varying depths across the site.

Clayey SAND (SC): At the locations of test pits TP-1 and TP-2, brown, orange, gray, and light gray, medium dense, very moist to wet, low plasticity, Clayey SAND layers were encountered below the Lean CLAY soil type at depths ranging from approximately 4.5 to 7 feet and extending to approximate depths of 9 to 10 feet bgs.

Clayey GRAVEL (GC): At the locations of test pits TP-4, and TP-5, brown to gray, medium dense, very moist to wet, low plasticity, Clayey GRAVEL containing subrounded gravel to cobble-sized rock was encountered below the Lean CLAY soil type at depths ranging from approximately 4 to 7 feet and extending to the maximum depth of exploration.

5.2 Shrink-Swell Potential

Low to moderately plasticity fine-grained and coarse-grained soils were encountered near the ground surface within subsurface explorations conducted at the site. Based upon the results of our soils laboratory testing and our local experience with the soil layers in the vicinity of the subject site, the plasticity of the soils is low, and the shrink-swell potential of the soil types is considered to be low. Special design measures are not considered necessary to minimize the risk of uncontrolled damage of foundations as a result of potential soil expansion at this site.

5.3 Groundwater and Soil Moisture

On March 2, 2021 observed soil moisture conditions were generally very moist to wet. Shallow perched groundwater seepage was observed within test pits TP-1, TP-2, TP-4, TP-5, TP-7, and TP-10 at depths ranging from approximately 5 to 10 feet below the existing ground surface. Moderately flowing static groundwater seepage was observed at a depth of approximately 7 feet within test pit TP-9. It is anticipated that groundwater conditions will vary depending on the season,

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local subsurface conditions, changes in site utilization, and other factors. Perched groundwater may be encountered in localized areas. Seeps and springs may exist in areas not explored and may become evident during site grading.

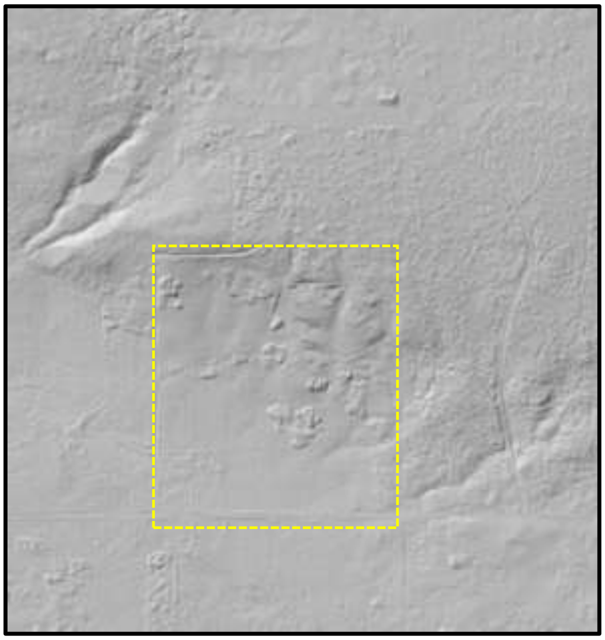
6.0 PRELIMINARY STEEP SLOPE ASSESSMENT

We reviewed available topographic data, LiDAR imagery, and geologic mapping, and Clark County Hazard mapping regarding potential geologic hazards associated with steep slope areas at the site. Based on our review we understand that Clark County geologic hazard mapping indicates that the site contains gradients ranging from level to maximum of 25 percent. The steepest portions of the site are located in the northern portion of the property. Gradients decrease rapidly to the south, with the approximate southern half of the property being relatively level or under 5 percent grade.

For the purpose of conducting a preliminary assessment of potential geologic hazards associated with development on or near a steep slope area GeoPacific (1) reviewed of available literature and published geologic mapping; (2) reviewed available LiDAR and landslide inventory mapping; (3) conducted field reconnaissance and slope measurements, and (4) conducted shallow subsurface exploration at the property consisting of excavator test pits. Quantitative slope stability modelling, detailed landslide investigation is beyond the scope of this preliminary study. Based on our review of the available public literature, no landslides have been identified to be present within or adjacent to the property boundaries.

6.1 LiDAR Review

Published regional geologic mapping and the Washington State Department of Natural Resources online LiDAR database show no mapped landslides at the subject site. We reviewed available LiDAR imagery of the site which indicates relatively smooth, topography for the majority of the subject site. The imagery does not indicate hummocky terrain or other typical features generally associated with the presence of a landslide. The subject site is located within the yellow square in the LiDAR imagery shown below.



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6.2 Field Reconnaissance Subsurface Exploration

A GeoPacific engineering geologist conducted field reconnaissance during our site investigation to observe geomorphic features and surficial soil conditions, and to assess the development area for evidence of potential slope instability. We did not observe geomorphic evidence of recent slope instability such as exposed terrace scarps, or areas of recent erosion. No tension cracks, slumping, or areas of recent landsliding were observed. Vegetation appeared to be native and undisturbed on the slope. The trees were observed to be large and growing with straight trunks. In general, the site displayed relatively smooth, even topography consistent with stable slope conditions.

We conducted subsurface exploration at the site consisting of ten excavator test pits. See Figures 2 and 3 for the approximate subsurface exploration locations, and the attached test pit logs for detail. Native soils encountered within our subsurface explorations consisted of stiff clayey soil types, or medium dense clayey gravels. Geologic mapping indicates the presence of conglomeritic bedrock at depth. No evidence of slip planes or bedding planes was detected or observed during subsurface exploration. Light groundwater seepage observed within some of our subsurface explorations which extended to a maximum depth of 13 feet bgs. In general, the results of our field reconnaissance and subsurface exploration indicated stable soil conditions within the proposed development area.

7.0 PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Our site investigation indicates that the proposed construction appears to be geotechnically feasible, provided that the recommendations of this report are incorporated into the design and construction phases of the project. The primary geotechnical concerns associated with site development are:

- A grading plan review should be conducted by GeoPacific when site planning is completed, and the findings and conclusions presented in this report should be updated to reflect the proposed final grades.
- Shallow perched groundwater was observed in some of the test pits and may be encountered in subsurface explorations during the wet season. Based on our observations we anticipate the observed groundwater seepage to be reduced during dry summer months, however the contractor should be prepared to utilize typical dewatering methods in trenches.
- Keyways, keying, and benching will be required for engineered fill placed in portions of the site where slopes exceed 15 percent. At this time a grading plan is not available. The earthworks contractor should work closely with GeoPacific during construction to properly locate and construct keyways for engineered fill slopes.

7.1 Site Preparation Recommendations

Areas of proposed construction and areas to receive fill should be cleared of any organic and inorganic debris, and loose stockpiled soils. Inorganic debris and organic materials from clearing should be removed from the site. Organic-rich soils and root zones should then be stripped from construction areas of the site or where engineered fill is to be placed. Depth of stripping of existing organic topsoil is estimated to be approximately 8 to 14 inches at the site and will be deepest where trees are present. Following removal of topsoil and undocumented fill soils, the existing ground surface should be aerated, scarified and recompacted in areas proposed for placement of engineered fill and structures.

The final depth of soil removal should be determined by the geotechnical engineer or designated representative during site inspection while stripping/excavation is being performed. Stripped topsoil should be removed from areas proposed for placement of engineered fill and structures. Any remaining topsoil should be stockpiled only in designated areas and stripping operations should be observed and documented by the geotechnical engineer or his representative.

Where encountered, undocumented fills and any subsurface structures (dry wells, basements, driveway and landscaping fill, old utility lines, septic leach fields, etc.) should be completely removed and the excavations backfilled with engineered fill. Some of the undocumented fill soil may be suitable for re-use as engineered fill.

Site earthwork may be impacted by wet weather conditions. Stabilization of subgrade soils may require aeration and re-compaction. If subgrade soils are found to be difficult to stabilize, over-excavation, placement of granular soils, or cement treatment of subgrade soils may be feasible options. GeoPacific should be onsite to observe preparation of subgrade soil conditions prior to placement of engineered fill.

7.2 Keyways, Benching, and Subdrains for Fill Slopes

Keying and benching will be required on this project where engineered fills are proposed on hillsides. Engineered fill placed on existing sloped areas inclining at, or steeper than an approximately fifteen percent grade should be constructed on a keyway and benches in accordance with the typical designs shown in the attached Fill Slope Detail (Figure 4). Keyways should have a minimum depth of three feet on the downhill size, and a minimum width of ten feet. Keyways should be excavated at the toe of the fill slope and extend perpendicular to the downslope direction. Additional removal of weakened or soft soils may be required depending on the conditions observed during construction. Benches and keyways should be roughly horizontal in the down slope direction, by may slope up to a 10 percent grade along a topographic contour. Keyways sloping more than a fifteen percent grade along a topographic contour should be benched or configured as approved by the geotechnical engineer or his designated representative. Actual determination and dimensions of keyways should be decided once final planning is complete, and under the direction of the geotechnical engineer.

If groundwater seepage is observed during excavation, keyways should include a subdrain consisting of a minimum 4-inch-diameter, ADS Heavy Duty Grade (or equivalent), perforated plastic pipe enveloped in a minimum of 4 cubic feet per lineal foot of 2”- ½”, open-graded gravel drain rock wrapped with geotextile filter fabric (Mirafi 140N or equivalent). A minimum 0.5 percent gradient should be maintained throughout all subdrain pipes and outlets. GeoPacific should inspect keyways, subdrains and benching prior to fill placement. Subdrains may be eliminated at the discretion of the geotechnical engineer.

7.3 Engineered Fill

We understand that cuts and fills are proposed on the order of 10 feet maximum, however a site grading plan has not yet been prepared for this project. Where incorporated into the project, all grading for the proposed construction should be performed as engineered grading in accordance with the applicable building code at the time of construction with the exceptions and additions noted herein. Site grading should be conducted in accordance with the requirements outlined in the 2018

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International Building Code (IBC), and Chapter 18 and Appendix J. Areas proposed for fill placement should be prepared as described in Section 6.1, *Site Preparation Recommendations,* and Section 6.2, *Keyways, Benching, and Subdrains for Fill Slopes*. Surface soils should be aerated, scarified and recompacted prior to placement of structural fill. Site preparation, soil stripping, and grading activities should be observed and documented by a geotechnical engineer or his representative. Proper test frequency and earthwork documentation usually requires daily observation and testing during stripping, rough grading, and placement of engineered fill.

Onsite native soils appear to be suitable for use as engineered fill. Soils containing greater than 5 percent organic content should not be used as structural fill. Imported fill material must be approved by the geotechnical engineer prior to being imported to the site. Oversize material greater than 6 inches in size should not be used within 3 feet of foundation footings, and material greater than 12 inches in diameter should not be used in engineered fill.

Engineered fill should be compacted in horizontal lifts not exceeding 12 inches using standard compaction equipment. We recommend that engineered fill be compacted to at least 95 percent of the maximum dry density determined by ASTM D698 (Standard Proctor) or equivalent. Soils should be moisture conditioned to within two percent of optimum moisture. Field density testing should conform to ASTM D2922 and D3017, or D1556. All engineered fill should be observed and tested by the project geotechnical engineer or his representative. Typically, one density test is performed for at least every 2 vertical feet of fill placed or every 500 yd^3, whichever requires more testing. Because testing is performed on an on-call basis, we recommend that the earthwork contractor be held contractually responsible for test scheduling and frequency.

Site earthwork may be impacted by shallow groundwater, soil moisture and wet weather conditions. Earthwork in wet weather would likely require extensive use of additional crushed aggregate, cement or lime treatment, or other special measures, at considerable additional cost compared to earthwork performed under dry-weather conditions.

7.4 Excavating Conditions and Utility Trench Backfill

We anticipate that onsite soils can generally be excavated using conventional heavy equipment. Bedrock was not encountered within subsurface explorations which extended to a maximum depth of approximately 13 feet bgs. Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. Actual slope inclinations at the time of construction should be determined based on safety requirements and actual soil and groundwater conditions. All temporary cuts in excess of 4 feet in height should be sloped in accordance with U.S. Occupational Safety and Health Administration (OSHA) regulations (29 CFR Part 1926) or be shored. The existing native soils to a depth of approximately 13 feet bgs classify as Type B Soil and temporary excavation side slope inclinations as steep as 1H:1V may be assumed for planning purposes. These cut slope inclinations are applicable to excavations above the water table only.

Shallow, perched groundwater may be encountered at the site and should be anticipated in excavations and utility trenches. Vibrations created by traffic and construction equipment may cause some caving and raveling of excavation walls. In such an event, lateral support for the excavation walls should be provided by the contractor to prevent loss of ground support and possible distress to existing or previously constructed structural improvements.

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Underground utility pipes should be installed in accordance with the procedures specified in ASTM D2321 and City of Camas standards. We recommend that structural trench backfill be compacted to at least 95 percent of the maximum dry density obtained by the Modified Proctor (ASTM D1557, AASHTO T-180) or equivalent. Initial backfill lift thicknesses for a ¾”-0 crushed aggregate base may need to be as great as 4 feet to reduce the risk of flattening underlying flexible pipe. Subsequent lift thickness should not exceed 1 foot. If imported granular fill material is used, then the lifts for large vibrating plate-compaction equipment (e.g. hoe compactor attachments) may be up to 2 feet, provided that proper compaction is being achieved and each lift is tested. Use of large vibrating compaction equipment should be carefully monitored near existing structures and improvements due to the potential for vibration-induced damage.

Adequate density testing should be performed during construction to verify that the recommended relative compaction is achieved. Typically, at least one density test is taken for every 4 vertical feet of backfill on each 100-lineal-foot section of trench.

7.5 Erosion Control Considerations

During our field exploration program, we did not observe soil and topographic conditions which are considered highly susceptible to erosion. In our opinion, the primary concern regarding erosion potential will occur during construction in areas that have been stripped of vegetation. Erosion at the site during construction can be minimized by implementing the project erosion control plan, which should include judicious use of straw waddles, fiber rolls, and silt fences. If used, these erosion control devices should remain in place throughout site preparation and construction.

Erosion and sedimentation of exposed soils can also be minimized by quickly re-vegetating exposed areas of soil, and by staging construction such that large areas of the project site are not denuded and exposed at the same time. Areas of exposed soil requiring immediate and/or temporary protection against exposure should be covered with either mulch or erosion control netting/blankets. Areas of exposed soil requiring permanent stabilization should be seeded with an approved grass seed mixture, or hydroseeded with an approved seed-mulch-fertilizer mixture.

7.6 Wet Weather Earthwork

Soils underlying the site are likely to be moisture sensitive and will be difficult to handle or traverse with construction equipment during periods of wet weather. Earthwork is typically most economical when performed under dry weather conditions. Earthwork performed during the wet-weather season will require expensive measures such as cement treatment or imported granular material to compact areas where fill may be proposed to the recommended engineering specifications. If earthwork is to be performed or fill is to be placed in wet weather or under wet conditions when soil moisture content is difficult to control, the following recommendations should be incorporated into the contract specifications.

- Earthwork should be performed in small areas to minimize exposure to wet weather. Excavation or the removal of unsuitable soils should be followed promptly by the placement and compaction of clean engineered fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance. Under some circumstances, it may be necessary to excavate soils with a backhoe to minimize subgrade disturbance caused by equipment traffic;

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- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water;
- Material used as engineered fill should consist of clean, granular soil containing less than 5 percent passing the No. 200 sieve. The fines should be non-plastic. Alternatively, cement treatment of on-site soils may be performed to facilitate wet weather placement;
- The ground surface within the construction area should be sealed by a smooth drum vibratory roller, or equivalent, and under no circumstances should be left uncompacted and exposed to moisture. Soils which become too wet for compaction should be removed and replaced with clean granular materials;
- Excavation and placement of fill should be observed by the geotechnical engineer to verify that all unsuitable materials are removed and suitable compaction and site drainage is achieved; and
- Geotextile silt fences, straw waddles, and fiber rolls should be strategically located to control erosion.

If cement or lime treatment is used to facilitate wet weather construction, GeoPacific should be contacted to provide additional recommendations and field monitoring.

7.7 Spread Foundations

As shown on Figure 3, GeoPacific understands that development at the site will consist of a 116-Lot residential subdivision supporting construction of single-family homes. We anticipate that the homes will be constructed with typical spread foundations and wood framing, with maximum structural loading on column footings and continuous strip footings on the order of 10 to 35 kips, and 2 to 4 kips respectively. We anticipate maximum cuts and fills will be on the order of ten feet.

The proposed structures may be supported on shallow foundations bearing on stiff, native soils and/or engineered fill, appropriately designed and constructed as recommended in this report. Foundation design, construction, and setback requirements should conform to the applicable building code at the time of construction. For maximization of bearing strength and protection against frost heave, spread footings should be embedded at a minimum depth of 12 inches below exterior grade. If soft soil conditions are encountered at footing subgrade elevation, they should be removed and replaced with compacted crushed aggregate.

The anticipated allowable soil bearing pressure is 1,500 lbs/ft^2 for footings bearing on competent, native soil and/or engineered fill. The recommended maximum allowable bearing pressure may be increased by 1/3 for short-term transient conditions such as wind and seismic loading. For loads heavier than 35 kips, the geotechnical engineer should be consulted. If heavier loads than described above are proposed, it may be necessary to over-excavate point load areas and replace with additional compacted crushed aggregate to achieve a higher allowable bearing capacity. The coefficient of friction between on-site soil and poured-in-place concrete may be taken as 0.42, which includes no factor of safety. The maximum anticipated total and differential footing movements (generally from soil expansion and/or settlement) are 1 inch and ¾ inch over a span of 20 feet, respectively. We anticipate that the majority of the estimated settlement will occur during construction, as loads are applied. Excavations near structural footings should not extend within a 1H:1V plane projected downward from the bottom edge of footings.

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Footing excavations should penetrate through topsoil and any disturbed soil to competent subgrade that is suitable for bearing support. All footing excavations should be trimmed neat, and all loose or softened soil should be removed from the excavation bottom prior to placing reinforcing steel bars. Due to the moisture sensitivity of on-site native soils, foundations constructed during the wet weather season may require over-excavation of footings and backfill with compacted, crushed aggregate.

Our recommendations are for residential construction incorporating raised wood floors and conventional spread footing foundations. After site development, a Final Soil Engineer's Report should either confirm or modify the above recommendations.

7.8 Concrete Slabs-on-Grade

Preparation of areas beneath concrete slab-on-grade floors should be performed as described in Section 6.1, *Site Preparation Recommendations* and Section 6.7, *Spread Foundations*. Care should be taken during excavation for foundations and floor slabs, to avoid disturbing subgrade soils. If subgrade soils have been adversely impacted by wet weather or otherwise disturbed, the surficial soils should be scarified to a minimum depth of 8 inches, moisture conditioned to within about 3 percent of optimum moisture content and compacted to engineered fill specifications. Alternatively, disturbed soils may be removed and the removal zone backfilled with additional crushed rock.

For evaluation of the concrete slab-on-grade floors using the beam on elastic foundation method, a modulus of subgrade reaction of 150 kcf (87 pci) should be assumed for the stiff, fine -grained soils anticipated to be present at foundation subgrade elevation following adequate site preparation as described above. This value assumes the concrete slab system is designed and constructed as recommended herein, with a minimum thickness of 8 inches of 1½"-0 crushed aggregate beneath the slab. The total thickness of crushed aggregate will be dependent on the subgrade conditions at the time of construction and should be verified visually by proof-rolling. Under-slab aggregate should be compacted to at least 95 percent of its maximum dry density as determined by ASTM D1557 (Modified Proctor) or equivalent.

In areas where moisture will be detrimental to floor coverings or equipment inside the proposed structure, appropriate vapor barrier and damp-proofing measures should be implemented. A commonly applied vapor barrier system consists of a 10-mil polyethylene vapor barrier placed directly over the capillary break material. Other damp/vapor barrier systems may also be feasible. Appropriate design professionals should be consulted regarding vapor barrier and damp proofing systems, ventilation, building material selection and mold prevention issues, which are outside GeoPacific's area of expertise.

7.9 Footing and Roof Drains

Construction should include typical measures for controlling subsurface water beneath the structure, including positive crawlspace drainage to an adequate low-point drain exiting the foundation, visqueen covering the expose ground in the crawlspace, and crawlspace ventilation (foundation vents). The client should be informed and educated that some slow flowing water in the crawlspaces is considered normal and not necessarily detrimental to the home given these other design elements incorporated into its construction. Appropriate design professionals should be consulting regarding

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crawlspace ventilation, building material selection and mold prevention issues, which are outside GeoPacific's area of expertise.

Down spouts and roof drains should collect roof water in a system separate from the footing drains to reduce the potential for clogging. Roof drain water should be directed to an appropriate discharge point and storm system well away from structural foundations. Grades should be sloped downward and away from buildings to reduce the potential for ponded water near structures. If the proposed structure will have a raised floor, and no concrete slab-on-grade floors are used, perimeter footing drains may be eliminated at the discretion of the geotechnical engineer based on soil conditions encountered at the site and experience with standard local construction practices. Where it is desired to reduce the potential for moist crawl spaces, footing drains may be installed.

If concrete slab-on-grade floors are used in living spaces, perimeter footing drains should be installed as recommended below. Concrete slab-on-grade garage floors are not considered living spaces and would not require perimeter footing drains unless the geotechnical engineer or builder deems it necessary.

Where necessary, perimeter footing drains should consist of 3 or 4-inch diameter, perforated plastic pipe embedded in a minimum of 1 ft^3 per lineal foot of clean, free-draining drain rock. The drain pipe and surrounding drain rock should be wrapped in non-woven geotextile (Mirafi 140N, or approved equivalent) to minimize the potential for clogging and/or ground loss due to piping. A minimum 0.5 percent fall should be maintained throughout the drain and non-perforated pipe outlet. Figure 5 presents a typical perimeter footing drain detail. In our opinion, footing drains may outlet at the curb, or on the back sides of lots where sufficient fall is not available to allow drainage to meet the street.

7.10 Permanent Below-Grade Walls

Lateral earth pressures against below-grade retaining walls will depend upon the inclination of any adjacent slopes, type of backfill, degree of wall restraint, method of backfill placement, degree of backfill compaction, drainage provisions, and magnitude and location of any adjacent surcharge loads. At-rest soil pressure is exerted on a retaining wall when it is restrained against rotation. In contrast, active soil pressure will be exerted on a wall if its top is allowed to rotate or yield a distance of roughly 0.001 times its height or greater.

If the subject retaining walls will be free to rotate at the top, they should be designed for an active earth pressure equivalent to that generated by a fluid weighing 35 pcf for level backfill against the wall. For restrained wall, an at-rest equivalent fluid pressure of 52 pcf should be used in design, again assuming level backfill against the wall. These values assume that the recommended drainage provisions are incorporated, and hydrostatic pressures are not allowed to develop against the wall.

During a seismic event, lateral earth pressures acting on below-grade structural walls will increase by an incremental amount that corresponds to the earthquake loading. Based on the Mononobe-Okabe equation and peak horizontal accelerations appropriate for the site location, seismic loading should be modeled using the active or at-rest earth pressures recommended above, plus an incremental rectangular-shaped seismic load of magnitude 6.5H, where H is the total height of the wall.

Exhibit 9

We assume relatively level ground surface below the base of the walls. As such, we recommend a passive earth pressure of 320 pcf for use in design, assuming wall footings are cast against competent native soils or engineered fill. If the ground surface slopes down and away from the base of any of the walls, a lower passive earth pressure should be used and GeoPacific should be contacted for additional recommendations.

A coefficient of friction of 0.42 may be assumed along the interface between the base of the wall footing and subgrade soils. The recommended coefficient of friction and passive earth pressure values do not include a safety factor, and an appropriate safety factor should be included in design. The upper 12 inches of soil should be neglected in passive pressure computations unless it is protected by pavement or slabs on grade.

The above recommendations for lateral earth pressures assume that the backfill behind the subsurface walls will consist of properly compacted structural fill, and no adjacent surcharge loading. If the walls will be subjected to the influence of surcharge loading within a horizontal distance equal to or less than the height of the wall, the walls should be designed for the additional horizontal pressure. For uniform surcharge pressures, a uniformly distributed lateral pressure of 0.3 times the surcharge pressure should be added. Traffic surcharges may be estimated using an additional vertical load of 250 psf (2 feet of additional fill), in accordance with local practice.

The recommended equivalent fluid densities assume a free-draining condition behind the walls so that hydrostatic pressures do not build-up. This can be accomplished by placing a 12 to 18-inch wide zone of sand and gravel containing less than 5 percent passing the No. 200 sieve against the walls. A 3-inch minimum diameter perforated, plastic drain-pipe should be installed at the base of the walls and connected to a suitable discharge point to remove water in this zone of sand and gravel. The drain-pipe should be wrapped in filter fabric (Mirafi 140N or other as approved by the geotechnical engineer) to minimize clogging.

Wall drains are recommended to prevent detrimental effects of surface water runoff on foundations – not to dewater groundwater. Drains should not be expected to eliminate all potential sources of water entering a basement or beneath a slab-on-grade. An adequate grade to a low point outlet drain in the crawlspace is required by code. Underslab drains are sometimes added beneath the slab when placed over soils of low permeability and shallow, perched groundwater.

Water collected from the wall drains should be directed into the local storm drain system or other suitable outlet. A minimum 0.5 percent fall should be maintained throughout the drain and non-perforated pipe outlet. Down spouts and roof drains should not be connected to the wall drains in order to reduce the potential for clogging. The drains should include clean-outs to allow periodic maintenance and inspection. Grades around the proposed structure should be sloped such that surface water drains away from the building.

GeoPacific should be contacted during construction to verify subgrade strength in wall keyway excavations, to verify that backslope soils are in accordance with our assumptions, and to take density tests on the wall backfill materials.

Exhibit 9

Structures should be located a horizontal distance of at least 1.5H away from the back of the retaining wall, where H is the total height of the wall. GeoPacific should be contacted for additional foundation recommendations where structures are located closer than 1.5H to the top of any wall.

8.0 SEISMIC DESIGN

Available geologic data indicates that the site is in an area where *very strong* ground shaking is anticipated during an earthquake. Structures should be designed to resist earthquake loading in accordance with the methodology described in the 2015 International Building Code (IBC) with applicable State of Washington Building Code revisions (current 2015). We recommend Site Class C be used for design as defined in ASCE 7-16, Chapter 20, and Table 20.3-1. Design values determined for the site using the ATC Hazards by Location 2021 Seismic Design Maps Summary Report are summarized in Table 1 and are based upon observed existing soil conditions.

Table 1: Recommended Earthquake Ground Motion Parameters (ASCE-7-16)

Parameter	Value
Location (Lat, Long), degrees	45.645, -122.439
Probabilistic Ground Motion Values, 2% Probability of Exceedance in 50 yrs	
Peak Ground Acceleration PGA_M	0.423 g
Short Period, S_s	0.787 g
1.0 Sec Period, S_1	0.348 g
Soil Factors for Site Class C:	
F_a	1.2
F_v	1.5
$SD_s = 2/3 \times F_a \times S_s$	0.63 g
$SD_1 = 2/3 \times F_v \times S_1$	0.348 g
Seismic Design Category	D

8.1 Soil Liquefaction

Soil liquefaction is a phenomenon wherein saturated soil deposits temporarily lose strength and behave as a liquid in response to ground shaking caused by strong earthquakes. Soil liquefaction is generally limited to loose, sands and granular soils located below the water table, and fine-grained soils with a plasticity index less than 15. According to *Clark County Maps Online*, the site is mapped as *very low* susceptibility for liquefaction. Based upon the results of our study, it is our opinion that the risk of soil liquefaction during a seismic event at the subject site should be considered to be low.

Exhibit 9

9.0 UNCERTAINTIES AND LIMITATIONS

We have prepared this report for the owner and their consultants for use in design of this project only. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. Experience has shown that soil and groundwater conditions can vary significantly over small distances. Inconsistent conditions can occur between explorations that may not be detected by a geotechnical study. If, during future site operations, subsurface conditions are encountered which vary appreciably from those described herein, GeoPacific should be notified for review of the recommendations of this report, and revision of such if necessary.

Sufficient geotechnical monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations. The checklist attached to this report outlines recommended geotechnical observations and testing for the project. Recommendations for design changes will be provided should conditions revealed during construction differ from those anticipated, and to verify that the geotechnical aspects of construction comply with the contract plans and specifications.

Within the limitations of scope, schedule and budget, GeoPacific attempted to execute these services in accordance with generally accepted professional principles and practices in the fields of geotechnical engineering and engineering geology at the time the report was prepared. No warranty, expressed or implied, is made. The scope of our work did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous or toxic substances in the soil, surface water, or groundwater at this site.

We appreciate this opportunity to be of service.

Sincerely,

GEOPACIFIC ENGINEERING, INC.

2978
BENJAMIN L COOK
3/5/2021

27177
Exp.3-31-22

Benjamin L. Cook, L.G.
Associate Geologist

James D. Imbrie, P.E.
Principal Geotechnical Engineer

Exhibit 9

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Exhibit 9

CHECKLIST OF RECOMMENDED GEOTECHNICAL TESTING AND OBSERVATION

Item No.	Procedure	Timing	By Whom	Done
1	Preconstruction meeting	Prior to beginning site work	Contractor, Developer, Civil and Geotechnical Engineers	
2	Fill removal from site or sorting and stockpiling	Prior to mass stripping	Soil Technician/ Geotechnical Engineer	
3	Stripping, aeration, and root-picking operations	During stripping	Soil Technician	
4	Compaction testing of engineered fill (95% of Standard Proctor)	During filling, tested every 2 vertical feet	Soil Technician	
5	Foundation Subgrade Compaction (95% of Modified Proctor)	During Foundation Preparation, Prior to Placement of Reinforcing Steel	Soil Technician/ Geotechnical Engineer	
6	Compaction testing of trench backfill (95% of Modified Proctor)	During backfilling, tested every 4 vertical feet for every 200 linear feet	Soil Technician	
7	Street Subgrade Inspection (95% of Standard Proctor)	Prior to placing base course	Soil Technician	
8	Base course compaction (95% of Modified Proctor)	Prior to paving, tested every 200 linear feet	Soil Technician	
9	Asphalt Compaction (92% Rice Value)	During paving, tested every 100 linear feet	Soil Technician	
10	Final Geotechnical Engineer's Report	Completion of project	Geotechnical Engineer	

Exhibit 9

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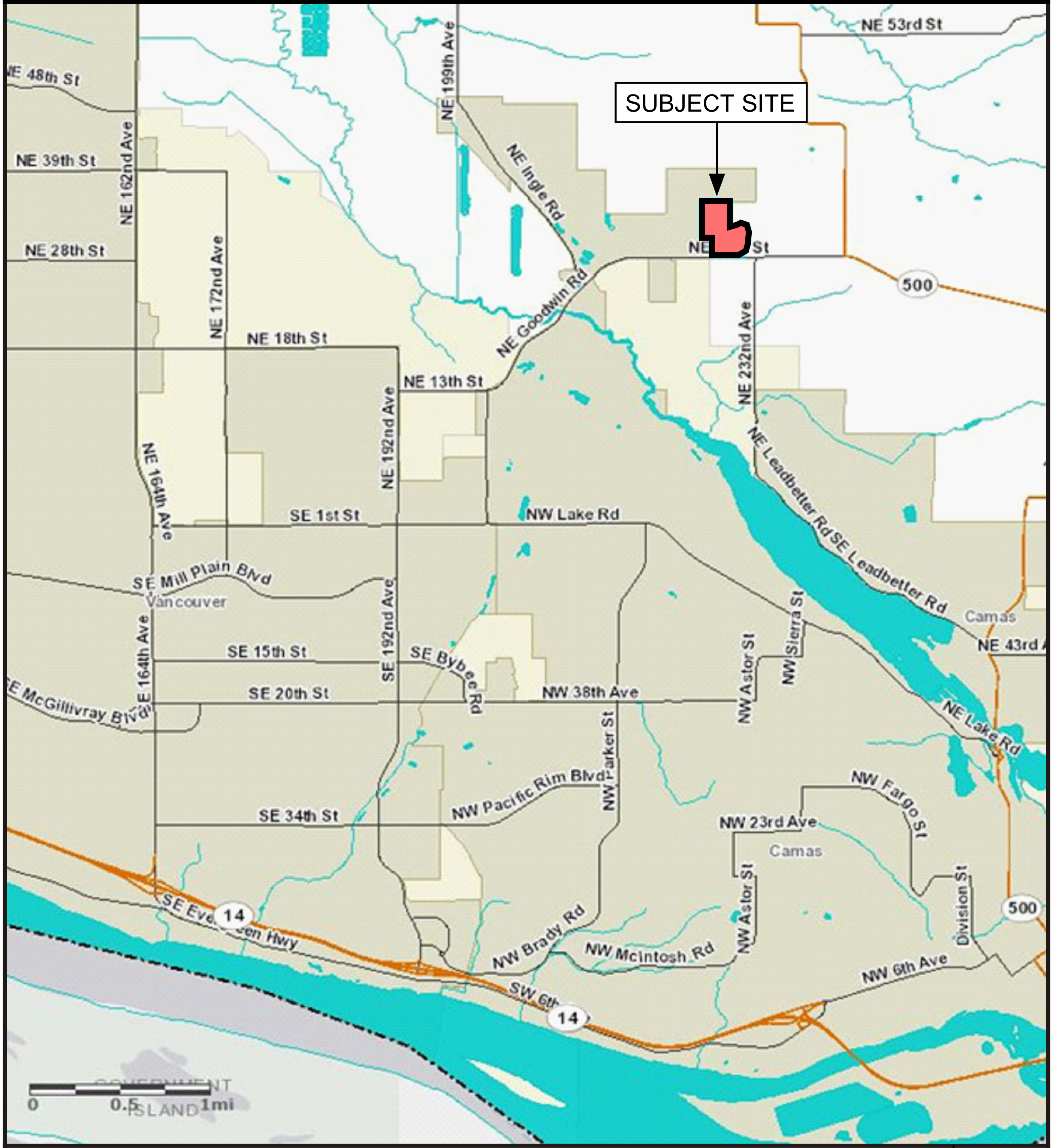
FIGURES

Exhibit 9

GeoPacific Engineering, Inc.

14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

SITE VICINITY MAP



Base Map: Clark Count Maps Online, 2021
Date: 3/4/2021
Drawn by: BLC

North

Project: Camas Valley Estates
22630 NE 28th Street
Camas, Washington 98607

Project No. 21-5741

FIGURE 1

Exhibit 9

GeoPacific Engineering, Inc.

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SITE AERIAL AND EXPLORATION LOCATIONS

Legend: Base Map Obtained From Google Earth 2021

TP-1
▨ Test Pit Exploration Designation and Approximate Location

APPROXIMATE SCALE
(FEET)
150 0 150 300

Drawn by: BLC
Date: 3/4/2021

North

Project: Camas Valley Estates
22630 NE 28th Street
Camas, Washington 98607

Project No. 21-5741

FIGURE 2

Exhibit 9

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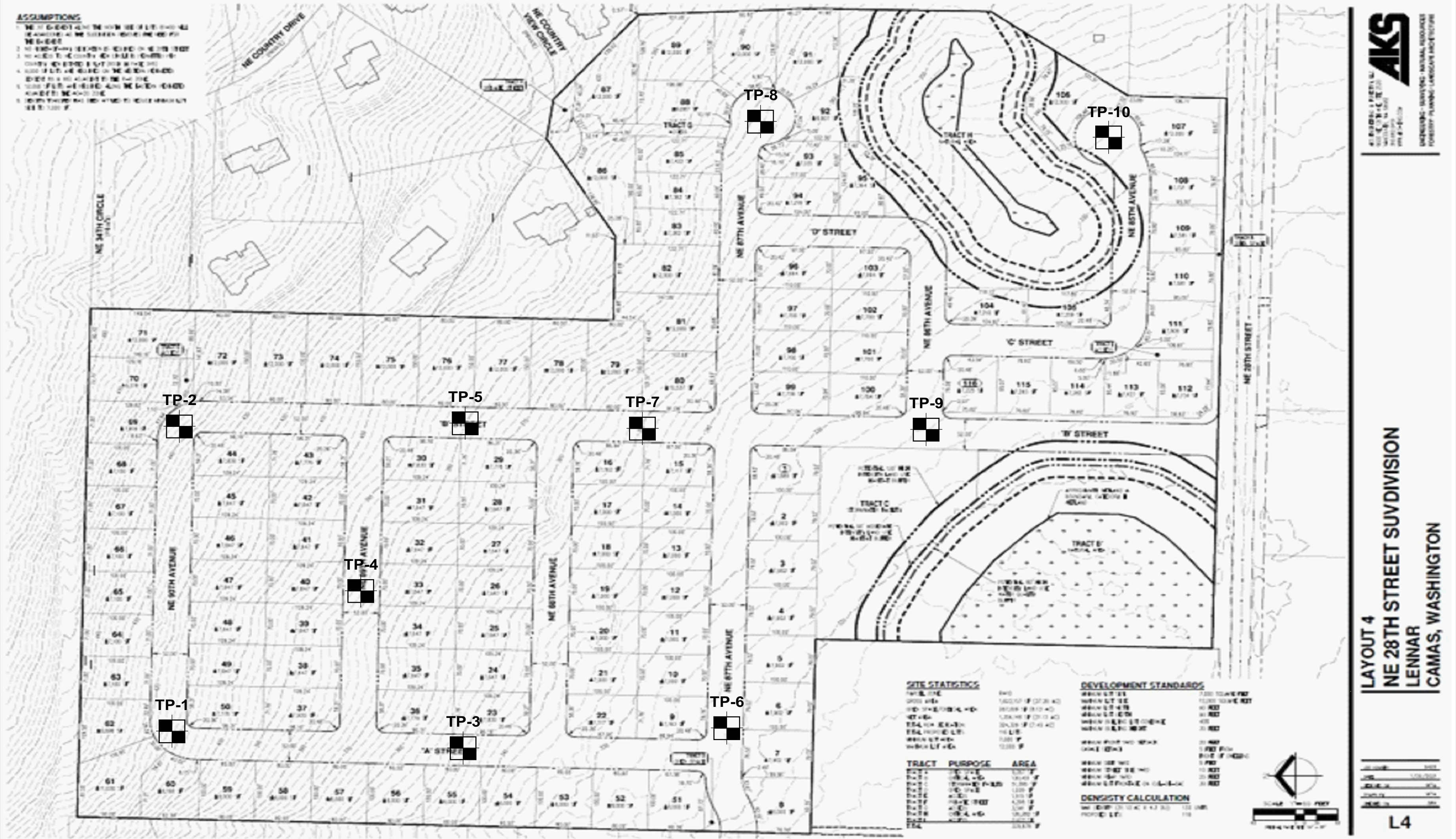
SITE PLAN AND EXPLORATION LOCATIONS



Legend:

TP-1

▨ Test Pit Exploration Designation and Approximate Location

Base Map: Layout 4, NE 28th Street Subdivision, AKS Engineering, Sheet L4

APPROXIMATE SCALE (AS NOTED)

Drawn by: BLC

Date: 3/4/2021

←

North

Project: Camas Valley Estates 22630 NE 28th Street Camas, Washington 98607	Project No. 21-5741	FIGURE 3

Exhibit 9

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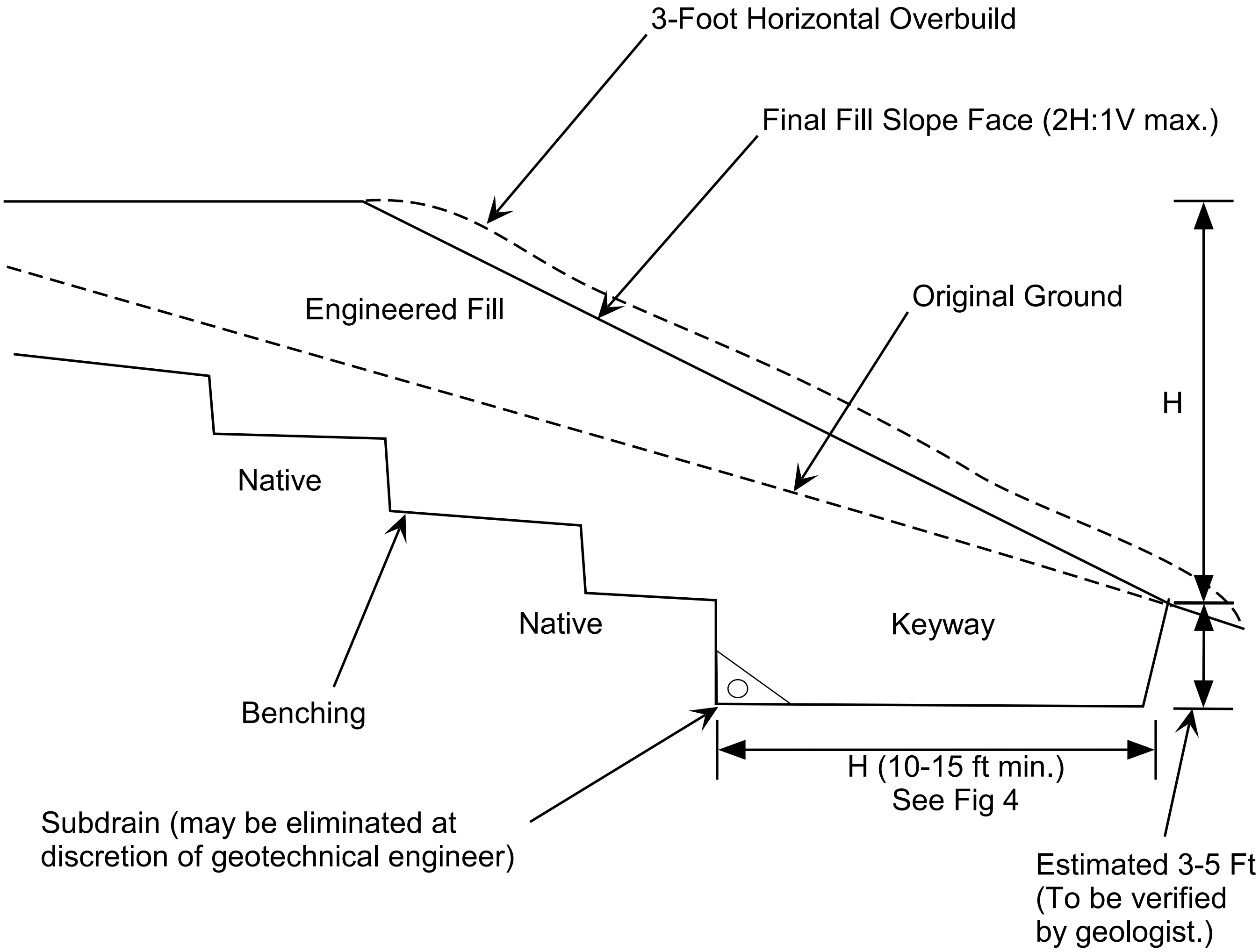
FILL SLOPE DETAIL

TYPICAL KEYWAY, BENCHING & FILL SLOPE DETAIL



Recommended subdrain is minimum 3-inch-diameter ADS Heavy Duty grade (or equivalent), perforated plastic pipe enveloped in a minimum of 3 cubic feet per lineal foot of 2" to 1/2" open-graded gravel drain rock wrapped with geotextile filter fabric (Mirafi 140N or equivalent).

Project: Camas Valley Estates 22630 NE 28th Street Camas, Washington 98607	Project No. 21-5741	FIGURE 4

Exhibit 9

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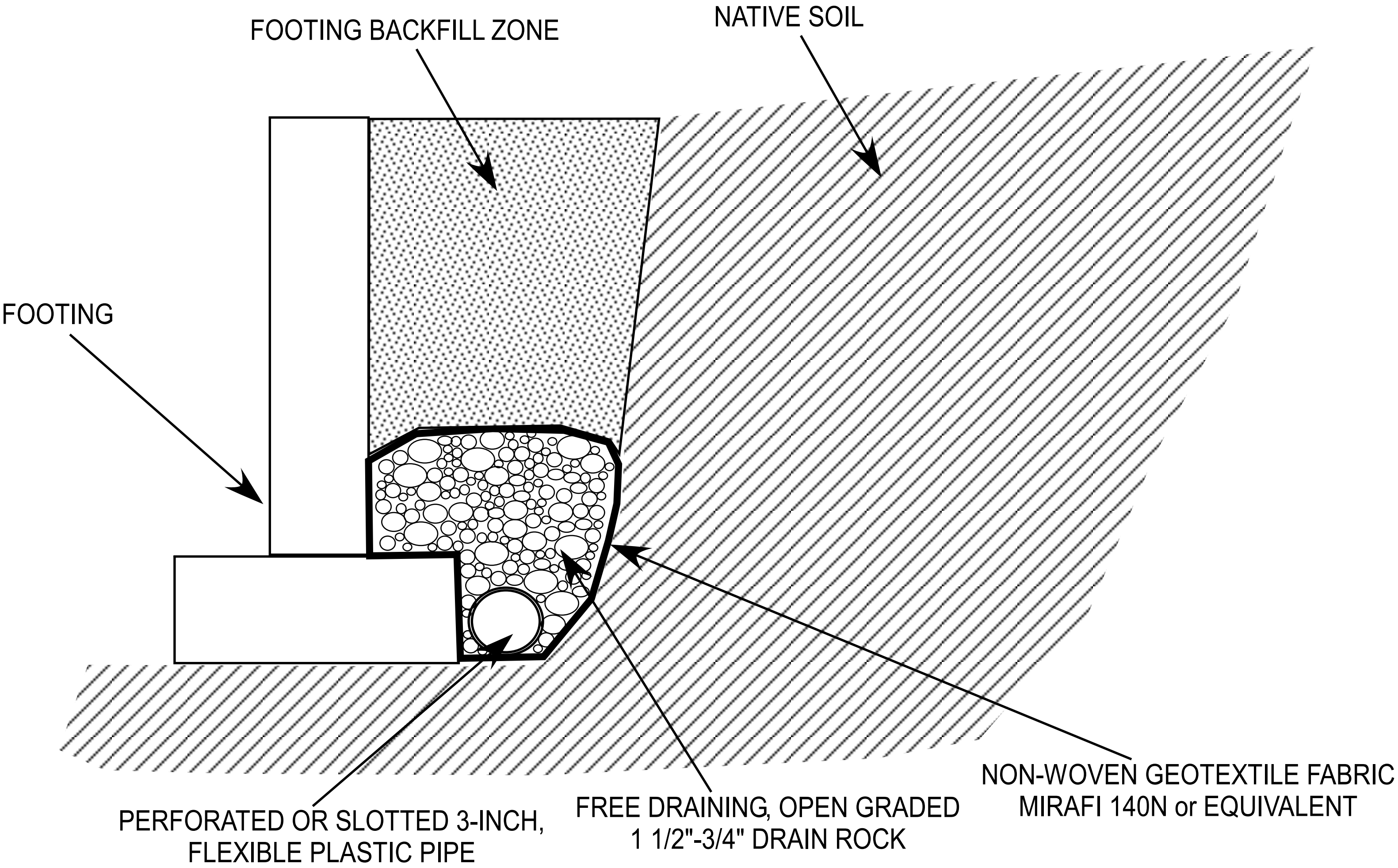
TYPICAL PERIMETER FOOTING DRAIN DETAIL



Notes:
1) Drain rock should contain no more than 5 percent fines passing the U.S. No. 200 Sieve.
2) Trench bottom and drain pipe should be sloped to drain to approved discharge location.

Date:3/4/2021
Drawn by: BLC

Project: Camas Valley Estates
22630 NE 28th Street
Camas, Washington 98607

Project No. 21-5741

FIGURE 5

Exhibit 9

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EXPLORATION LOGS

Exhibit 9

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TEST PIT LOG

Project: Camas Valley Estates
Camas, Washington

Project No. 21-5741

Test Pit No. **TP-1**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Torvane Shear (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
							TOPSOIL. Blackberry growth. Dark brown, organic, Lean CLAY, with roots extending to approximately 14 inches bgs.
1	1.5						
2	2.5						Lean CLAY (CL), brown, medium stiff, very moist, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
3	3.0		100 to 1,000 g				
4	3.0						
5							Clayey SAND (SC), brown/orange/gray, with light gray seams, medium dense, very moist, containing fine to medium-sized sand, and displaying minor lamination, low to moderate plasticity.
6			100 to 1,000 g				
7							
8							
9			100 to 1,000 g				Lean CLAY (CL), brown, stiff, wet, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
10						10 ▼ ▨	
11							Test pit terminated at 10.5 feet bgs. Light groundwater seepage observed at 10 feet bgs. Excavator: New Holland 11-88 Tracked Excavator
12							
13							
14							
15							
16							
17							

LEGEND

100 to 1,000 g	5 Gal. Bucket	▯	💧	▨	▼
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 3/2/2021
Logged By: B. Cook
Surface Elevation: 410 Feet

Exhibit 9

GeoPacific Engineering, Inc.

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Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

TEST PIT LOG

Project: Camas Valley Estates
Camas, Washington

Project No. 21-5741

Test Pit No. **TP-2**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Torvane Shear (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	Material Description
							TOPSOIL. Blackberry growth. Dark brown, organic, Lean CLAY, with roots extending to approximately 14 inches bgs.
1	1.5						Lean CLAY (CL), brown, medium stiff, very moist to wet, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
2	2.5						
3	2.5		100 to 1,000 g				
4	2.5					5 ▼	
5						▨	Light perched groundwater seeps observed piping on sides of test pit
6			100 to 1,000 g			▨	
7						▨	Clayey SAND (SC), brown/orange/gray, with light gray seams, medium dense, very moist to wet, containing fine to medium-sized sand, and displaying minor lamination, low to moderate plasticity.
8						▨	
9			100 to 1,000 g			▨	
10						▨	Lean CLAY (CL), brown, stiff, very moist to wet, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
11						▨	
12						▨	
13							Test pit terminated at 13 feet bgs. Light groundwater seepage observed at 5 feet bgs. Excavator: New Holland 11-88 Tracked Excavator
14							
15							
16							
17							

LEGEND

100 to 1,000 g	5 Gal. Bucket	▯	💧	▨	▼
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 3/2/2021
Logged By: B. Cook
Surface Elevation: 444 Feet

Exhibit 9

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TEST PIT LOG

Project: Camas Valley Estates
Camas, Washington

Project No. 21-5741

Test Pit No. **TP-3**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Torvane Shear (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
							TOPSOIL. Grassy area growth. Red brown, organic, Lean CLAY, with roots extending to approximately 8 inches bgs.
1	1.5						Lean CLAY (CL), reddish brown, medium stiff, very moist, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
2	1.5						
3	2.0		100 to 1,000 g				Lean CLAY (CL), light brown, medium stiff to stiff, very moist, low to moderate plasticity.
4	2.5						
5							
6			100 to 1,000 g				
7							Sandy Lean CLAY (CL), gray brown, stiff, very moist, low to moderate plasticity.
8							
9			100 to 1,000 g				
10							Lean CLAY (CL), brown, stiff, very moist, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
11							Test pit terminated at 11 feet bgs. No groundwater seepage observed. Excavator: New Holland 11-88 Tracked Excavator
12							
13							
14							
15							
16							
17							

LEGEND

100 to 1,000 g	5 Gal. Bucket	▯	💧	▨	▽
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 3/2/2021
Logged By: B. Cook
Surface Elevation: 351 Feet

Exhibit 9

GeoPacific Engineering, Inc.
14835 SW 72nd Avenue
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Tel: (503) 598-8445 Fax: (503) 941-9281

TEST PIT LOG

Project: Camas Valley Estates
Camas, Washington

Project No. 21-5741

Test Pit No. **TP-4**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Torvane Shear (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
							TOPSOIL. Grassy area growth. Red brown, organic, Lean CLAY, with roots extending to approximately 8 inches bgs.
1	1.5						Lean CLAY (CL), red brown, medium stiff, very moist to wet, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
2	2.5						
3	2.5						Lean CLAY (CL), light brown to gray, medium stiff to stiff, very moist to wet, low to moderate plasticity.
4	2.5						
5						5 ▼ ▨	Light perched groundwater seeps observed piping on sides of test pit
6						▨	
7						▨	Clayey GRAVEL (GC), brown/gray, medium dense, very moist to wet, containing subrounded gravel to cobble-sized rock, low plasticity.
8						▨	
9						▨	
10						▨	
11						▨	
12							Test pit terminated at 12 feet bgs. Light groundwater seepage observed at 5 feet bgs. Excavator: New Holland 11-88 Tracked Excavator
13							
14							
15							
16							
17							

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 3/2/2021
Logged By: B. Cook
Surface Elevation: 382 Feet

Exhibit 9

GeoPacific Engineering, Inc.

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Portland, Oregon 97224
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TEST PIT LOG

Project: Camas Valley Estates
Camas, Washington

Project No. 21-5741

Test Pit No. **TP-5**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Torvane Shear (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
							TOPSOIL. Grassy area growth. Red brown, organic, Lean CLAY, with roots extending to approximately 8 inches bgs.
1	1.5						Lean CLAY (CL), red brown, medium stiff, very moist to wet, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
2	2.5						
3	2.5						
4	2.5					5 ▼	Clayey GRAVEL (GC), brown/gray, medium dense, very moist to wet, containing subrounded gravel to cobble-sized rock, low plasticity.
5						▨	Light perched groundwater seeps observed piping on sides of test pit
6						▨	
7						▨	
8						▨	
9						▨	
10							Test pit terminated at 10 feet bgs. Light groundwater seepage observed at 5 feet bgs. Excavator: New Holland 11-88 Tracked Excavator
11							
12							
13							
14							
15							
16							
17							

LEGEND

100 to 1,000 g	5 Gal. Bucket	▯	💧	▨	▽
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 3/2/2021
Logged By: B. Cook
Surface Elevation: 386 Feet

Exhibit 9

GeoPacific
Engineering, Inc.

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Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

TEST PIT LOG

Project: Camas Valley Estates
Camas, Washington

Project No. 21-5741

Test Pit No. **TP-6**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Torvane Shear (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
							TOPSOIL. Grassy area growth. Red brown, organic, Lean CLAY, with roots extending to approximately 8 inches bgs.
1	1.5						Lean CLAY (CL), red brown, medium stiff to stiff, very moist, low to moderate plasticity.
2	3.5						
3	3.5						
4	3.5						
5							Lean CLAY (CL), brown, medium stiff to stiff, very moist, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
6							
7							Lean CLAY (CL), light brown to gray, stiff, very moist to wet, low to moderate plasticity.
8							
9			100 to 1,000 g				
10							
11							Test pit terminated at 11 feet bgs. No groundwater seepage observed. Excavator: New Holland 11-88 Tracked Excavator
12							
13							
14							
15							
16							
17							

LEGEND

100 to 1,000 g	5 Gal. Bucket	▯	💧	▨	▽
Bag Sample	Bucket Sample	Shelby Tube Sample	Seepage	Water Bearing Zone	Water Level at Abandonment

Date Excavated: 3/2/2021
Logged By: B. Cook
Surface Elevation: 322 Feet

Exhibit 9

GeoPacific Engineering, Inc.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

TEST PIT LOG

Project: Camas Valley Estates
Camas, Washington

Project No. 21-5741

Test Pit No. **TP-7**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Torvane Shear (tons/ft²)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
							TOPSOIL. Grassy area growth. Red brown, organic, Lean CLAY, with roots extending to approximately 8 inches bgs.
1	1.5						Lean CLAY (CL), red brown, medium stiff to stiff, very moist, low to moderate plasticity.
2	2.5						
3	3.0						
4	3.5					5 ▼	Lean CLAY (CL), brown, medium stiff to stiff, very moist, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
5						▨	
6						▨	
7						▨	
8						▨	
9						▨	
10							Test pit terminated at 10 feet bgs. Light groundwater seepage observed at 5 feet bgs. Excavator: New Holland 11-88 Tracked Excavator
11							
12							
13							
14							
15							
16							
17							

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- ▼ Water Level at Abandonment

Date Excavated: 3/2/2021
Logged By: B. Cook
Surface Elevation: 350 Feet

Exhibit 9

GeoPacific Engineering, Inc.

14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

TEST PIT LOG

Project: Camas Valley Estates
Camas, Washington

Project No. 21-5741

Test Pit No. **TP-8**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Torvane Shear (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
							TOPSOIL. Grassy area growth. Red brown, organic, Lean CLAY, with roots extending to approximately 8 inches bgs.
1	1.5						Lean CLAY (CL), red brown, medium stiff, very moist, low to moderate plasticity.
2	1.5						
3	2.0						
4	3.0						
5							Lean CLAY (CL), gray, stiff, very moist, low to moderate plasticity.
6							
7							Lean CLAY (CL), tan, stiff, very moist, low to moderate plasticity.
8							
9							
10							Test pit terminated at 10 feet bgs. No groundwater seepage observed. Excavator: New Holland 11-88 Tracked Excavator
11							
12							
13							
14							
15							
16							
17							

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- Shelby Tube Sample
- Seepage
- ▨ Water Bearing Zone
- Water Level at Abandonment

Date Excavated: 3/2/2021
Logged By: B. Cook
Surface Elevation: 369 Feet

Exhibit 9

GeoPacific Engineering, Inc.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

TEST PIT LOG

Project: Camas Valley Estates
Camas, Washington

Project No. 21-5741

Test Pit No. **TP-9**

Depth (ft)	Pocket Penetrometer ($tons/ft^2$)	Torvane Shear ($tons/ft^2$)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	**Material Description**
							TOPSOIL. Grassy area growth. Red brown, organic, Lean CLAY, with roots extending to approximately 8 inches bgs.
1	2.0						Lean CLAY (CL), red brown, medium stiff to stiff, very moist, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
2	2.0						
3	2.5						
4	3.0						
5							Lean CLAY (CL), light brown, medium stiff to stiff, very moist, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
6							
7						7 ▼ ▨	Moderate groundwater seepage observed, filling bottom of test pit.
8						▨	
9						▨	
10							Test pit terminated at 10 feet bgs. Moderate groundwater seepage observed at 7 feet bgs. Excavator: New Holland 11-88 Tracked Excavator
11							
12							
13							
14							
15							
16							
17							

LEGEND

- 100 to 1,000 g — Bag Sample
- 5 Gal. Bucket — Bucket Sample
- ▯ Shelby Tube Sample
- 💧 Seepage
- ▨ Water Bearing Zone
- ▼ Water Level at Abandonment

Date Excavated: 3/2/2021
Logged By: B. Cook
Surface Elevation: 326 Feet

Exhibit 9

GeoPacific Engineering, Inc.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

TEST PIT LOG

Project: Camas Valley Estates
Camas, Washington

Project No. 21-5741

Test Pit No. **TP-10**

Depth (ft)	Pocket Penetrometer (tons/ft^2)	Torvane Shear (tons/ft^2)	Sample Type	% Passing No. 200 Sieve	Moisture Content (%)	Water Bearing Zone	Material Description
							TOPSOIL. Grassy area growth. Red brown, organic, Lean CLAY, with roots extending to approximately 8 inches bgs.
1	2.0						Lean CLAY (CL), brown, medium stiff, very moist, low to moderate plasticity.
2	2.5						
3	2.5		100 to 1,000 g				
4	2.5						Lean CLAY (CL), light brown, medium stiff to stiff, very moist, low to moderate plasticity. Light perched groundwater seeps observed piping on sides of test pit
5						5 ▼ ▨	
6			100 to 1,000 g			▨	Lean CLAY (CL), light brown, medium stiff to stiff, very moist to wet, containing minor amounts of subrounded gravel to cobble-sized rock, low to moderate plasticity.
7						▨	
8						▨	
9			100 to 1,000 g			▨	
10						▨	
11							Test pit terminated at 10.5 feet bgs. Light groundwater seepage observed at 5 feet bgs. Excavator: New Holland 11-88 Tracked Excavator
12							
13							
14							
15							
16							
17							

LEGEND

Legend entry	Label
100 to 1,000 g	Bag Sample
5 Gal. Bucket	Bucket Sample
▯	Shelby Tube Sample
💧	Seepage
▨	Water Bearing Zone
▼	Water Level at Abandonment

Date Excavated: 3/2/2021
Logged By: B. Cook
Surface Elevation: 334 Feet

Exhibit 9

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
	Clean Gravels (Less than 5% fines)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	▨	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	▨	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)		
	▨	GM	Silty gravels, gravel-sand-silt mixtures
	▨	GC	Clayey gravels, gravel-sand-clay mixtures
	Clean Sands (Less than 5% fines)		
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	▨	SW	Well-graded sands, gravelly sands, little or no fines
	▨	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)		
	▨	SM	Silty sands, sand-silt mixtures
	▨	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%	▨	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or 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 50% or greater	▨	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	▨	CH	Inorganic clays of high plasticity, fat clays
	▨	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	▨	PT	Peat and other highly organic soils

LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent	GW, GP, SW, SP
More than 12 percent	GM, GC, SM, SC
5 to 12 percent	Borderline cases requiring dual symbols

PLASTICITY CHART

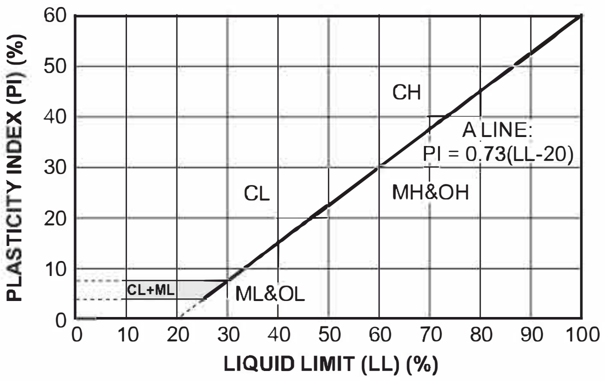


Exhibit 9

SOIL DESCRIPTION AND CLASSIFICATION GUIDELINES

Particle-Size Classification

COMPONENT	ASTM/USCS		AASHTO	
	size range	sieve size range	size range	sieve size range
Cobbles	> 75 mm	greater than 3 inches	> 75 mm	greater than 3 inches
Gravel	75 mm – 4.75 mm	3 inches to No. 4 sieve	75 mm – 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm – 19.0 mm	3 inches to 3/4-inch sieve	-	-
Fine	19.0 mm – 4.75 mm	3/4-inch to No. 4 sieve	-	-
Sand	4.75 mm – 0.075 mm	No. 4 to No. 200 sieve	2.00 mm – 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm – 2.00 mm	No. 4 to No. 10 sieve	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm – 0.425 mm	No. 10 to No. 40 sieve	-	-
Fine	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve	0.425 mm – 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	< 0.075 mm	Passing No. 200 sieve	< 0.075 mm	Passing No. 200 sieve

Consistency for Cohesive Soil

CONSISTENCY	SPT N-VALUE (BLOWS PER FOOT)	POCKET PENETROMETER (UNCONFINED COMPRESSIVE STRENGTH, tsf)
Very Soft	2	less than 0.25
Soft	2 to 4	0.25 to 0.50
Medium Stiff	4 to 8	0.50 to 1.0
Stiff	8 to 15	1.0 to 2.0
Very Stiff	15 to 30	2.0 to 4.0
Hard	30 to 60	greater than 4.0
Very Hard	greater than 60	-

Relative Density for Granular Soil

RELATIVE DENSITY	SPT N-VALUE (BLOWS PER FOOT)
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	more than 50

Moisture Designations

TERM	FIELD IDENTIFICATION
Dry	No moisture. Dusty or dry.
Damp	Some moisture. Cohesive soils are usually below plastic limit and are moldable.
Moist	Grains appear darkened, but no visible water is present. Cohesive soils will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grains. Sand and silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is much wetter than optimum moisture content and is above plastic limit.

Exhibit 9

AASHTO SOIL CLASSIFICATION SYSTEM

TABLE 1. Classification of Soils and Soil-Aggregate Mixtures

	Granular Materials			Silt-Clay Materials			
General Classification	(35 Percent or Less Passing .075 mm)			(More than 35 Percent Passing 0.075)			
Group Classification	A-1	A-3	A-2	A-4	A-5	A-6	A-7
Sieve analysis, percent passing:							
2.00 mm (No. 10)	-	-	-				
0.425 mm (No. 40)	50 max	51 min	-	-	-	-	-
0.075 mm (No. 200)	25 max	10 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)							
Liquid limit				40 max	41 min	40 max	41 min
Plasticity index	6 max	N.P.		10 max	10 max	11 min	11 min
General rating as subgrade	Excellent to good			Fair to poor			

Note: The placing of A-3 before A-2 is necessary in the "left to right elimination process" and does not indicate superiority of A-3 over A-2.

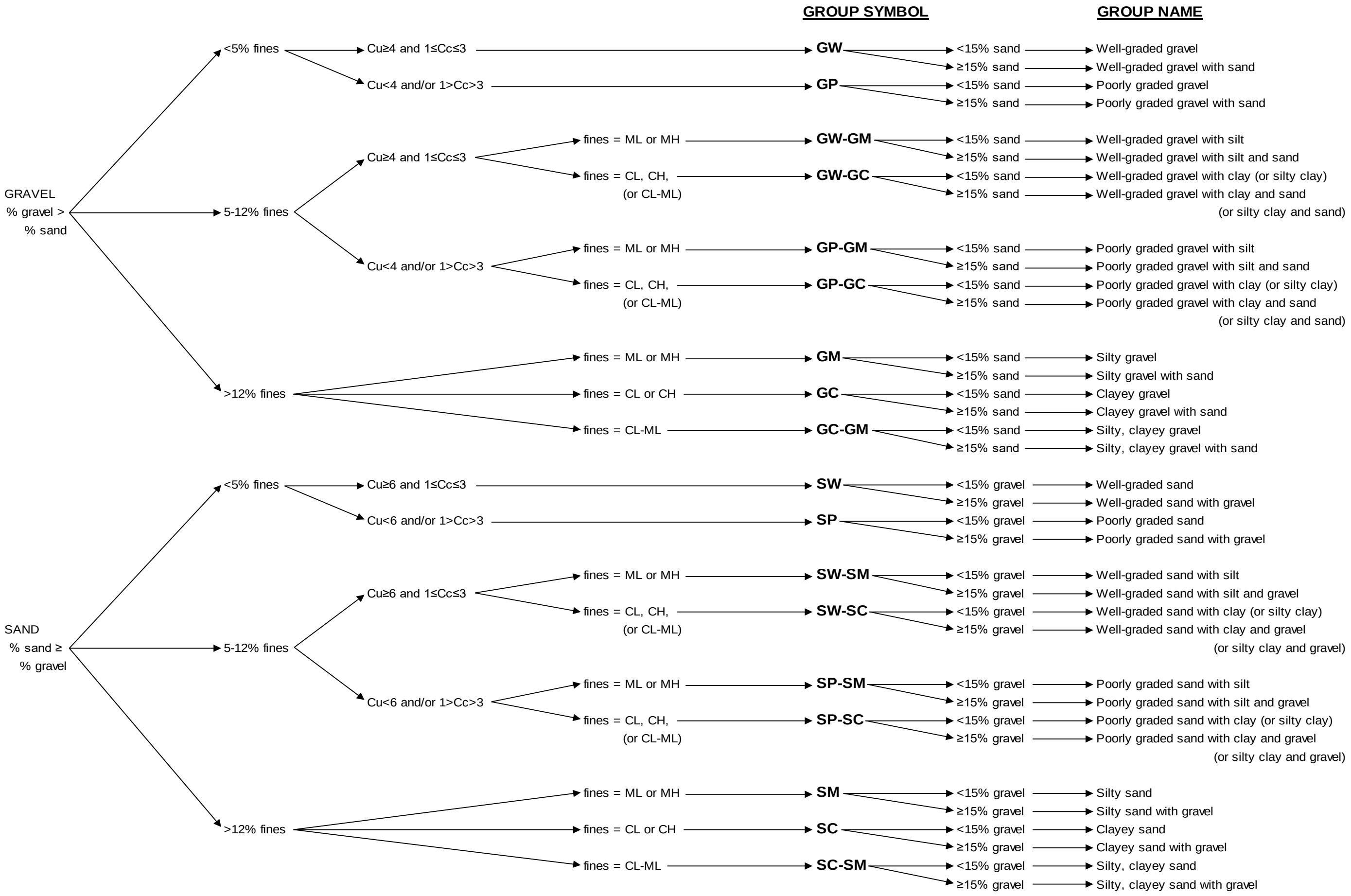
TABLE 2. Classification of Soils and Soil-Aggregate Mixtures

	Granular Materials							Silt-Clay Materials			
General Classification	(35 Percent or Less Passing 0.075 mm)							(More than 35 Percent Passing 0.075 mm)			
	A-1			A-2							A-7
Group Classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5, A-7-6
Sieve analysis, percent passing:											
2.00 mm (No. 10)	50 max	-	-	-	-	-	-	-	-	-	-
0.425 mm (No. 40)	30 max	50 max	51 min	-	-	-	-	-	-	-	-
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11min
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General ratings as subgrade	Excellent to Good							Fair to poor			

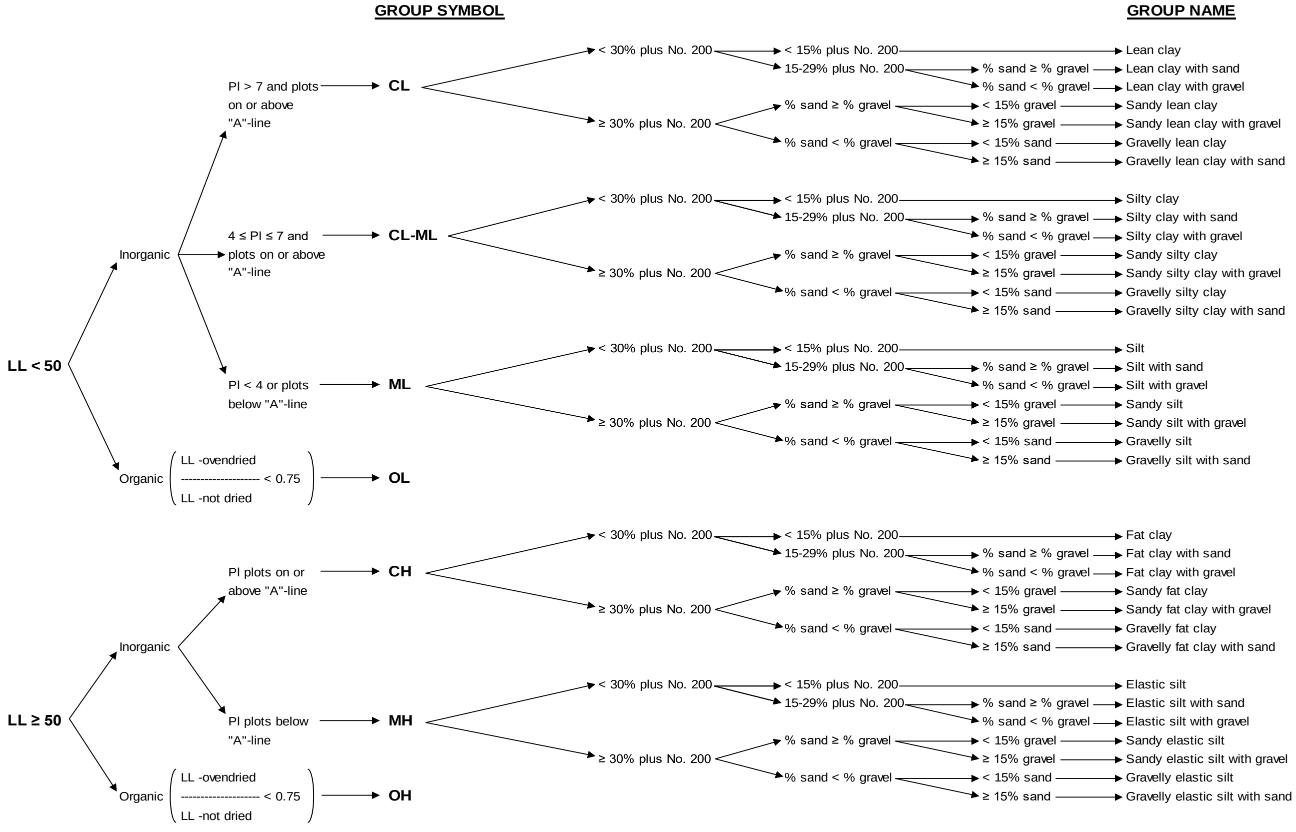
Note: Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30 (see Figure 2).

AASHTO = American Association of State Highway and Transportation Officials

Exhibit 9



Flow Chart for Classifying Coarse-Grained Soils (More Than 50% Retained on No. 200 Sieve)



Flow Chart for Classifying Fine-Grained Soil (50% or More Passes No. 200 Sieve)

Exhibit 9

GEOPACIFIC

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

SITE RESEARCH

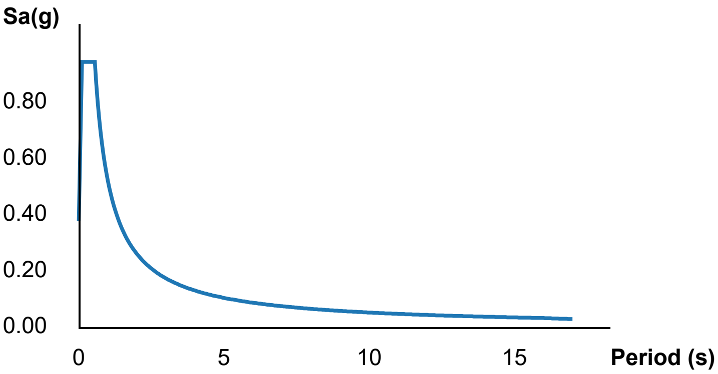
Exhibit 9

Hazards by Location

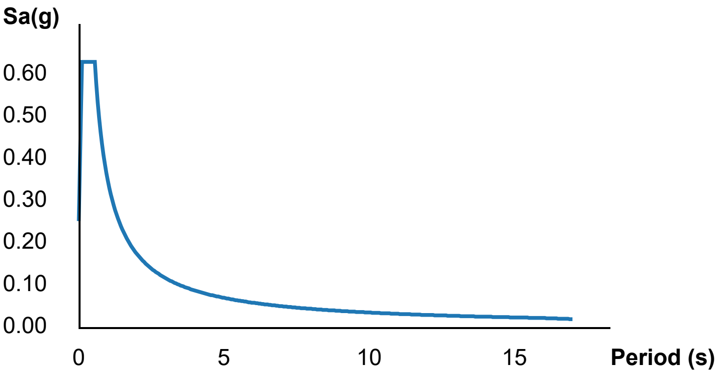
Search Information

Coordinates:	45.645516, -122.439154
Elevation:	337 ft
Timestamp:	2021-03-05T19:11:00.505Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	C

MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.787	MCE$_R$ ground motion (period=0.2s)
S_1	0.348	MCE$_R$ ground motion (period=1.0s)
S_{MS}	0.945	Site-modified spectral acceleration value
S_{M1}	0.522	Site-modified spectral acceleration value
S_{DS}	0.63	Numeric seismic design value at 0.2s SA
S_{D1}	0.348	Numeric seismic design value at 1.0s SA

▾Additional Information

Name	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	1.5	Site amplification factor at 1.0s
CR_S	0.89	Coefficient of risk (0.2s)

Exhibit 9

CR_1	0.868	Coefficient of risk (1.0s)
PGA	0.352	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.423	Site modified peak ground acceleration
T_L	16	Long-period transition period (s)
SsRT	0.787	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.885	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.348	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.401	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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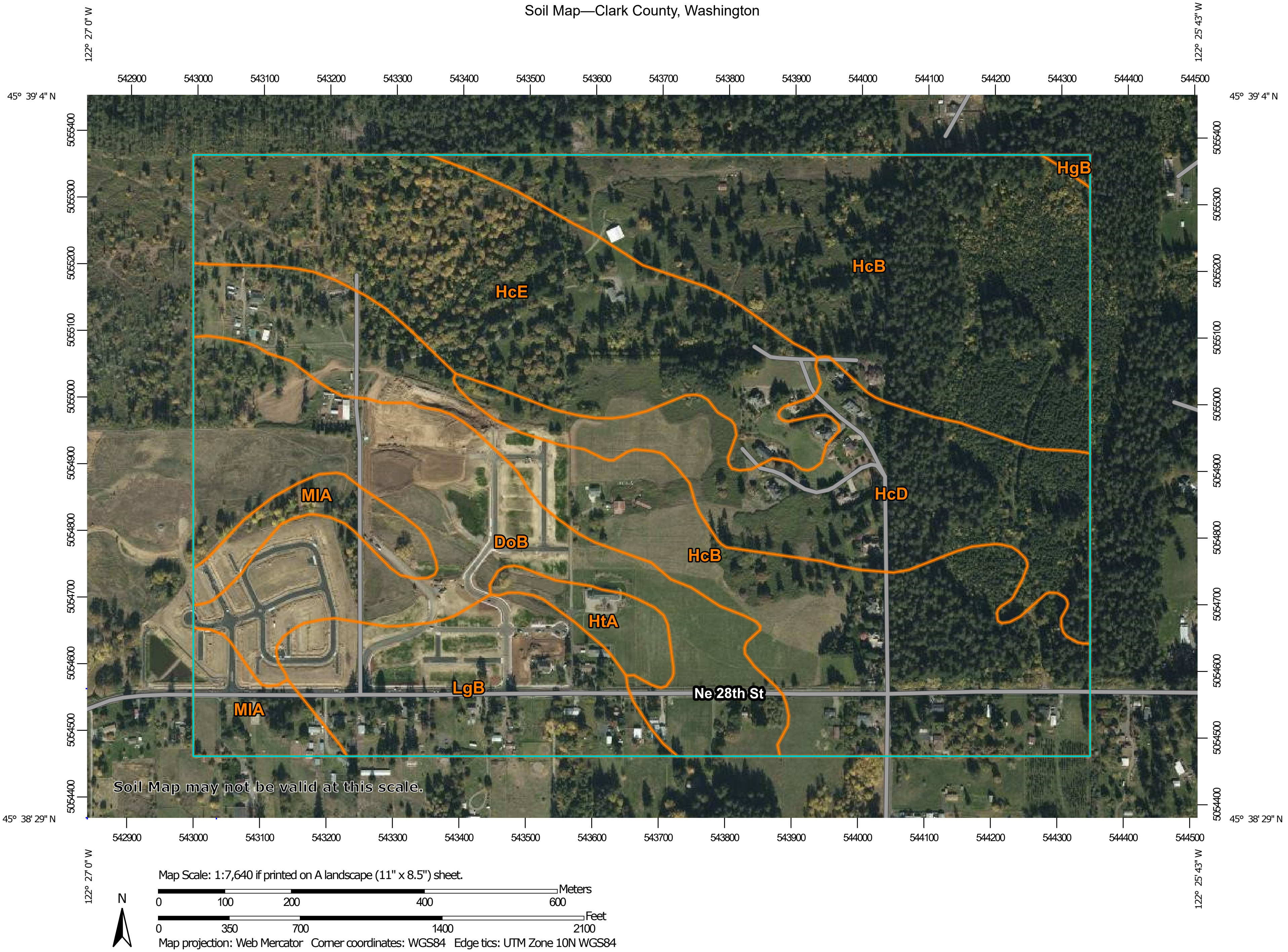
Exhibit 9

Soil Map—Clark County, Washington



Map Scale: 1:7,640 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Exhibit 9

MAP LEGEND

Area of Interest (AOI)

- □ Area of Interest (AOI)

Soils

- □ Soil Map Unit Polygons
- 〰 Soil Map Unit Lines
- ■ Soil Map Unit Points

Special Point Features

- Blowout
- ☒ Borrow Pit
- ✱ Clay Spot
- ◇ Closed Depression
- ✕ Gravel Pit
- ∴ Gravelly Spot
- Landfill
- Λ Lava Flow
- Marsh or swamp
- Mine or Quarry
- ◎ Miscellaneous Water
- ○ Perennial Water
- ∨ Rock Outcrop
- + Saline Spot
- ⁙ Sandy Spot
- ⊖ Severely Eroded Spot
- ◈ Sinkhole
- Slide or Slip
- ∅ Sodic Spot
- ≣ Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- △ Other
- Special Line Features

Water Features

- 〰 Streams and Canals

Transportation

- ┼┼┼ Rails
- 〰 Interstate Highways
- 〰 US Routes
- 〰 Major Roads
- 〰 Local Roads

Background

- ▨ Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clark County, Washington
Survey Area Data: Version 18, Jun 4, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 15, 2018—Oct 18, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Exhibit 9

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
DoB	Dollar loam, 0 to 5 percent slopes	50.7	16.8%
HcB	Hesson clay loam, 0 to 8 percent slopes	118.7	39.3%
HcD	Hesson clay loam, 8 to 20 percent slopes	36.1	12.0%
HcE	Hesson clay loam, 20 to 30 percent slopes	52.8	17.5%
HgB	Hesson gravelly clay loam, 0 to 8 percent slopes	0.4	0.1%
HtA	Hockinson loam, 0 to 3 percent slopes	4.8	1.6%
LgB	Lauren gravelly loam, 0 to 8 percent slopes	25.8	8.5%
MlA	McBee silt loam, coarse variant, 0 to 3 percent slopes	12.7	4.2%
Totals for Area of Interest		**302.1**	**100.0%**

Exhibit 9

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PHOTOGRAPHIC LOG

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GEOPACIFIC
Real-World Geotechnical Solutions
Investigation • Design • Construction Support

CAMAS VALLEY ESTATES
GEOTECHNICAL INVESTIGATION
PHOTOGRAPHIC LOG

Site Facing Southwest

Site Facing Northeast

Exhibit 9

CAMAS VALLEY ESTATES
GEOTECHNICAL INVESTIGATION
PHOTOGRAPHIC LOG

Southern Half of Site, Facing East

Northern Portion of Site Facing South, Moderately Sloping Area

Exhibit 9

CAMAS VALLEY ESTATES
GEOTECHNICAL INVESTIGATION
PHOTOGRAPHIC LOG

Excavator Test Pits

Test Pit TP-1

Exhibit 9

CAMAS VALLEY ESTATES
GEOTECHNICAL INVESTIGATION
PHOTOGRAPHIC LOG

Test Pit TP-3

Test Pit TP-3

Exhibit 9

CAMAS VALLEY ESTATES
GEOTECHNICAL INVESTIGATION
PHOTOGRAPHIC LOG

Test Pit TP-4

Test Pit TP-4

Exhibit 9

CAMAS VALLEY ESTATES
GEOTECHNICAL INVESTIGATION
PHOTOGRAPHIC LOG

Test Pit TP-7

Test Pit TP-7

Exhibit 9

CAMAS VALLEY ESTATES
GEOTECHNICAL INVESTIGATION
PHOTOGRAPHIC LOG

Test Pit TP-8

Test Pit TP-8

Exhibit 9

CAMAS VALLEY ESTATES
GEOTECHNICAL INVESTIGATION
PHOTOGRAPHIC LOG

Test Pit TP-9

Test Pit TP-9