GEOTECHNICAL REPORT

Port of Olympia Property
76th Avenue Southwest and Center Street Southwest
Tumwater, Washington

Project No. T-8388

Terra Associates, Inc.

Prepared for:

Panattoni Development Company
Tacoma, Washington

Draft September 22, 2020
Revised January 31, 2022

TERRA ASSOCIATES, Inc.
Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

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Ms. Brenda Fodge
Panattoni Development Company
1821 Dock Street, Suite 100
Tacoma, Washington 98402

Subject: Geotechnical Report
Port of Olympia Property
76th Avenue Southwest and Center Street Southwest
Tumwater, Washington

Dear Ms. Fodge:

As requested, we have conducted a geotechnical engineering study for the subject project. The attached report presents our findings and recommendations for the geotechnical aspects of project design and construction.

Site soils consist of a two- to nine-inch-thick layer of topsoil/duff overlying Recessional outwash sand, gravel, and silt deposits. Fill soils of variable composition and depth were observed in 18 of the test pits. No groundwater seepage was observed our test pits. Previous studies indicate winter groundwater depths are approximately 10 to 14 feet below current grades, with shallower levels possible following periods of high precipitation.

In our opinion, there are no geotechnical conditions that would preclude the planned development. The buildings can be supported on conventional spread footings bearing on the outwash soils or on structural fill placed on these soils. Pavements can be similarly supported.

Detailed recommendations addressing these issues and other geotechnical design considerations are presented in the attached report. We trust the information presented is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,
TERRA ASSOCIATES, INC.

1-31-2022

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1.0 PROJECT DESCRIPTION

The project consists of developing an approximately 200-acre site with several industrial buildings and associated access driveways, parking, and infrastructure improvements. We anticipate buildings floor slabs will be constructed at grade with dock high loading planned for each structure. We expect that each building will be constructed using precast concrete tilt-up wall panels with interior isolated columns supporting the roof framing.

Though most site areas and the overall topography are relatively level, localized grade changes from past log yard operations indicate minor to locally moderate grading will be required to achieve finished grade elevations. We anticipate a combination of slopes and retaining walls will be used to accommodate grade changes at the site. Project stormwater management will include construction of detention/retention facilities, with infiltration utilized as a means of stormwater flow control where feasible.

Foundation loads for tilt-up panel construction and interior column supports should be relatively light, in the range of 4 to 6 kips per foot for continuous bearing walls and 100 to 150 kips for isolated columns.

The recommendations in the following sections of this report are based on our understanding of the design features outlined above. We should review design drawings as they become available to verify that our recommendations have been properly interpreted and to supplement them, if required.

2.0 SCOPE OF WORK

Our work was completed in accordance with our authorized proposal, revised dated May 27, 2020. On August 18, 19, and 20, 2020, we excavated 49 test pits to depths of 9 to 15 feet below existing site grades. Using the information obtained from our subsurface exploration, we performed analyses to develop geotechnical engineering recommendations for project design and construction.

- Soil and groundwater conditions.
- Geologic hazards per the Tumwater Municipal Code (TMC).
- Seismic site class.
- Site preparation and grading.
- Excavations.
- Foundations.
- Slab-on-grade floors.

- Lateral earth pressures for wall design.
- Stormwater facilities.
- Infiltration feasibility.
- Drainage.
- Utilities.
- Pavements.

It should be noted that recommendations outlined in this report regarding drainage are associated with soil strength, design earth pressures, erosion, and stability. Design and performance issues with respect to moisture as it relates to the structure environment is beyond Terra Associates' purview. A building envelope specialist or contactor should be consulted to address these issues, as needed.

3.0 SITE CONDITIONS

3.1 Surface

The property consists of approximately 200 acres of land located northwest, southwest, and southeast of the intersection of 76th Avenue Southwest and Center Street Southwest in Tumwater, Washington. The approximate location of the site is shown on Figure 1.

The site is a mix of open and sparsely vegetated areas, with second-growth forest located at the approximate northern and southern thirds of the site. A log storage yard is located at the northwestern site margin. Site topography is generally level.

Review of historical aerial imagery and the *Real Estate Master Development Plan – New Market Industrial Campus & Town Square* show that from the 1970s through the 1990s, the central and southeastern portions of the site were used for log storage and transfer purposes. Our field observations and LIDAR imagery indicate localized grading from these uses created mounds, berms, storage pads and rectangular depressions. Fill mounds also extend along the western perimeter of existing log stacks at the western log storage yard. An approximately 25-foot high fill pile was observed at the location of Test Pit TP-42. A dry stormwater facility was observed at the southeastern site margin. Remnants of asphalt pavements were also observed at east-central areas.

3.2 Soils

The site soils generally consist of a two- to nine-inch thick layer of topsoil or forest duff overlying Recessional outwash gravel, sand, and silt deposits. Variably thick layers of undocumented fill underlie the site's western, central, and southeastern areas.

Fill was observed in 18 of the test pits. Except for Test Pits TP-39 and TP-42, fill depths ranged from 1-foot to 6 feet below existing site grades. Test Pit TP-42, excavated at the top of a large fill mound, showed very loose to loose silty sand fill to its total depth of 15 feet. Fill at Test Pit TP-39 consists of a two-foot thick layer of medium dense silty sand/silt underlain by very loose organic silt with abundant wood pieces to a depth of 13 feet. High organic contents (wood pieces, sticks, and branches) were also observed in Test Pits TP-2, TP-19, TP-32, TP-33, TP-35, TP-39, TP-47, and TP-48.

Ten of the test pits showed fill layers composed mainly of two-inch to eight-inch quarry spalls, with varying amounts of silt, sand and organics (wood chunks). Quarry spall fill layers vary in thickness from one-foot at Test Pit TP-34 to 6 feet at the location of Test Pit TP-1.

Except for Test Pit TP-42, all test pits found Recessional outwash soils underlying topsoil/duff or undocumented fills. The outwash soils consist of variably thick layers of sand, silty sand, silt, and gravel. Fourteen of the test pits indicated that upper outwash silty sand and sand soils are in a loose to medium dense condition. Outwash silty sand and sand soils at other test pit locations are generally medium dense. Outwash gravels are dense, contain scattered cobbles and trace 12- to 24-inch boulders.

The *Geologic Map of the Maytown 7.5-Minute Quadrangle, Thurston County, Washington,* by R.L. Logan et al (2009) maps the site as Vashon recessional outwash sand and silt (Qgos). The published description of this map unit is generally consistent with the native soils observed in the test pits.

The preceding discussion is intended to be a brief review of the soil conditions encountered on the site. Detailed descriptions can be found on the Test Pit Logs attached in Appendix A.

3.3 Groundwater

No groundwater was observed in our test pits excavated at the site. Soil mottling of sand, silty sand and silt soils was noted during logging of several test pits indicating localized areas of seasonal perched groundwater likely develop at the site.

Groundwater levels at the site were expected to be near their seasonal lows at the time of our field investigation. Pacific Groundwater Group (PGG) completed a groundwater study for the Port of Olympia in 2015. They completed an analysis to estimate the 1999 seasonal high groundwater elevations in accordance with Salmon Creek Basin requirements throughout the Ports “New Market Area” which this property is a part of. PGG updated and revised their findings in a technical memorandum dated September 24, 2020. Based on this memorandum the 1999 seasonal high groundwater elevation ranges from Elev. 192 feet at the southern boundary to Elev. 186 feet and the northern boundary of the subject property. Groundwater elevations from the PGG report relative to this subject property are shown on attached Figure 3.

3.4 Geologic Hazards

We evaluated site conditions and available literature for the presence of geologic hazard areas. Chapter 16.20 of Tumwater Municipal Code (TMC) states that "Geologically hazardous areas include areas determined to be susceptible to erosion, sliding, earthquake, or other geological events…"

3.4.1 Erosion Hazard Areas

Chapter 16.20.045 A. of TMC states that "Erosion hazard areas are at least those areas identified by the U.S. Department of Agriculture's Natural Resources Conservation Service as having a "moderate to severe," "severe," or "very severe" rill and inter-rill erosion hazard."

The NRCS maps the dominant soil type at the site as *Cagey loamy sand.* Areas of *Norma silt loam, Everett very gravelly sandy loam, 0 to 8 percent slopes,* and *Nisqually loamy fine sand, 0 to 3 percent slopes* are also mapped at the site. The NRCS designates each of these soil types as having slight erosion hazard. Accordingly, no erosion hazard areas as defined by TMC are present at the site.

The site soils will be susceptible to erosion when exposed during construction. In our opinion, proper implementation and maintenance of Best Management Practices (BMPs) for erosion prevention and sedimentation control will adequately mitigate the erosion potential in the planned development area. Erosion protection measures as required by City of Tumwater will need to be in place prior to and during grading activity on the site.

3.4.2 Landslide Hazard Areas

As indicated in Chapter 16.20.045 B., "Landslide hazard areas are areas potentially susceptible to landslides based on a combination of geologic, topographic, and hydrologic factors. They include areas susceptible to landslides because of any combination of bedrock, soil, slope (gradient), slope aspect, structure, hydrology, or other factors."

Subsection B.8 of the "Landslide Hazard Areas" definition indicates that soil slopes inclined at greater than 40 percent that are higher than 10 feet are "landslide hazard areas." As described in Section 3.1 of this report, localized short cut slopes and mounds resulting from past log yard activities are present at the site. Based on visual observations, some of the mounds and berms appeared to exceed ten feet in height. We anticipate these features will be regraded as part of site development thereby removing the landslide hazard. We should review the topographic survey and grading plan to determine the project's impacts, if any, to site slopes.

3.4.3 Seismic Hazard Areas

Chapter 16.20.045 C. of TMC states that "Seismic hazard areas are areas subject to severe risk of damage as a result of earthquake induced ground shaking, slope failure, settlement, soil liquefaction, lateral spreading, or surface faulting.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations. Liquefaction mainly affects geologically recent deposits of fine-grained sands underlying the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction; thus, eliminating the soil's strength. Due to the medium dense to dense condition and predominantly coarse-grained nature of the site's outwash soils, seismic hazards to the site's structures due to soil liquefaction are low.

A review of a map titled "Faults and Earthquakes in Washington State," dated 2014 by Jessica L. Czajkowski and Jeffrey D. Bowman shows that the nearest fault is part of the Olympia Structure. This fault is located approximately five miles north of the site. This fault is designated as "Class B" having indeterminate age and "…shows no evidence of activity during the Quaternary." Accordingly, during a seismic event, the risk of ground rupture along a fault line at the site is low.

Based on the above, in our opinion, unusual seismic hazard areas do not exist at the site, and design in accordance with applicable building codes for determining seismic forces would adequately mitigate project impacts associated with ground shaking.

3.4.4 Volcanic Hazard Areas

Chapter 16.20.045 D. of TMC states that "Volcanic hazard areas are subject to pyroclastic flows, lava flows, debris avalanche, inundation by debris flows, lahars, mudflows, or related flooding resulting from volcanic activity."

We reviewed "Plate II, Volcanic Hazards from Mount Rainier, Washington, Revised 1998," prepared by R.P. Hoblitt et al (United States Geological Survey Open File Report 98-428). Our review indicated the site lies west and outside of Inundation Zones for Case I, II, III, and M Lahars. Based on this mapping, as defined by TMC, the site does not lie within a volcanic hazard area.

3.4.5 Well Head Protection Areas

A review of a report titled "City of Tumwater, Wellhead Protection Program, February 2010 Update" indicates Wellhead Protection Areas are located at the site. The six-month Wellhead Protection Zone for Wells #12 and #14 is mapped at the southwestern site margin. Six-month, 1-year, and 5-year Wellhead Protection Zones for Wells #9, #10, #11, and #15 are located at the northeastern corner and eastern portion of the site.

3.4.6 High Groundwater Hazard Areas

Thurston County has included "High Groundwater Hazard Areas" (HGHAs) as part of their critical areas ordinance. The City of Tumwater regulates HGHAs by adopting the Salmon Creek Basin Development Standards as relates to stormwater infiltration facility design. Figure 3.4 in the *NMICTS Real Estate Master Development Plan* maps HGHAs adjacent to Kimmie Street SW near Test Pits TP-25 and TP-26, at a small area east and adjacent to the Tumwater School District property, and in the vicinity of Test Pits TP-22, TP-40, TP-41, and TP-42.

3.5 Seismic Site Class

Based on the soil conditions encountered and the local geology, the 2018 International Building Code (IBC) indicates that site class “D” should be used in structural design.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 General

In our opinion, there are no geotechnical conditions that would preclude the planned development. The buildings can be supported on conventional spread footings bearing on competent outwash soils, or structural fill placed on these soils. Floor slabs and pavements can be similarly supported.

Organic fills underlie the site’s western margin, as well as central and southeastern portions of the site. The fills resulted from grading that occurred during current and past log yard storage and transfer activities at these locations. Organic fill will not be suitable for support of new construction as unacceptable levels of settlement would occur. Removal of organic fill soils and replacement with structural fill will be required for support of structures and pavements. Quarry spalls observed in some of the fills can be re-used for subgrade protection purposes or can be blended with other suitable fill material provided the spalls are free of organics and debris.

Several of the test pits showed silty sands that are in a loose to medium dense condition. These soils, when exposed, should be densified in place by compaction to establish suitable bearing for the spread footing foundations. The moisture sensitivity of these upper silty sands is high, and it is likely that the soils will be loose and easily disturbed by normal construction activity when exposed. If foundation preparation or site grading occurs during wet weather, excavation and replacement of native foundation soils with clean granular pit run or crushed rock, may be required.

The site lies within the Salmon Creek Drainage Basin, Sub-Basin SCR. Thurston County issued stormwater facility design guidelines for new developments in the Salmon Creek Drainage Basin in response to historic high groundwater levels observed during winter of 1999. Accordingly, per County requirements, a winter season groundwater monitoring program followed by data analysis and adjustment to historically high 1999 groundwater levels will be required for project design. As discussed earlier this determination has already been completed for the Port by PGG. Figure 3, attached to this report should be referenced for determining the 1999 seasonal high groundwater for this property.

Detailed recommendations regarding these issues and other geotechnical design considerations are provided in the following sections. These recommendations should be incorporated into the final design drawings and construction specifications.

4.2 Site Preparation and Grading

To prepare the site for construction, all vegetation and organic soils should be stripped and removed from the site. Surface stripping depths of two to nine inches should be expected to remove topsoil and forest duff. Organic soils will not be suitable for use as structural fill, but may be used for limited depths in nonstructural areas or for landscaping purposes. We recommend removing all pavements and buried building foundation and slab remnants prior to preparing subgrades for new pavement and building construction.

As noted above, areas of organic fills containing abundant wood pieces are present at the site. In areas of new construction, we recommend removing the organic fills to expose native outwash soils and restoring finish grade elevations with structural fill. Quarry spalls can be re-used for subgrade protection purposes or, provided the spalls are free of organics and debris, can be used as general-purpose structural fill if blended with on-site outwash or imported soils. Test Pit TP-42 indicates the silty sand soils at that location's large fill mound are relatively free of organics and, following moisture conditioning as needed, can be re-used as structural fill at the site.

To provide adequate foundation support, we recommend that building footing excavations exposing the upper loose to medium dense silty sands be densified in place by compaction. Adequate densification should be confirmed by observation at the time of footing excavation and construction.

Prior to building and pavement construction, we recommend that all exposed bearing surfaces be observed by a representative of Terra Associates, Inc. to verify that soil conditions are as expected and suitable for structural support. Our representative may request proofrolling the exposed subgrade for pavement and floor slab support with a loaded 10 yard dump truck. If unstable soils are observed and cannot be stabilized in place by compaction, the affected soils should be excavated and removed to firm bearing and grade restored with new structural fill.

Outwash sands and gravels that contain low percentages of fines should be suitable for use as structural fill in most weather conditions. Our study indicates that outwash soils consisting of silty sands, silts, and silty gravels contain relatively high fines contents which will make them difficult to compact as structural fill if too wet or too dry. Accordingly, the ability to use native soils from site excavations as structural fill will depend on their moisture content and the prevailing weather conditions when site grading activities take place. Native soils that are too wet to properly compact could be dried by aeration during dry weather conditions, or mixed with an additive such as cement, to stabilize the soil and facilitate compaction. If an additive is used, appropriate BMPs for its use will need to be incorporated into the Temporary Erosion and Sedimentation Control (TESC) Plan for the project.

If grading activities are planned during the wet winter months, or if they are initiated during the summer and extend into fall and winter, the owner should be prepared to import wet weather structural fill. For this purpose, we recommend importing a granular soil that meets the following grading requirements:

U.S. Sieve Size	Percent Passing
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

*Based on the 3/4-inch fraction.

Prior to use, Terra Associates, Inc. should examine and test all materials imported to the site for use as structural fill.

We recommend removing cobbles larger than six inches (three inches for pond berm construction) and boulders from the fill prior to placement and compaction.

Structural fill should be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-698 (Standard Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this ASTM standard. In nonstructural areas, the degree of compaction can be reduced to 90 percent.

We recommend establishing permanent slopes with a finished inclination no steeper than 2:1 (Horizontal:Vertical). Finished slope faces should be thoroughly compacted and vegetated to guard against erosion.

4.3 Excavations

All excavations at the site associated with confined spaces, such as utility trenches, must be completed in accordance with local, state, and federal requirements. Based on regulations outlined in the Washington Industrial Safety and Health Act (WISHA), the site soils would be classified as Type C soils. Accordingly, temporary excavations in Type C soils should be sloped at an inclination of 1.5:1 or flatter. If there is insufficient lateral distance to complete the excavations in this manner or if excavations greater than 20 feet deep are planned, you may need to use temporary shoring to support the excavations. For utility trenches, properly designed and installed trench boxes may be used.

Previous groundwater studies at the site indicate groundwater levels exist at depths of approximately 10 to 15 feet, with higher levels possible during periods of high precipitation storm events. Our experience with outwash sands and gravels is that deep excavations below the water table will require installation of a dewatering system to maintain relatively drained conditions in trenches. The dewatering system will require deep pump wells and/or closely spaced well points installed in advance of trenching activities. Special consideration must be given to adequately sizing well points, pumps, and piping systems to effectively dewater the expected high seepage volumes.

This information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that Terra Associates, Inc. assumes responsibility for job site safety. Job site safety is the sole responsibility of the project contractor.

4.4 Foundations

The industrial buildings may be supported on conventional spread footing foundations bearing on competent native outwash soils or on structural fill placed above these soils. Foundation subgrades should be prepared as recommended in Section 4.2 of this report. Perimeter foundations exposed to the weather should bear at a minimum depth of 1.5 feet below final exterior grades for frost protection. Interior foundations can be constructed at any convenient depth below the floor slab.

Foundations supported on undisturbed bearing surfaces consisting of the native outwash soils or structural fill that is placed as recommended in Section 4.2 can be dimensioned for a net allowable bearing capacity of 2,500 pounds per square foot (psf). For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used. With structural loading as anticipated and this bearing stress applied, estimated total and differential settlements are less than one-inch and one-half inch, respectively.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressures acting on the side of the footing can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 350 pounds per cubic foot (pcf). We recommend not including the upper 12 inches of soil in this computation because it can be affected by weather or disturbed by future grading activity. This value assumes the foundation will be constructed neat against competent native soil or backfilled with structural fill as described in Section 4.2 of this report. The recommended lateral resistance values include a safety factor of 1.5.

4.5 Slab-on-Grade Floors

Slabs on grade may be supported on subgrades prepared as recommended in Section 4.2 of this report. Immediately below the floor slabs, we recommend placing a four-inch thick capillary break layer of clean, free-draining, coarse sand or fine gravel that has less than three percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slabs. Installation of a capillary break layer will not be necessary where the floor subgrade consists of clean native outwash or structural fill constructed using the clean outwash soils. A representative of Terra Associates, Inc. should observe the subgrade at the time of construction to verify this condition and determine if an imported capillary break layer is required.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and aid in uniform curing of the concrete slab. It should be noted that if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will be ineffective in assisting in uniform curing of the slab, and can actually serve as a water supply for moisture transmission through the slab and affecting floor coverings. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided if floor slab construction occurs during the wet winter months and the layer cannot be effectively drained. We recommend floor designers and contractors refer to the current American Concrete Institute (ACI) Manual of Concrete Practice for further information regarding vapor barrier installation below slab-on-grade floors.

A subgrade modulus of 100 pounds per square inch per inch of deflection (pci) can be used for thickness design of floor slabs subject to lift truck vehicle traffic and storage rack loading.

4.6 Retaining Walls

The magnitude of earth pressure development on engineered retaining walls will partly depend on the quality of the wall backfill. We recommend placing and compacting wall backfill as structural fill as described in Section 4.2 of this report. To guard against hydrostatic pressure development, wall drainage must also be installed. A typical recommended wall drainage detail is shown on Figure 3.

With wall backfill placed and compacted as recommended, and drainage properly installed, we recommend designing unrestrained walls that support level grades for an active earth pressure equivalent to a fluid weighing 35 pounds per cubic foot (pcf). We recommend designing unrestrained walls that support a 2:1 (Horizontal:Vertical) backslope for an active earth pressure equivalent to a fluid weighing 50 pcf. For restrained walls, an additional uniform load of 100 psf should be added to the above values. For evaluation of wall performance under seismic loading, a uniform pressure equivalent to 8H psf, where H is the height of the below-grade portion of the wall should be applied in addition to the static lateral earth pressure.

Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 4.4 of this report.

4.7 Stormwater Facilities

We anticipate stormwater ponds will be constructed to provide primary stormwater runoff control at the site. As an option or supplement to pond construction, we are also providing geotechnical recommendations for stormwater detention vault design and construction.

Detention Vault

Vault foundations supported by the medium dense to dense outwash sands and gravels may be designed for an allowable bearing capacity of 4,500 pounds per square foot (psf). For short-term loads, such as seismic, a one-third increase in this allowable capacity can be used. Friction at the base of the vault foundations and passive earth pressures will provide resistance to the lateral loads. These values are provided in Section 4.4.

The magnitude of earth pressures developing on the vault walls will depend in part on the quality and compaction of the wall backfill. To prevent development of hydrostatic pressure and uplift on the vault, wall drainage must be installed. Vault wall drainage should consist of a minimum 4-inch diameter perforated PVC pipe placed around the perimeter of the vault at an elevation no higher than its dead storage elevation. The drain pipe should be enveloped in drainage aggregate that extends as a 12-inch thick layer to the top of the vault. Alternatively, prefabricated drainage panels such as Miradrain G100N can be substituted for the 12-inch gravel drainage layer. The panels should extend at least six inches into the drainage aggregate surrounding the perforated drain pipe.

With the recommended wall backfill and drainage, we recommend designing the vault walls for an earth pressure imposed by an equivalent fluid weighing 50 pcf. Any portion of the wall for which drainage cannot be provided should be designed for an earth pressure equivalent to a fluid weighing 85 pcf. For evaluating walls under seismic loading, an additional uniform earth pressure equivalent to 8H psf, where H is the height of the below-grade wall in feet, can be used. These values assume a horizontal backfill condition. Where applicable, a uniform horizontal traffic surcharge value of 75 psf should be included in design of vault walls.

Stormwater Ponds

Based on the results of our test pit explorations, we expect that medium dense to dense outwash soils would be exposed at stormwater pond bottom elevations. If fill berms will be constructed, the berm locations should be stripped of topsoil, duff, and soils containing organic material prior to the placement of fill. The fill berms should be constructed by placing structural fill in layers no more than 12 inches thick, compacting each layer as structural fill. Material used to construct pond berms should consist of predominately granular soils with a maximum size of 3 inches and a minimum of 20 percent fines. We recommend pond berm fill be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-1557 (Modified Proctor).

Because of exposure to fluctuating stored water levels, soils exposed on the interior side slopes of the ponds may be subject to some risk of periodic shallow instability or sloughing. Establishing interior slopes at a 3:1 gradient will significantly reduce or eliminate this potential. Exterior berm slopes and interior slopes above the maximum water surface should be graded to a finished inclination no steeper than 2:1. Finished slope faces should be thoroughly compacted and vegetated to guard against erosion.

4.8 Infiltration Feasibility

Based on our observations, the site's outwash sands and gravels with relatively low fines contents will support infiltration of project stormwater. As discussed earlier, attached Figure 3 should be referenced to determine the 1999 seasonal high groundwater level for design. Site grades will likely need to be raised to allow facility design and construction.

On a preliminary basis, an average long-term design infiltration rate of 2 inches per hour can be used for preliminary design of an infiltration facility. This rate assumes the base of the facility will expose or be hydraulically connected to sand or gravel outwash soils. We should review the final stormwater retention facility plans when available to confirm facility design is consistent with our seasonal high groundwater level analysis and ground conditions as observed at the site.

Our recommended preliminary infiltration rate was derived using grain size distribution results for samples from Test Pits TP-11, TP-14, and TP-29, and methods outlined in the 2018 City of Tumwater Drainage Design and Erosion Control Manual. The calculation is also based on a minimum separation distance of three feet between the base of the infiltration facility and design high groundwater levels. The preliminary design infiltration rate incorporates correction factors recommended in the manual.

The permeability of the native outwash soils will be significantly impacted by the intrusion of soil fines (silt- and clay-sized particles). A relatively minor amount of soil fines can reduce the permeability of the formation by a factor of ten. The greatest exposure to soil fines contamination will occur during mass grading and construction. Therefore, we recommend that the Temporary Erosion and Sedimentation Control (TESC) plans route construction stormwater to a location other than the permanent infiltration facility.

4.9 Drainage

Surface

Final exterior grades should promote free and positive drainage away from the site at all times. Water must not be allowed to pond or collect adjacent to foundations, or within the immediate building areas. If a positive drainage gradient cannot be provided, surface water should be collected adjacent to the structures and disposed to appropriate storm facilities.

Subsurface

In our opinion, with the area immediately adjacent to the structure paved, and positive surface drainage maintained, perimeter foundation drains would not be necessary. If the grade is not positively drained away from the structure or is landscaped, perimeter foundation drains should be installed.

Where foundation drains are installed, the drains should be laid to grade at an invert elevation equivalent to the bottom of footing grade. The drains can consist of four-inch diameter perforated PVC pipe that is enveloped in washed pea gravel-sized drainage aggregate. The aggregate should extend six inches above and to the sides of the pipe. Roof and foundation drains should be tightlined separately to the storm drains. All drains should be provided with cleanouts at easily accessible locations.

4.10 Utilities

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA), or local jurisdiction specifications. As a minimum, trench backfill should be placed and compacted as structural fill, as described in Section 4.2 of this report. As noted, the relatively clean sand and gravel fills should be suitable for use as trench backfill in most weather conditions. The site’s silty sand, silty gravel, and silt soils may require moisture conditioning prior to placement and compaction as structural fill.

4.11 Pavements

Pavement subgrades should be prepared as described in Section 4.2 of this report. Regardless of the degree of relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. The subgrade should be proofrolled with heavy rubber-tired construction equipment such as a loaded 10-yard dump truck to verify this condition.

The pavement design section is dependent upon the supporting capability of the subgrade soils and the traffic conditions to which it will be subjected. We expect traffic at the facility will consist of cars and light trucks, along with heavy traffic in the form of tractor-trailer rigs. For design considerations, we have assumed traffic in parking and in car/light truck access pavement areas can be represented by an 18-kip Equivalent Single Axle Loading (ESAL) of 50,000 over a 20-year design life. For heavy traffic pavement areas, we have assumed an ESAL of 300,000 would be representative of the expected loading. These ESALs represent loading approximately equivalent to 3 and 18, loaded (80,000 pound GVW) tractor-trailer rigs traversing the pavement daily in each area, respectively. We should be contacted if higher truck traffic volumes are expected to revise the following recommended pavement sections.

With a stable subgrade composed of the existing on-site granular fill prepared as recommended, we recommend the following options for pavement sections:

Light Traffic and Parking:

- Two inches of hot mix asphalt (HMA) over four inches of crushed rock base (CRB)
- Full depth HMA – 3 ½ inches

Heavy Traffic:

- Three inches of HMA over six inches of CRB
- Full depth HMA – five inches

For exterior Portland cement concrete (PCC) pavement, we recommend the following:

- 6 inches of PCC over two inches of CRB
    - 28-day compressive strength – 4,000 psi
    - Control joints spaced at a maximum of 15 feet

The paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for ½-inch class HMA, PCC, and CRB.

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating the subgrade soils and reducing their supporting capability. For optimum performance, we recommend surface drainage gradients of at least two percent. Some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks as they occur.

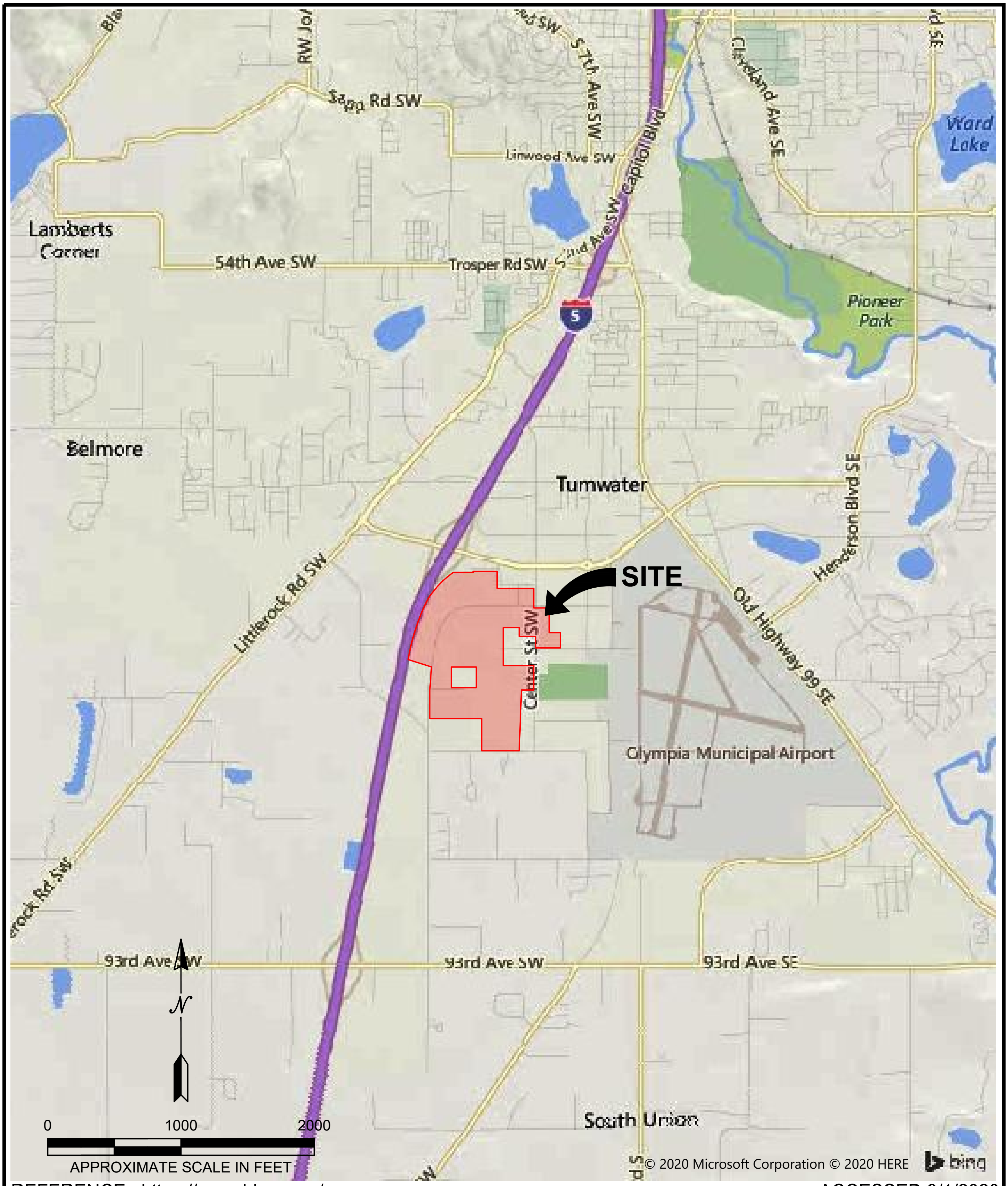
5.0 ADDITIONAL SERVICES

Terra Associates, Inc. should review the final design drawings and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and implemented in project design. We should also provide geotechnical services during construction to observe compliance with our design concepts, specifications, and recommendations. This will allow for design changes if subsurface conditions differ from those anticipated prior to the start of construction.

6.0 LIMITATIONS

We prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made. This report is the copyrighted property of Terra Associates, Inc. and is intended for planning and design for the Port of Olympia Property project in Tumwater, Washington. This report is for the exclusive use of Panattoni Development Company and their authorized representatives.

The analyses and recommendations presented in this report are based on data obtained from the test pits excavated on the site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, Terra Associates, Inc. should be requested to re-evaluate the recommendations in this report prior to proceeding with construction.



REFERENCE: https://www.bing.com/maps

ACCESSED 9/1/2020

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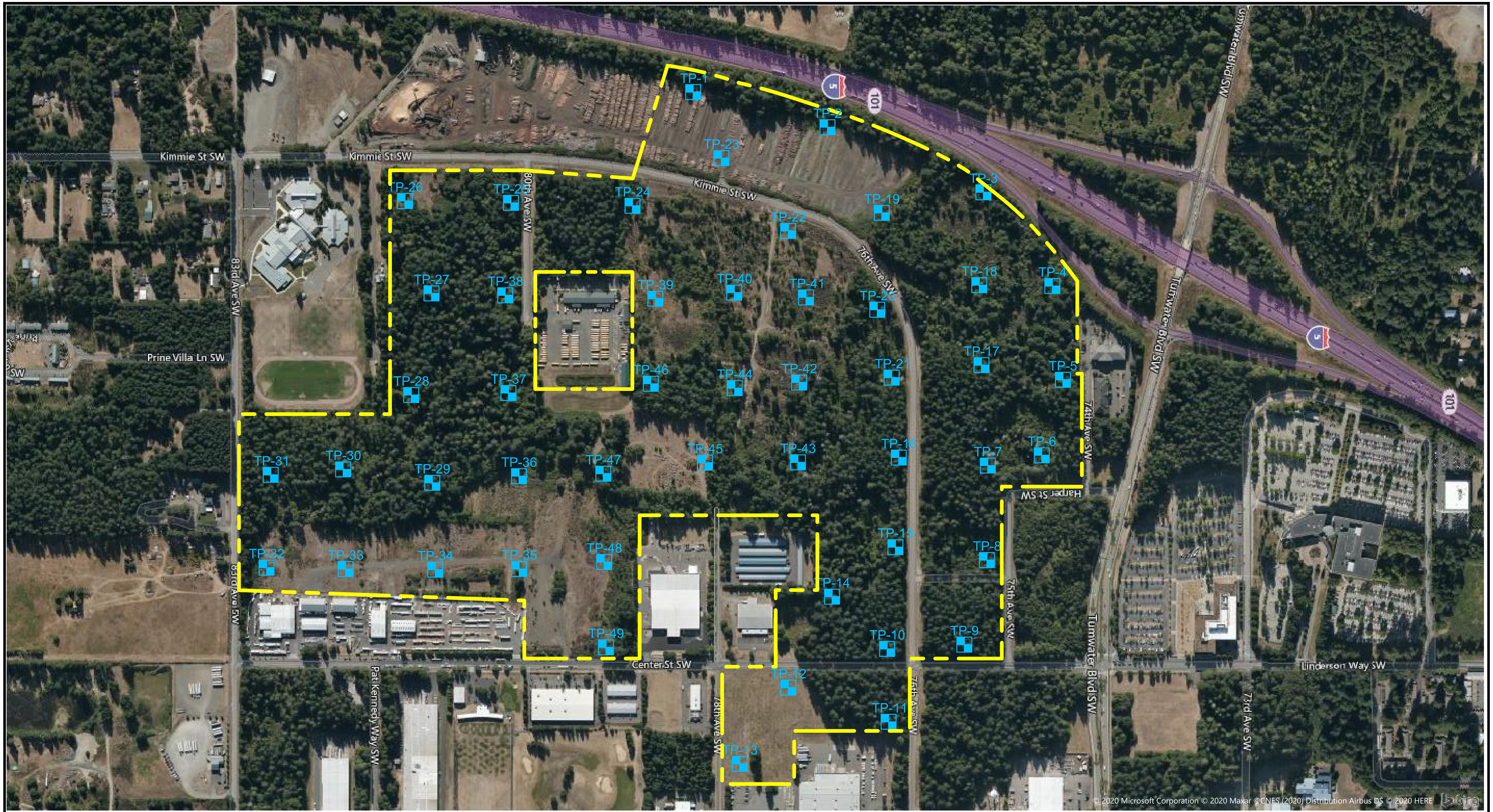
VICINITY MAP
PORT OF OLYMPIA PROPERTY
TUMWATER, WASHINGTON

Proj.No. T-8388	Date:JAN 2022	Figure 1



NOTE:

THIS SITE PLAN IS SCHEMATIC. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE. IT IS INTENDED FOR REFERENCE ONLY AND SHOULD NOT BE USED FOR DESIGN OR CONSTRUCTION PURPOSES.

REFERENCE: SITE PLAN PROVIDED BY BING MAPS.

LEGEND:

▨ APPROXIMATE TEST PIT LOCATION

0 150 300

APPROXIMATE SCALE IN FEET

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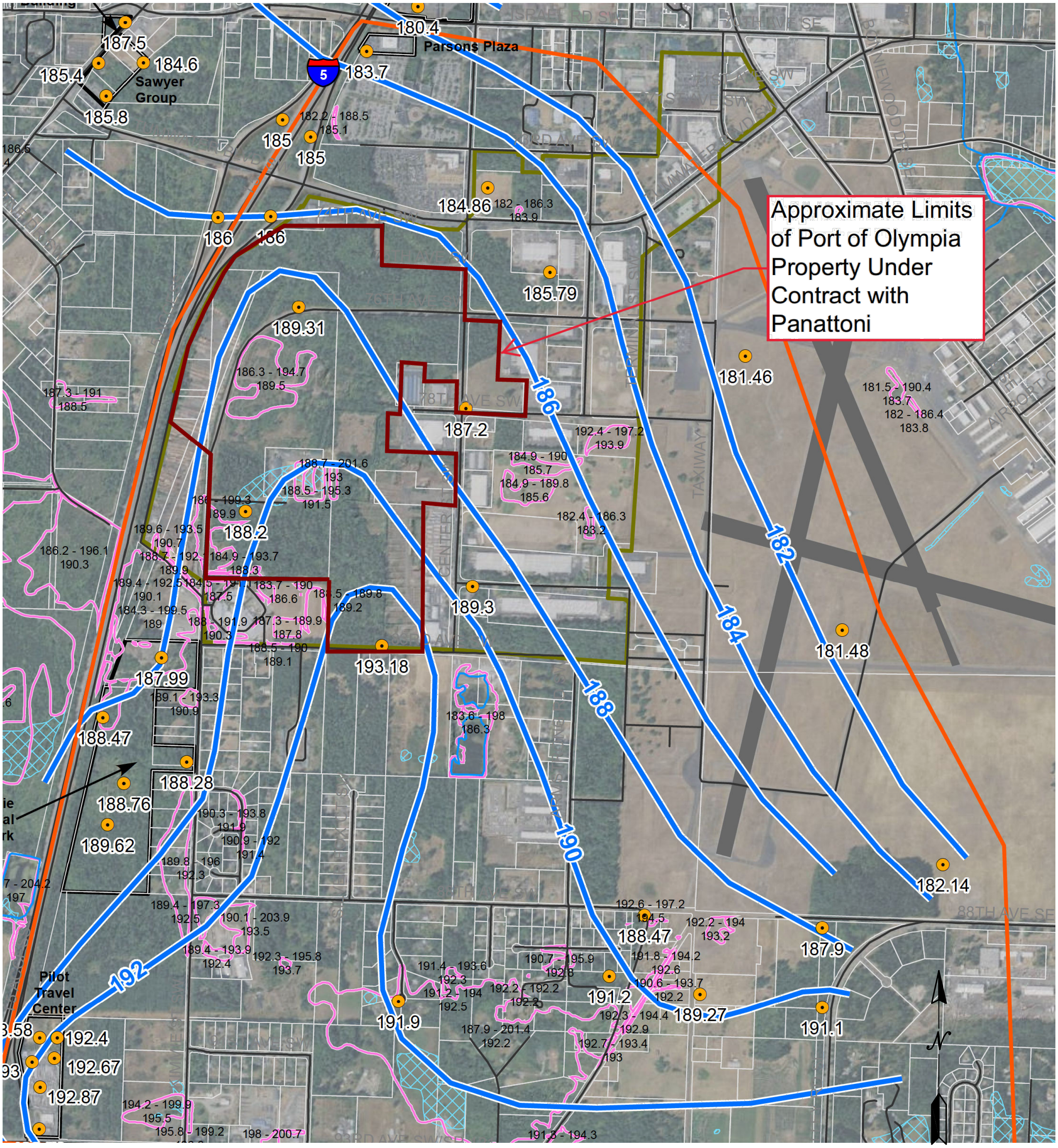
EXPLORATION LOCATION PLAN
PORT OF OLYMPIA PROPERTY
TUMWATER, WASHINGTON

Proj.No. T-8388	Date:JAN 2022	Figure 2



APPROXIMATE SCALE: 1"=1,500'

REFERENCE: Pacific Groundwater Group, Technical Memorandum, dated September 24, 2020

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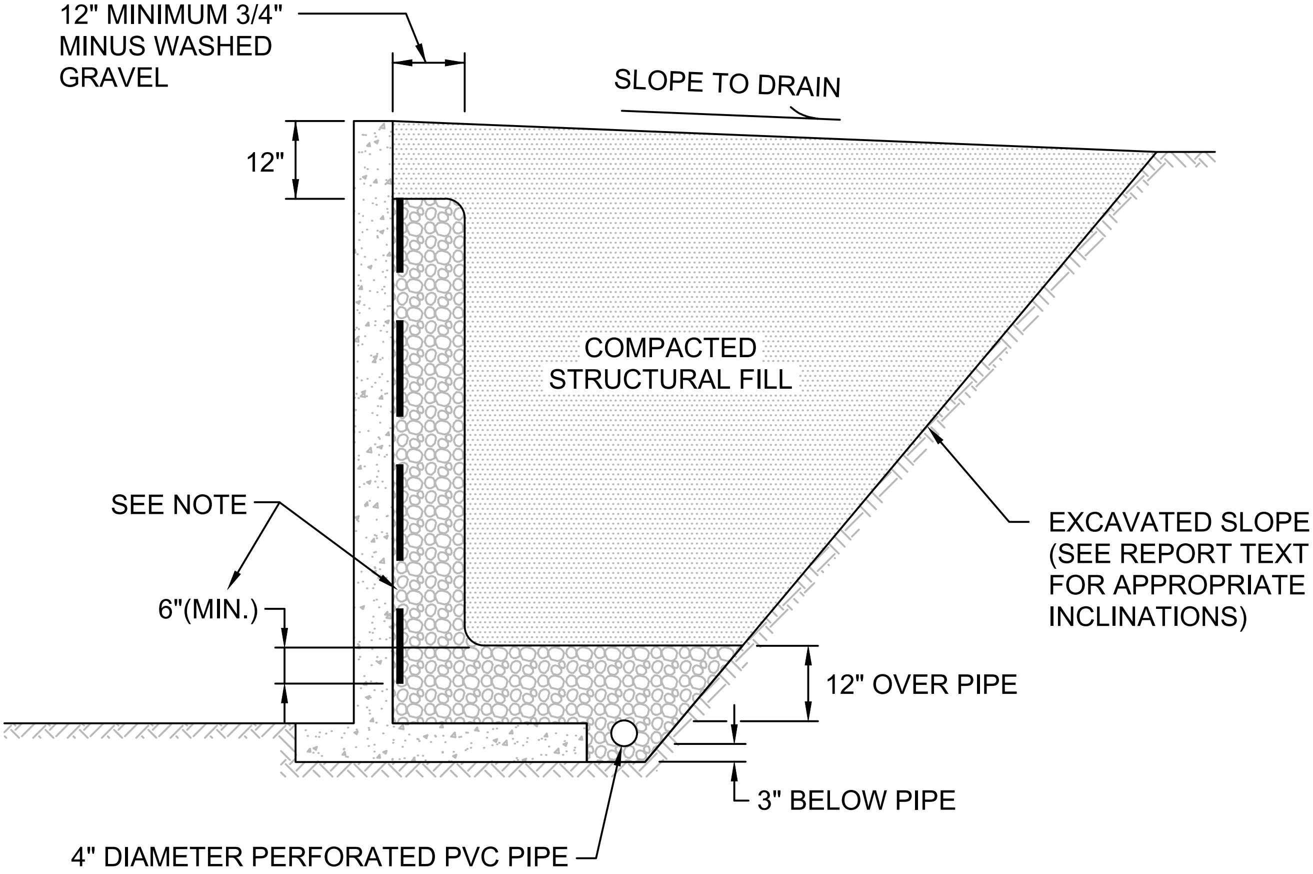
Estimated 1999 Seasonal High Groundwater
Port of Olympia Property
Tumwater, Washington

Proj. No.T-8388	Date JAN 2022	Figure 3



NOT TO SCALE

NOTE:

MIRADRAIN G100N PREFABRICATED DRAINAGE PANELS OR SIMILAR PRODUCT CAN BE SUBSTITUTED FOR THE 12-INCH WIDE GRAVEL DRAIN BEHIND WALL. DRAINAGE PANELS SHOULD EXTEND A MINIMUM OF SIX INCHES INTO 12-INCH THICK DRAINAGE GRAVEL LAYER OVER PERFORATED DRAIN PIPE.

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TYPICAL WALL DRAINAGE DETAIL
PORT OF OLYMPIA PROPERTY
TUMWATER, WASHINGTON

Proj.No. T-8388 | Date:JAN 2022 | Figure 4

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

Port of Olympia Property
Tumwater, Washington

On August 18, 29 and 20, 2020, we investigated subsurface conditions at the site by excavating 49 test pits to a maximum depth of 15 feet below existing surface grades using a CAT 312D excavator. The test pit locations are shown on Figure 2. The test pit locations were approximately determined in the field by using excavator-mounted and hand-held global positioning system devices. The Test Pit Logs are presented on Figures A-2 through A-50.

A geotechnical engineer from our office maintained a log of each test pit as it was excavated, classified the soil conditions encountered, and obtained representative soil samples. All soil samples were visually classified in the field in accordance with the Unified Soil Classification System. A copy of this classification is presented as Figure A-1.

Representative soil samples obtained from the test pits were placed in sealed plastic bags and taken to our laboratory for further examination and testing. The moisture content of each sample was measured and is reported on the Test Pit Logs. Grain size analyses were performed on 11 of the soil samples. The results are shown on Figures A-51 through A-54.

MAJOR DIVISIONS				LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	More than 50% material larger than No. 200 sieve size	**GRAVELS** More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (less than 5% fines)	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	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
				GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
		SANDS More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, sands with gravel, little or no fines.
				SP	Poorly-graded sands, sands with gravel, little or no fines.
			Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines.
				SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS	More than 50% material smaller than No. 200 sieve size	**SILTS AND CLAYS** Liquid Limit is less than 50%		ML	Inorganic silts, rock flour, clayey silts with slight plasticity.
				CL	Inorganic clays of low to medium plasticity. (Lean clay)
				OL	Organic silts and organic clays of low plasticity.
		SILTS AND CLAYS Liquid Limit is greater than 50%		MH	Inorganic silts, elastic.
				CH	Inorganic clays of high plasticity. (Fat clay)
				OH	Organic clays of high plasticity.
HIGHLY ORGANIC SOILS				PT	Peat.

DEFINITION OF TERMS AND SYMBOLS

COHESIONLESS

Density	Standard Penetration Resistance in Blows/Foot
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	>50

COHESIVE

Consistancy	Standard Penetration Resistance in Blows/Foot
Very Soft	0-2
Soft	2-4
Medium Stiff	4-8
Stiff	8-16
Very Stiff	16-32
Hard	>32

Ⅰ	2" OUTSIDE DIAMETER SPILT SPOON SAMPLER
Ⅱ	2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER
▼	WATER LEVEL (Date)
Tr	TORVANE READINGS, tsf
Pp	PENETROMETER READING, tsf
DD	DRY DENSITY, pounds per cubic foot
LL	LIQUID LIMIT, percent
PI	PLASTIC INDEX
N	STANDARD PENETRATION, blows per foot

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UNIFIED SOIL CLASSIFICATION SYSTEM
PORT OF OLYMPIA PROPERTY
TUMWATER, WASHINGTON

Proj.No. T-8388	Date:JAN 2022	Figure A-1

LOG OF TEST PIT NO. TP-1

FIGURE A-2

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Sparse Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** 1-Foot

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		FILL: Dark brown silty angular GRAVEL/COBBLES (2-inch to 8-inch quarry spalls) with fine sand, moist. (GM)		
1				
2				
3			Loose	
4				
5				
6		Brown SAND with silt, fine to medium grained, moist. (SP-SM)		13.0
7		Gray-brown SAND, fine to medium grained, moist. (SP)		
8			Medium Dense	
9				7.9
10				
11		Test pit terminated at approximately 11 feet. No groundwater. Caving at 1-foot.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-2

FIGURE A-3

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Weeds **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** 6 Feet

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		FILL: Dark gray organic SILT/silty GRAVEL/COBBLES (2-inch to 8-inch quarry spalls), sticks and branches, moist. (OL/GM)		
1			Loose	
2				
3		Brown fine SAND with silt, moist. (SP-SM)		
4			Medium Dense	14.0
5				
6		Gray-brown fine GRAVEL with medium to coarse sand, moist to wet. (GP)		
7				
8			Dense	3.6
9				
10		Test pit terminated at approximately 10 feet. No groundwater. Caving at 6 feet.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-3

FIGURE A-4

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** 1-Foot

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(8 inches TOPSOIL)		
1		Light brown silty SAND, fine to medium grained, dry to moist. (SM)		
2			Loose to Medium Dense	
3				8.1
4		6-inch cemented gravel layer.		
5		Gray GRAVEL with medium sand and cobbles, fine to coarse gravel, moist. (GP)		
6				
7			Medium Dense	
8				
9				3.0
10		Test pit terminated at approximately 10 feet. No groundwater. Caving at 1-foot.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-4

FIGURE A-5

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches TOPSOIL)		
1		Gray-brown fine SAND with silt, moist. (SP-SM)	Loose to Medium Dense	
2				12.3
3		Light brown mottled SAND with silt, fine to medium grained, moist. (SP-SM)		
4				
5				
6				
7			Medium Dense	11.3
8				
9				
10				
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-5

FIGURE A-6

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(3 inches TOPSOIL)		
1		Dark brown silty fine SAND, dry to moist. (SM)	Loose to Medium Dense	
2				11.6
3		Light brown SAND with silt, fine to medium grained, moist. (SP-SM)		
4				
5				
6				8.9
7			Medium Dense	
8				
9				
10				
11		Gray-brown fine to coarse GRAVEL with medium to coarse sand, moist to wet. (GP)	Dense	
12		Test pit terminated at approximately 12 feet. No groundwater. No caving.		3.1
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-6

FIGURE A-7

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches DUFF)		
1		Light brown silty fine SAND, moist. (SM)		
2			Loose to Medium Dense	6.3
3				
4		Light brown-gray SAND, fine to medium grained, moist. (SP)		
5				
6				
7			Medium Dense	
8				
9				
10				
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-7

FIGURE A-8

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(3 inches DUFF)		
1		Light brown to brown-gray SAND with silt, fine to medium grained, moist. (SP-SM)		
2				8.5
3				
4				
5			Loose to Medium Dense	
6				
7				
8				
9				16.1
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-8

FIGURE A-9

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(3 inches DUFF)		
1		Light brown fine SAND with silt, moist. (SP-SM)	Loose to Medium Dense	
2				8.8
3		Gray SAND, fine to medium grained, moist. (SP)		
4				
5				
6			Medium Dense	
7				
8				6.5
9		Test pit terminated at approximately 9 feet. No groundwater. No caving.		
10				
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-9

FIGURE A-10

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(5 inches DUFF)	Medium Dense	
1		Brown silty fine SAND, moist. (SM)		
2				7.9
3		Brown-gray SAND, fine to medium grained, moist. (SP)		
4				
5				
6				
7				7.1
8				
9		Brown mottled silty SAND, fine to medium grained, moist. (SM)		
10				35.2
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-10

FIGURE A-11

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches DUFF)		
1		Brown to light brown SAND with silt, moist. (SP-SM)		
2				10.1
3				
4				
5			Medium Dense	
6				
7		Light brown mottled silty fine SAND, stratified, moist. (SM)		
8				24.7
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-11

FIGURE A-12

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(3 inches DUFF)		
1		Brown silty fine SAND, moist. (SM)	Loose to Medium Dense	
2				9.6
3		Brown-gray SAND, fine grained, moist. (SP)		
4				
5				
6			Medium Dense	6.3
7		Light brown mottled silty fine SAND/SILT, moist. (SM/ML)		
8				
9				12.0
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-12

FIGURE A-13

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Lawn **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches DUFF)		
1		Dark brown fine SAND with silt, moist. (SP-SM)		
2				8.6
3		Light brown to gray SAND, fine to medium grained, moist. (SP)		
4				
5			Medium Dense	
6				7.9
7				
8				
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-13

FIGURE A-14

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Lawn **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(5 inches SOD)	Medium Dense	
1		Dark brown fine SAND with silt, moist. (SP-SM)		
2				13.2
3		Light brown SILT with fine sand, non-plastic, moist. (ML)		
4				27.4
5				
6				
7				
8		Light brown silty SAND, fine to medium grained, moist. (SM)		
9				14.5
10				
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-14

FIGURE A-15

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(7 inches DUFF)		
1		Brown fine SAND with silt, moist. (SP-SM)	Loose to Medium Dense	
2				8.3
3		Brown-gray fine to medium SAND interbedded with silty fine SAND, moist. (SP, SM)		
4				
5				
6			Medium Dense	6.0
7				
8				
9		Brown-gray mottled SILT with fine sand, non-plastic, moist. (ML)		
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		34.9
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-15

FIGURE A-16

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches DUFF)		
1		Brown silty fine SAND with silt, moist. (SM)		8.9
2		Light brown-gray SAND, fine to medium grained, moist. (SP)		
3				
4				
5			Medium Dense	
6				5.5
7		Light brown mottled fine to medium SAND interbedded with silty fine SAND, moist. (SP, SM)		
8				
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-16

FIGURE A-17

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(8 inches TOPSOIL/DUFF)		
1		Dark brown fine SAND with silt, moist. (SP-SM)	Loose to Medium Dense	
2		Light brown to brown-gray coarse GRAVEL with silt and fine sand, scattered cobbles, moist. (GP-GM)		10.7
3				
4				
5				
6			Dense	3.6
7				
8				
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-17

FIGURE A-18

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(3 inches DUFF)		
1		Light brown to brown-gray SAND with silt, fine to medium grained, moist. (SP-SM)		
2			Loose to Medium Dense	6.2
3				
4				
5				
6				
7			Medium Dense	
8				
9				7.6
10				
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-18

FIGURE A-19

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(6 inches DUFF/ROOTS) FILL: Brown-gray silty fine SAND with scattered 2-inch to 8-inch quarry spalls, moist. (SM)	Loose	
2		Light brown SAND with silt, fine to medium grained, moist. (SP-SM)	Medium Dense	9.7
5		Brown-gray GRAVEL with medium sand, scattered cobbles, fine to coarse gravel, moist. (GP)	Dense	2.6
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-19

FIGURE A-20

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** 7 Feet

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		FILL: Dark brown organic SILT/silty SAND, wood chunks, dry to moist. (OL/SM)	Loose	17.3
3		FILL: Blue-gray angular gravel and cobbles (2-inch to 8-inch quarry spalls), silt matrix, moist. (GM)	Very Dense	
4		Brown SAND with silt, fine to medium grained, moist. (SP-SM)	Medium Dense	12.5
7		Brown-gray fine GRAVEL with fine to medium sand, moist. (GP)	Dense	2.7
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-20

FIGURE A-21

PROJECT NAME: Port of Olympia **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(5 inches DUFF)		
1		Brown SAND with silt, fine to medium grained, moist. (SP-SM)		
2				12.6
3				
4				
5		Brown-gray GRAVEL with medium sand, stratified, fine to coarse gravel, moist. (GP)	Medium Dense	2.8
6				
7				
8				
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-21

FIGURE A-22

PROJECT NAME: Port of Olympia **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches DUFF)		
1		Light brown silty GRAVEL with fine sand, fine to coarse gravel, dry to moist. (GM)		
2				3.3
3		Brown-gray interbedded fine GRAVEL and fine to medium SAND, stratified, moist. (SP, GP)		
4				
5			Medium Dense	
6				
7				3.8
8				
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-22

FIGURE A-23

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(3 inches TOPSOIL)		
1		Brown-gray fine to coarse GRAVEL with fine to medium sand, scattered cobbles, trace boulders, dry to moist. (GP)		
2				2.0
3				
4				
5			Dense	
6				
7				
8				
9				2.0
10				
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-23

FIGURE A-24

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Bare Ground **APPROX. ELEV:** N/A

DATE LOGGED: August 18, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** 1-Foot

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		FILL: Brown-gray silty angular GRAVEL/COBBLES (2-inch to 8-inch quarry spalls) with fine sand, dry to moist. (GM)		
1				
2			Dense	
3				
4		Dark brown silty SAND, fine to medium grained, moist. (SM)		
5			Medium Dense	18.3
6		Brown-gray fine to coarse GRAVEL with silt and fine to medium sand, moist. (GP-GM)		
7				
8			Dense	2.7
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-24

FIGURE A-25

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(5 inches TOPSOIL)		
1		Light brown SAND with silt, fine to medium grained, weakly cemented to 2 feet, moist. (SP-SM)		
2			Medium Dense	6.5
3				
4				
5		Brown-gray fine to coarse GRAVEL with fine to medium sand, scattered cobbles, trace boulders, moist. (GW)		
6				2.3
7			Dense	
8				
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

LOG OF TEST PIT NO. TP-25

FIGURE A-26

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches TOPSOIL)		
1		Light brown silty fine SAND with gravel, moist. (SM)		
2				10.8
3			Medium Dense	
4				
5				
6				
7		Gray-brown fine GRAVEL with silt, fine to medium sand, scattered cobbles, moist. (GP-GM)		
8			Dense	
9		*Moist to wet.		3.3
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-26

FIGURE A-27

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Weeds **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(2 inches TOPSOIL)		
1		FILL: Dark brown-gray silty GRAVEL with 2-inch to 4-inch quarry spalls, moist. (GM)	Dense	
2		Light brown SAND with silt, fine to medium grained, moist. (SP-SM)		
3				
4				12.1
5		Gray-brown SAND, fine to medium grained, moist. (SP)		
6			Medium Dense	
7				7.6
8				
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-27

FIGURE A-28

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches DUFF)		
1		Brown fine SAND with silt, moist. (SP-SM)		
2				10.4
3				
4				
5			Medium Dense	
6		Light brown mottled silty fine SAND, moist. (SM)		
7		Gray medium SAND, moist. (SP)		
8				36.9
9				
10				
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-28

FIGURE A-29

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(3 inches DUFF)		
1		Light brown fine SAND with silt, moist. (SP-SM)		
2			Loose to Medium Dense	
3				2.7
4		Brown-gray SAND with gravel, fine to medium sand, moist. (SP)		
5				5.3
6				
7		Light brown mottled silty fine SAND, moist. (SM)	Medium Dense	
8				
9				22.9
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-29

FIGURE A-30

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(5 inches DUFF)		
1		Brown SAND with silt and gravel, fine to medium sand, moist. (SP-SM)	Loose to Medium Dense	
2				4.8
3		Brown-gray SAND, fine to medium grained, moist. (SP)	Medium Dense	
5				6.0
7		Brown mottled silty fine SAND, moist. (SM)		
8				27.6
10		Brown-gray SAND, fine to medium grained, moist. (SP)		
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-30

FIGURE A-31

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Duff **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(9 inches DUFF)		
1		Light brown silty fine SAND with gravel, moist. (SM)	Loose to Medium Dense	
2				5.7
3		Brown silty fine to coarse GRAVEL with fine sand, moist. (GP)		
4				
5		Tan mottled SILT with fine sand, non-plastic, moist. (ML)		
6			Medium Dense	9.4
7		Gray SAND, medium grained, moist. (SP)		
8				2.9
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-31

FIGURE A-32

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(5 inches DUFF)		
1		Brown silty fine SAND with gravel, moist. (SM)		
2				4.5
3				
4			Medium Dense	
5				
6		Gray SAND with gravel, fine to medium sand, moist. (SP)		
7				2.6
8				
9		Gray mottled SILT with fine sand, non-plastic, moist. (ML)	Dense	
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-32

FIGURE A-33

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(2 inches FILL/SOD)		
1		FILL: Dark gray organic silty GRAVEL, scattered angular cobbles (4-inch to 8-inch quarry spalls), abundant wood pieces, moist to wet. (GM/OL)		
2			Loose	
3				
4				
5		Dark gray silty fine GRAVEL, moist to wet. (GM)		
6				3.1
7		Gray SAND, medium grained, moist. (SP)	Medium Dense	
8				
9				6.1
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-33

FIGURE A-34

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Bare Ground **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		FILL: Brown silty GRAVEL with scattered angular cobbles (2-inch to 4-inch quarry spalls), moist. (GM)		
1			Dense	
2		FILL: Dark gray organic silty GRAVEL, scattered angular cobbles (4-inch to 8-inch quarry spalls), abundant wood pieces, scattered debris, moist to wet. (GM/OL)		
3			Loose	
4				
5		Brown silty fine GRAVEL with medium to coarse sand, moist. (GM)		
6			Medium Dense	6.4
7		Gray fine to coarse GRAVEL with silt and medium to coarse sand, scattered cobbles, moist to wet. (GP-GM)		
8				
9			Dense	
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		3.7
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-34

FIGURE A-35

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Bare Ground **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		FILL: Gray angular GRAVEL/COBBLES (2-inch to 4-inch quarry spalls), dry to moist. (GP)	Dense	
1		Brown SAND with silt, fine to medium grained, moist. (SP-SM)	Medium Dense	
2				8.4
3				
4		Brown to gray fine to coarse GRAVEL with medium sand, stratified , moist to wet. (GP)	Dense	
5				1.6
6				
7				
8				
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-35

FIGURE A-36

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Bare Ground **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(5 inches TOPSOIL/FILL)		
1		FILL: Dark gray SILT with gravel and scattered angular cobbles (4-inch to 8-inch quarry spalls), abundant wood pieces, moist. (ML)		
2			Loose	
3				
4		Brown silty fine SAND, moist. (SM)		
5				21.5
6				
7			Medium Dense	
8		Gray SAND, fine to medium grained, moist.		
9				5.3
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-36

FIGURE A-37

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		FILL: Brown silty fine SAND/SILT with gravel, moist. (SM/ML)		
1				
2		FILL: Dark brown-gray organic SILT with gravel, angular cobbles (4-inch to 8-inch quarry spalls), abundant sticks and branches, moist. (OL)		
3			Loose	
4				
5				
6		Brown mottled silty fine SAND, pockets of silt, moist. (SM)		
7				14.6
8			Medium Dense	
9				
10				
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-37

FIGURE A-38

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(3 inches DUFF)		
1		Brown to brown-gray silty fine SAND, moist. (SM)		
2			Loose to Medium Dense	
3				12.2
4				
5				
6				
7				
8			Medium Dense	
9		Gray SAND, fine to medium grained, moist. (SP)		
10				7.4
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-38

FIGURE A-39

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 19, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(8 inches TOPSOIL)		
1		Brown silty SAND, fine to medium grained, moist. (SM)		
2				
3				18.5
4				
5			Medium Dense	
6				
7		Gray medium SAND, moist. (SP)		
8				5.3
9		*With gravel and scattered cobbles.		
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

LOG OF TEST PIT NO. TP-39

FIGURE A-40

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Sparse Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
1		FILL: Brown silty fine SAND/SILT with gravel, scattered wood pieces, dry to moist. (SM/ML)	Medium Dense	12.1
2				
3		FILL: Dark gray to black organic SILT with sand, abundant wood pieces, scattered debris, moist. (OL)		
4				
5				
6				
7			Very Loose	
8				
9				
10				
11				
12				
13		Gray fine GRAVEL with medium to coarse sand, moist to wet. (GP)	Dense	
14				3.4
15		Test pit terminated at approximately 14 feet. No groundwater. No caving.		
16				
17				
18				
19				
20				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-40

FIGURE A-41

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Sparse Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(5 inches TOPSOIL)		
1		Brown silty SAND with gravel, scattered cobbles, fine to medium sand, dry to moist. (SM) (Possible fill)	Medium Dense	6.4
2		Brown-gray fine GRAVEL with fine to medium sand, moist. (GP)		
3				
4				
5				2.3
6			Dense	
7				
8				
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-41

FIGURE A-42

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Sparse Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(5 inches TOPSOIL)		
1		Brown silty fine SAND/SILT, moist. (SM) (Possible fill)	Medium Dense	9.1
2		Brown-gray fine GRAVEL with fine to medium sand, scattered cobbles, moist. (GP)		
3				
4				
5				2.9
6			Dense	
7				
8				
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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Environmental Earth Sciences

LOG OF TEST PIT NO. TP-42

FIGURE A-43

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Sparse Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		FILL: Dark gray-brown silty SAND, trace to scattered debris, fine to medium sand, moist. (SM)		
1				
2			Very Loose	
3				
4				
5				12.1
6				
7				
8				
9				
10			Loose	12.5
11				
12				
13		*With gravel		
14				
15		Test pit terminated at approximately 15 feet. No groundwater. No caving.		
16				
17				
18				
19				
20				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-43

FIGURE A-44

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches DUFF)		
1		Brown silty fine SAND, moist. (SM)	Loose to Medium Dense	
2				
3		Yellow-brown GRAVEL with fine sand, fine to coarse gravel, scattered cobbles, moist. (GW)		8.4
4				
5			Medium Dense	
6				3.8
7				
8		Gray-brown fine GRAVEL with silt and medium to coarse sand, moist to wet. (GP-GM)		
9			Dense	
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-44

FIGURE A-45

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(5 inches DUFF)		
1		Brown silty fine SAND, dry to moist. (SM)		
2				7.9
3		Light brown SAND with silt, fine to medium grained, moist. (SP-SM)		
4			Medium Dense	
5				6.4
6				
7				
8		Gray-brown fine to coarse GRAVEL with fine to medium sand, scattered cobbles, moist. (GP)		
9			Dense	1.4
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-45

FIGURE A-46

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Bare Ground **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		FILL: Six inches of brown-gray silty GRAVEL over gray angular GRAVEL/COBBLES (2-inch to 8-inch quarry spalls), dry to moist. (GP/GM)		
1			Very Dense	
2				
3		Brown silty SAND, fine to medium grained, moist. (SM)		10.8
4			Medium Dense	
5				
6		Gray-brown fine to coarse GRAVEL with sand, scattered cobbles, dry to moist. (GP)		
7				1.7
8			Dense	
9				
10				2.7
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-46

FIGURE A-47

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches DUFF)		
1		Brown silty fine SAND, weakly cemented to 2 feet, moist. (SM)		
2			Medium Dense	10.9
3				
4				
5		Light gray-brown fine to coarse GRAVEL with silt and sand, scattered cobbles, trace boulders, moist. (GP-GM)		
6				
7			Dense	1.8
8				
9				
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-47

FIGURE A-48

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Sparse Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches DUFF) FILL: Brown silty fine SAND, scattered debris, abundant sticks and branches, moist. (SM)	Loose	17.9
5		Light brown mottled silty fine SAND/SILT, moist. (SM/ML)	Medium Dense	27.5
9		Gray-brown fine GRAVEL with fine to coarse sand, moist to wet. (GP)	Dense	4.1
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-48

FIGURE A-49

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Sparse Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(3 inches SOD/FILL)	Medium Dense	
1		FILL: Dark gray silty GRAVEL with angular (2-inch to 8-inch quarry spalls), scattered debris and wood pieces, moist. (GM)		
2		Dark gray to light brown SAND with silt, fine to medium grained, moist. (SP-SM)		
3				9.8
4				
5				
6				
7				
8		Light brown SILT with fine sand, non-plastic, pockets of silty sand, moist. (ML)		
9				
10				29.0
11		Test pit terminated at approximately 11 feet. No groundwater. No caving.		
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-49

FIGURE A-50

PROJECT NAME: Port of Olympia Property **PROJ. NO:** T-8388 **LOGGED BY:** KPR

LOCATION: Tumwater, Washington **SURFACE CONDITIONS:** Sparse Brush **APPROX. ELEV:** N/A

DATE LOGGED: August 20, 2020 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(4 inches TOPSOIL)		
1		Dark brown silty fine SAND, moist. (SM)	Loose to Medium Dense	
2				11.7
3		Light brown SAND with silt, fine to medium grained, moist. (SP-SM)		
4				5.8
5				
6			Medium Dense	
7				
8		Light brown mottled SILT with fine sand, non-plastic, moist. (ML)		
9				25.4
10		Test pit terminated at approximately 10 feet. No groundwater. No caving.		
11				
12				
13				
14				
15				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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Particle Size Distribution Report

	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.2	10.7	86.7	2.4	
□	0.0	0.0	0.0	0.0	1.0	87.7	11.3	
△	0.0	0.0	0.4	0.2	13.8	82.4	3.2	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.3964	0.2919	0.2627	0.2116	0.1750	0.1617	0.95	1.81
□			0.2673	0.2017	0.1834	0.1481	0.1077			
△			0.4195	0.2821	0.2481	0.1929	0.1533	0.1165	1.13	2.42

Material Description	USCS	AASHTO
○ SAND	SP	
□ SAND with silt	SP-SM	
△ SAND	SP	

Project No. T-8388 **Client:** Panattoni Development Company

Project: Port of Olympia Property

○ **Location:** TP-1 **Depth:** -9 feet
□ **Location:** TP-4 **Depth:** -2 feet
△ **Location:** TP-11 **Depth:** -6 feet

Remarks:

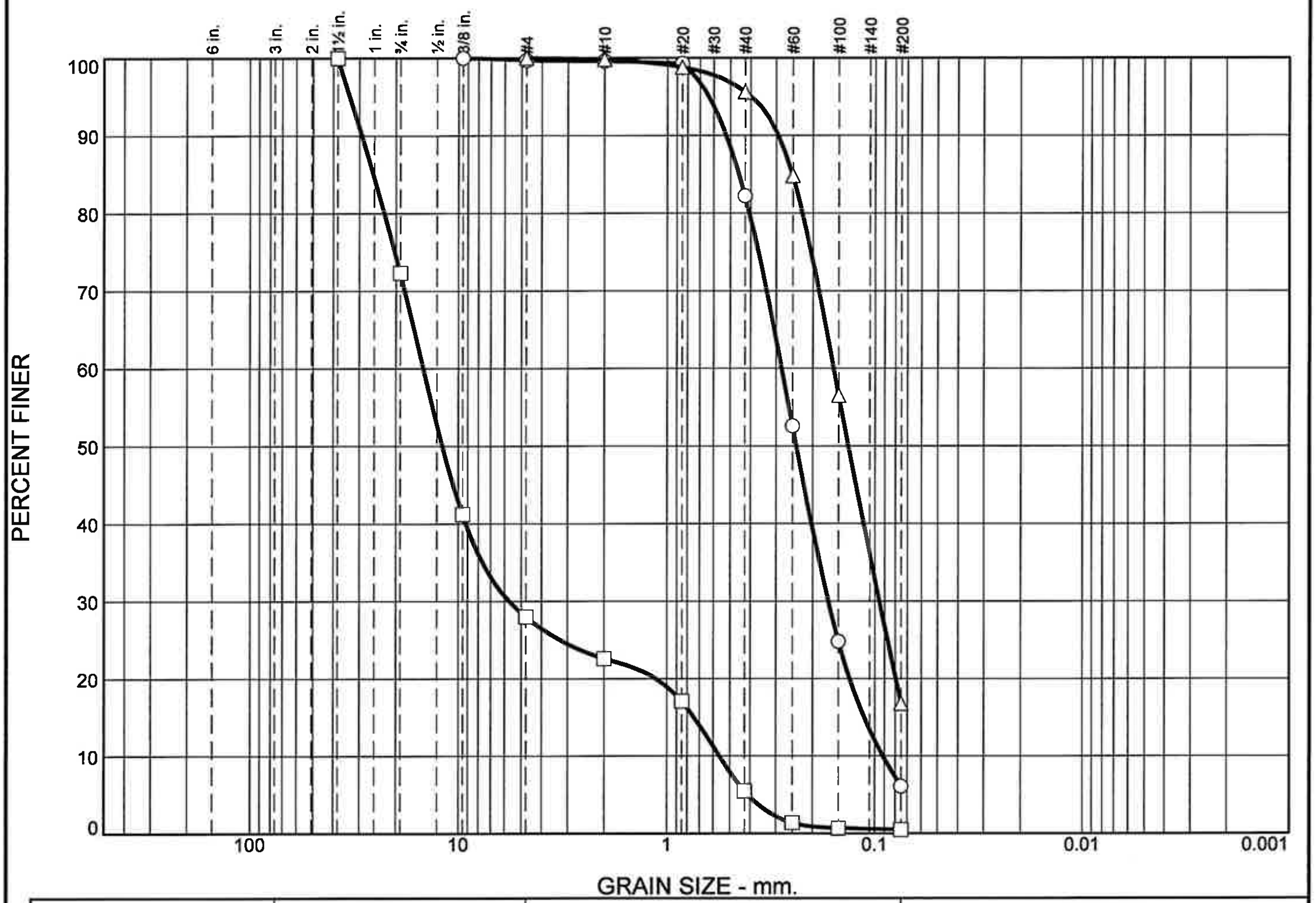
Terra Associates, Inc.

Kirkland, WA

Figure A-51

Tested By: FQ

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.3	0.1	17.4	76.1	6.1	
□	0.0	27.7	44.3	5.4	17.1	5.0	0.5	
△	0.0	0.0	0.0	0.2	4.2	78.8	16.8	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.4543	0.2823	0.2395	0.1679	0.1127	0.0913	1.09	3.09
□			25.6656	14.7278	11.8931	5.6960	0.7406	0.5599	3.93	26.31
△			0.2513	0.1588	0.1347	0.0951				

Material Description	USCS	AASHTO
○ SAND with silt	SP-SM	
□ GRAVEL with sand	GP	
△ Silty SAND	SM	

Project No. T-8388 **Client:** Panattoni Development Company

Project: Port of Olympia Property

○ **Location:** TP-14 **Depth:** -6 feet

□ **Location:** TP-22 **Depth:** -9 feet

△ **Location:** TP-25 **Depth:** -2 feet

Remarks:

Terra Associates, Inc.

Kirkland, WA

Figure A-52

Tested By: FQ

Particle Size Distribution Report

	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.5	0.6	4.3	89.8	3.8	
□	0.0	2.3	12.0	11.1	54.0	20.3	0.3	
△	0.0	23.3	27.4	2.3	6.3	38.7	2.0	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.3064	0.2235	0.2050	0.1730	0.1425	0.1070	1.25	2.09
□			4.5242	0.7727	0.6584	0.4945	0.3799	0.3340	0.95	2.31
△			24.1325	11.8768	6.5174	0.3066	0.2105	0.1819	0.04	65.30

Material Description	USCS	AASHTO
○ SAND	SP	
□ SAND	SP	
△ GRAVEL with sand	GP	

Project No. T-8388 **Client:** Panattoni Development Company

Project: Port of Olympia Property

○ **Location:** TP-29 **Depth:** -5 feet
□ **Location:** TP-31 **Depth:** -7 feet
△ **Location:** TP-43 **Depth:** -6 feet

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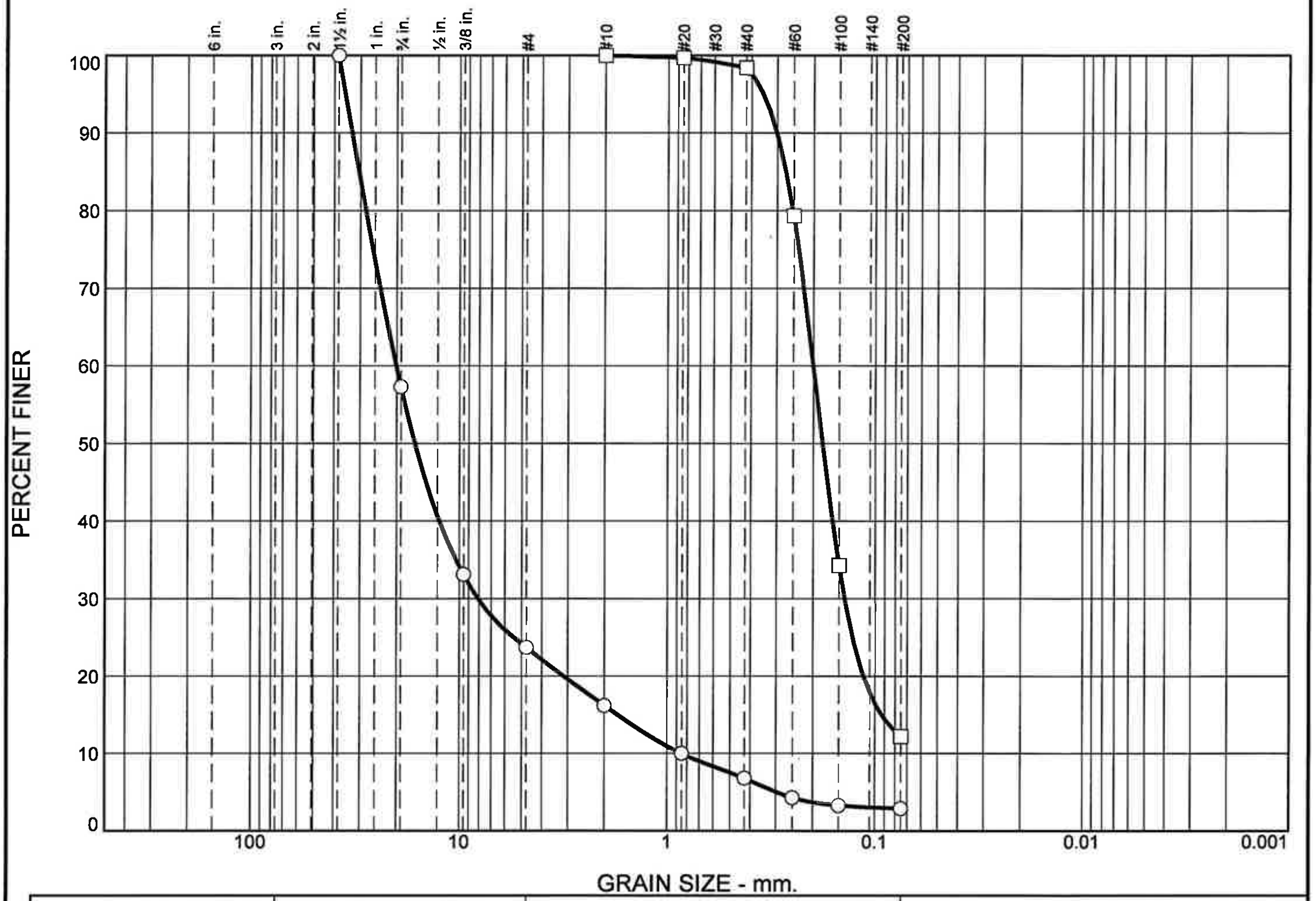
Kirkland, WA

Remarks:

Figure A-53

Tested By: FQ

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	42.7	33.6	7.5	9.4	3.9	2.9	
□	0.0	0.0	0.0	0.0	1.6	86.2	12.2	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			30.4277	20.0763	16.2769	8.0864	1.7271	0.8500	3.83	23.62
□			0.2731	0.2001	0.1802	0.1408	0.0928			

Material Description	USCS	AASHTO
○ GRAVEL with sand	GP	
□ Silty SAND	SM	

Project No. T-8388 **Client:** Panattoni Development Company

Project: Port of Olympia Property

○ **Location:** TP-45 **Depth:** -10 feet

□ **Location:** TP-49 **Depth:** -2 feet

Remarks:

Terra Associates, Inc.

Kirkland, WA

Figure A-54

Tested By: FQ