

*Geotechnical Assessment
Clackamette Cove Development
Oregon City, Oregon*

Prepared for:
Pacific Property Search, LLC

May 26, 2011
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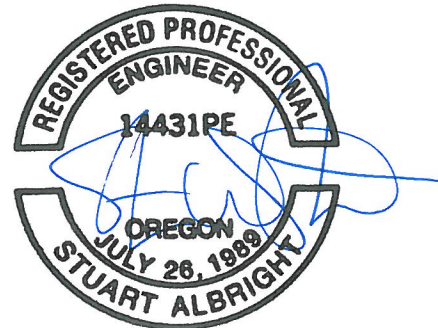
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Environmental and Geotechnical Consultants

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Project Number

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1.0 Introduction and Limitations

This report presents Ash Creek Associates, Inc.'s (Ash Creek's) geologic and geotechnical engineering evaluation and recommendations for the proposed redevelopment of the Clackamette Cove site in Oregon City, Oregon (Figure 1). Ash Creek has in the past conducted several Geotechnical Site Investigations of the proposed project site. The most recent of these past investigations was detailed in a report issued by Ash Creek on November 12, 2009, entitled "Pacific Property Search, Geotechnical Assessment – Clackamette Cove Development".

The purpose of our work was to review and assess the previous soil-related work for the proposed project and to update our Geotechnical Report for the proposed project. Moreover, since November of 2009, additional project detailing and layout of proposed structures has been conducted. In light of the additional planning for the proposed project, further subsurface exploration work was completed by Ash Creek.

Ash Creek's scope of work was detailed in our proposal and estimated work scope. The work was performed for the exclusive use of Pacific Property Search, LLC for specific geotechnical-related application to this project. This work was conducted in accordance with generally accepted professional practices in the same or similar localities related to the nature of the work accomplished, at the time the services were performed. No other warranty, express or implied, is made.

Our scope of work included a preliminary geologic site reconnaissance followed by a subsurface investigation. Additional aspects of our work scope included a site vicinity geologic reference review, as well as the preparation of this report.

2.0 Site Description and Project Understanding

Site Description. The Clackamette Cove site is located in Oregon City, Oregon in the area generally bounded by Highway 99E on the west, the Clackamas River on the north, the old Rossman Landfill and Tri-Cities Wastewater Treatment Plant on the east, and Main Street on the south. It consists of the tax lots that surround and totally contain Clackamette Cove.

Clackamette Cove is a former sand/gravel mining pit that is now connected to the Clackamas River. The Clackamette Cove area was undeveloped and used for agricultural purposes through the early 1950s. From the mid 1950s through 1986, the property was used for mining sand and gravel and manufacturing asphalt concrete. Since 1986, the property has been generally undeveloped.

Project Understanding. As we understand it, the overall approach to site development includes excavation of the lakefront to soften grades at the waterfront with filling on the eastern half of the site. We understand that the project may include construction of a mixed-use development featuring condominiums,

apartments, and commercial parcels, as well as the installation of services, parking areas, and access drives. The project layout in terms of proposed parking, access drives and building footprints was provided to Ash Creek as part of our additional site investigation work. The base map for the proposed project layout was utilized as our Site Vicinity Plan (see Figure 2). The Site Vicinity Plan (Figure 2) indicates the locations of proposed pavements and buildings as well as the locations of all of Ash Creek's previous subsurface investigations.

The project will also feature a significant amount of roadway construction, including the relocation of Main Street southward into the former cement plant property, and the construction of a new Agnes Avenue along the approximate location of the former railroad right-of-way.

3.0 Geologic Setting

Based upon a review of available geologic literature and a review of previous work in the area, the most prevalent materials in the area are surface fills, recent alluvium (silts, sands, and gravels) and the Troutdale Formation (gravels, cobbles, sands, and intermittent boulders).

Groundwater. Previous work in the area by environmental consultants indicates that the groundwater table is typically encountered at a depth of 15 to 25 feet below current ground surface elevations. However, of importance in terms of proposed utility trenching, site grading, and excavation work, very shallow, perched water was observed at very shallow depths within a number of our test pits. Trench and excavation dewatering should therefore be anticipated by contractors, and they should bid their work accordingly.

3.1 Seismicity and Earthquake Sources

The seismicity of the Oregon City area, and hence the potential for ground shaking, is controlled by three separate fault mechanisms. These include the Cascadia Subduction Zone (CSZ), the mid-depth intraplate zone, and the relatively shallow crustal zone. Descriptions of these potential earthquake sources are presented below.

The CSZ is located offshore and extends from northern California to British Columbia. Within this zone, the oceanic Juan De Fuca Plate is being subducted beneath the continental North American Plate to the east. The interface between these two plates is located at a depth of approximately 15 to 20 kilometers (km). The seismicity of the CSZ is subject to several uncertainties, including the maximum earthquake magnitude and the recurrence intervals associated with various magnitude earthquakes. Anecdotal evidence of previous CSZ earthquakes has been observed within coastal marshes along the Washington coast. Sequences of interlayered peat and sands have been interpreted to be the result of large subduction zone earthquakes occurring at intervals on the order of 300 to 500 years, with the most recent event taking place approximately 300 years ago. A recent study by Geomatrix (1995) suggests that the maximum earthquake associated with the CSZ is moment magnitude (M_w) 8 to 9. This is based on an empirical expression

relating moment magnitude to the area of fault rupture derived from earthquakes that have occurred within subduction zones in other parts of the world. An M_w 9 earthquake would involve a rupture of the entire CSZ. As discussed by Geomatrix (1995), this has not occurred in other subduction zones that have exhibited much higher levels of historical seismicity than the CSZ, and is considered unlikely. For the purpose of this study, an earthquake of M_w 8.5 was assumed to occur within the CSZ.

The intraplate zone encompasses the portion of the subducting Juan De Fuca Plate located at a depth of approximately 30 to 50 km below western Washington and western Oregon. Very low levels of seismicity have been observed within the intraplate zone in Oregon. However, much higher levels of seismicity within this zone have been recorded in Washington and California. Several reasons for this seismic quiescence were suggested in the Geomatrix (1995) study and include changes in the direction of subduction between Oregon, Washington, and British Columbia, as well as the effects of volcanic activity along the Cascade Range. Historical activity associated with the intraplate zone includes the 1949 Olympia magnitude 7.1 and the 1965 Puget Sound magnitude 6.5 earthquakes. Based on the data presented within the Geomatrix (1995) report, an earthquake of magnitude 7.25 has been chosen to represent the seismic potential of the intraplate zone.

The third source of seismicity that can result in ground shaking in the area is near-surface crustal earthquakes occurring within the North American Plate. The historical seismicity of crustal earthquakes in western Oregon is higher than the seismicity associated with the CSZ and the intraplate zone. The 1993 Scotts Mills (magnitude 5.6) and Klamath Falls (magnitude 6.0) earthquakes were crustal earthquakes.

4.0 Subsurface Conditions

The field explorations for this project were conducted between June 2006 and November 2007. Additional test pit explorations were also conducted on April 21, 2011. The exploration program consisted of 30 trackhoe test pits excavated throughout the site. The approximate locations of the test pits are indicated on the accompanying Site Vicinity Plan (Figure 2). The maximum depth penetrated by the test pits was approximately 19 feet below the existing ground surface. Subsurface conditions encountered during our field exploration are described below.

Topsoil. Native soils are generally not exposed at the ground surface and as such, topsoil development is limited. However, there are many areas of the site where grass and light brush has taken root. These areas will require stripping during site grading in order to remove surface organics and root matter from below proposed parking areas, building footprints, sidewalks and other settlement-sensitive features/structures. Topsoil and organic-rich soil over these areas of the site will likely require between 2 to 4 inches of stripping. This material should be stripped during initial site work. Topsoil strippings should not be reemployed as structural fill, but can potentially be reused in landscaping areas.

Fill. The entire site has been previously filled. The fills generally consist of a mix of silts, sands, and gravels with some boulders. Large slabs of concrete and other debris were encountered at depth throughout the site. Some organic material, including sticks and branches was spread throughout the fill. Significant trench wall caving was also noted within some of our test pits, particularly with areas where seepage was also observed, or when fill materials consisted of loose sands or loose gravels.

Native Sandy Silt. The majority of the test pits excavated for this project terminated in fills. Boring logs for a monitoring well installed on the site indicate that the shallow, native soils consist of sandy silts. These soils are generally encountered as stiff to hard.

Groundwater. The static groundwater table was not observed in any of our exploratory test pits. Previous work in the area by environmental consultants indicates that the groundwater table is typically encountered at depths of 15 to 25 feet below current ground surface elevations. Shallow, perched water is anticipated throughout the site during prolonged wet weather. The static groundwater table will typically correspond/fluctuate, within a few feet, of the surface water levels within the Cove and within the Clackamas River.

However, of importance in terms of proposed trenching and excavation work, intermittent seepage was encountered within a number of our test pits. Flows varied from light to very heavy. Notable areas of very heavy seepage were observed in the vicinity of Test Pits TP-24, TP-27, TP-28 and TP-30. As areas of subsurface seepage as observed within our test pits was relatively random in nature, it's also very likely that other areas of subsurface seepage will be encountered during site grading, trenching and excavation work. Contractors should be prepared for trench and excavation dewatering and should account for the likelihood of dewatering within their work scopes and bids.

5.0 Conclusions and Recommendations

The presence of loose fill throughout the site will have the most significant impact on the future development. The remediation of these fills will require careful site grading in order to mitigate the need for deep foundations.

In general, the fills encountered throughout the site consist of mineral soils or inert materials. No domestic refuse or large organic pockets were observed. Some limited amount of organics was encountered, including logs and limbs. Our explorations did encounter abandoned or dumped pipes as well as boulders, which can be nested and result in voids. It is possible that these voids could collapse over time, leading to surface deformations. In order to mitigate the effects of such collapses on potential structures, we are recommending that all buildings are underlain by re-compacted structural fill. Ultimately, the safest approach to developing the site would consist of removing the entire fill mass and placing it as structural fill. However, the costs of such an approach would be prohibitive. Based upon our experience with similar sites,

it is our opinion that a program of selective replacement will result in acceptable performance for residential and light commercial structures.

The fill soils in the area of the northernmost building pad were particularly notable in terms of how soft and wet they were. Test Pit TP-30 was excavated in the proposed area of this north most building pad. It is likely that an old sediment pond was located in the area of this northern most building, and that TP-30 was actually excavated through the reclamation fill used for backfilling this old pond. Based upon the smell emanating from the test pit, it's likely that the backfill employed in the pond reclamation contained a large fraction of organic matter. Very heavy seepage, and test pit wall caving/sloughing was also observed within this test pit.

5.1 Settlement and Fills

It is our recommendation that all structures proposed for the site be underlain by at least 10 feet of re-compacted structural fill. Based upon the randomness of fill materials employed over the site, we are also anticipating that some areas of the site will require additional material removal from below proposed building pads. This will most likely be the case with the northernmost building pad, due to the poor quality of backfill employed in this area, and the potential that this proposed building pad is located over an old sediment pond.

Over time, areas of un-compacted fills present on this site will continue to collapse and consolidate. This could eventually be manifested as settlements at the site surface. If a sufficient thickness of compacted fill is placed beneath proposed buildings, the differential settlement issues could be lowered to acceptable levels (less than 1 inch total, 1/2 inch differential). However, longer-term fill settlements may still be manifested in surface pavements, sidewalks, utilities, etc. This condition is of most concern in areas along the northern side of the proposed development, where extremely marginal backfill materials were utilized as part of the old quarry reclamation. Subgrade areas at the base of trenches as well as subgrade for pavements and sidewalks in these areas will require assessment on a case-by case basis to determine if overexcavation and subgrade stabilization via crushed rock and filter fabric is required.

5.2 Grading Recommendations

Topsoil Stripping. Topsoil depths on the site are generally in the range of 2 to 6 inches below the ground surface. Topsoil should be stripped from all building and pavement areas. This soil should not be reused as structural fill but can be reused in low-lying landscape berms.

Wet Weather Grading. We recommend that site work be conducted during summer months (late June through early October). If wet weather grading is to be conducted, it should be anticipated that grading and site work costs will increase significantly. All fills placed during wet weather should consist of clean gravel or clean crushed rock. Clean granular wet weather fill (gravel or crushed rock) should contain less than 5 to 7 percent fines by weight. If wet weather grading and site work is conducted, a granular work pad should be



constructed over the site. This should consist of 18 inches of clean gravel or clean crushed rock, or 12 inches of clean gravel or clean crushed rock placed over a geotextile filter fabric.

Compaction Recommendations. Structural fills should be installed on a subgrade that has been prepared in accordance with the above recommendations. Fills should be installed in horizontal lifts not exceeding 8 inches in thickness (loose—prior to compaction), and should be compacted to at least 92 percent of the maximum dry density for fine-grained native soils. The maximum dry densities should be determined in accordance with ASTM D 1557 (Modified Proctor Test). The compaction criteria may be reduced to 85 percent in non-structural landscape or planter areas. Fills placed over ground that slopes in excess of 3H:1V should be keyed and benched into firm soils beneath all topsoil and tree or brush roots.

A summary of recommended compaction specifications is provided in the following table.

Table 1 – Recommended Fill Compaction Specifications

Material	Percent of Maximum Dry Density ASTM D 1557
Structural Fill and Trench Backfill	92
Landscaping Fill	85
Base Rock for Slabs and Pavements	95

Structural Fills During Summer Grading. During dry weather, structural fills may consist of virtually any well-graded soil that is free of debris, organic matter, and high percentages of clay or clay lumps, and that can be compacted to the preceding specifications. However, if excess moisture causes the fill to pump or weave, those areas should be dried and re-compacted, or removed and backfilled with compacted granular fill. In order to achieve adequate compaction during wet weather, or if proper moisture content cannot be achieved by drying, we recommend that fills consist of well-graded granular soils (sand or sand and gravel) that do not contain more than 5 percent material by weight passing the No. 200 sieve. In addition, it is usually desirable to limit this material to a maximum 6 inches in diameter for ease of compaction and future installation of utilities.

5.3 Finished Cut and Fill Slopes

Although steeper rock slopes may be feasible for portions of the site, we recommend that finished cut and fill slopes not exceed gradients of 2H:1V. Cut and fill slopes should be protected immediately from erosion following completion of grading. Erosion protection should consist of placement of jute mesh and seeding with erosion-resistant vegetation or other engineer-approved erosion control methods. New finished cut and fill slopes that exceed 15 feet in height should be assessed on a case-by-case basis for global stability.

5.4 Excavations

Subsurface conditions encountered during the site investigation indicate that precautions in utility excavations will be required due to the potential for caving/sloughing. Any excavations deeper than 4 feet should be sloped or shored in accordance with Occupational Safety and Health Act (OSHA) regulations. Normally, shoring systems (for excavations less than 20 feet in depth) are contractor-designed and -installed items. Our test pit explorations encountered boulders and rock fills throughout the site. In spite of using a trackhoe, we met refusal in some of these fills. It is anticipated that difficult excavation conditions will be encountered throughout the property.

Of particular note is the presence of waste concrete on the former cement plant site. Our test pits within this property encountered widespread evidence of buried waste concrete that was likely placed during operation of the facility. Removal of this material may require techniques similar those used for rock removal, including the use of hydrohammers or other demolition tools.

As indicated within the subsurface section of this report, static groundwater will typically correspond approximately with the surface water levels within the Cove and the nearby Clackamas River. Shallower perched water was observed in a number of our test pits around the site, and trench and excavation dewatering will be required when seepage is encountered within trenches and excavations.

5.5 Erosion Control

Ash Creek recommends that finished cut and fill slopes be protected immediately following grading with vegetation, gravel, or other approved erosion control methods. Water should not be allowed to flow over slope faces or drop from outfalls, but should be collected and routed to stormwater disposal systems. Riprap, gabion baskets, or similar erosion control methods may be necessary at stormwater outfalls or to reduce water velocity in ditches. Silt fences should be established and maintained throughout the construction period. Silt fence barriers should be established downslope from all construction areas to protect natural drainage channels from erosion and/or siltation. In order to decrease erosion potential, care should be taken to maintain native vegetation and organic soil cover over as much of the site as possible.

5.6 Foundation Support

Based on our review of the current grading plan, and dependent upon final structural loading conditions, we anticipate that conventional spread footings can be employed for building support. This conclusion is based on the assumption that a minimum of 10 feet of structural fill will be placed under all buildings.

For initial planning purposes, Ash Creek has made a number of assumptions. If the proposed structures will be four stories or less, and column loads do not exceed maximum factored loads of about 450 kips, and factored loads for continuous wall footing do not exceed approximately 3 or 4 kips per lineal foot (Klf), then

spread footings established on native soils and structural fills can be designed for an allowable bearing capacity of 3 kips per square foot (Ksf). We estimate that foundations designed in accordance with the above recommendations will experience less than 1 inch of total settlement, and less than 1/2 inch of differential settlement between adjacent foundation elements.

5.7 Slabs on Grade

In order to establish a capillary break between ground moisture and the bottoms of slab-on-grade areas, we recommend installation of at least 6 inches of clean crushed rock or gravel section between the bottom of the slab and the subgrade. In addition, a vapor retarder should be employed between the slab and the subgrade soils. A number of valid construction approaches can be employed for the vapor retarder.

One approach involves the placement of the slab-on-grade base rock section followed by placement of the retarder over the base rock, then covering the retarder with approximately 2 inches of clean, dry sand. Another approach includes placement of the retarder between the subgrade and the slab's base rock section. This would entail use of a stronger retarder in order to reduce the potential for retarder damage during placement and compaction of the slab's base rock section.

5.8 Retaining Structures

The following guidelines for restrained and non-restrained walls assume that the associated recommendations regarding drainage, compaction, and other issues will be implemented. The design parameters in this section are for conventional retaining walls. If alternative retaining wall systems are proposed, Ash Creek should be contacted for additional soil parameters.

Restrained Walls. Restrained walls are any walls that are prevented from rotation during backfilling. Walls with corners and those that are restrained by a floor slab or roof fall into the category of restrained walls. We recommend that restrained walls be designed for pressures developed from the equivalent fluid weights shown in the following table.

Table 2a – Restrained Wall Pressure Design Recommendations

Backfill Slope Horizontal:Vertical	Equivalent Fluid Weight (pounds per cubic foot [pcf])
Level	50
3H:1V	60
2H:1V	90

These pressures represent our best estimates of actual pressures that may develop and do not contain a factor of safety. These pressures are assumed to act horizontally (normal to the wall). This is based on the assumption that drainage membranes or impervious wall coatings will prevent friction between the wall and

backfill. These pressures assume retaining wall backfill material is well-drained. If traffic loads are expected within a horizontal distance from the top of the wall equal to the wall height, uniform lateral earth pressure acting horizontally on restrained walls equal to 80 pounds per square foot (psf) should be added to earth loads acting on the wall.

Non-Restrained Walls. Non-restrained walls have no restraint at the top and are free to rotate about their bases. Most cantilever retaining walls fall into this category. We recommend that non-restrained walls be designed for pressures developed from the equivalent fluid weights shown in the following table.

Table 2b – Non-Restrained Wall Pressure Design Recommendations

Backfill Slope Horizontal:Vertical	Equivalent Fluid Weight (pcf)
Level	40
3H:1V	50
2H:1V	75

The above pressures represent our best estimate of actual pressures that may develop and do not contain a factor of safety. These pressures assume retaining wall backfill material is well-drained. If traffic loads are expected within a horizontal distance from the top of the wall equal to the wall height, uniform lateral earth pressure acting horizontally on non-restrained walls equal to 60 psf should be added to earth loads acting on the wall.

Seismic Lateral Earth Pressure. Lateral earth pressure acting on a retaining wall should be increased to account for seismic loadings. These pressures may be approximated by an evenly distributed pressure which is applied over the entire back of the wall. Using a design acceleration coefficient of 0.17 (this is equal to 1/2 of the peak horizontal ground acceleration) and a wall height “H” of up to 25 feet, we recommend that the seismic loadings be based on the surcharge pressures given in the following table.

Table 3 – Seismic Surcharge Design Pressure Recommendations

Design Condition	Seismic Pressure Surcharge (psf)
Active Earth Pressure	9H
At-Rest Earth Pressure	20H

These pressures represent our best estimate of actual pressures that may develop and do not contain a factor of safety. These pressures assume retaining wall backfill material is well-drained.

Retaining Wall Backfill. Backfill behind retaining walls should consist of free-draining granular material. To minimize pressures on retaining walls, we recommend the use of well-graded crushed rock backfill with

less than 5 percent fines by weight passing the No. 200 sieve. Use of other material could increase wall pressures. Over-compaction of this fill can greatly increase lateral soil pressures. We therefore recommend that this fill be compacted to approximately 90 percent of the material's maximum density as determined by ASTM D 1557 testing.

We recommend that foundations or major loads not be placed within the zone that extends back from the base of retaining walls at a 1H:1V slope. Foundation loads located within this zone will significantly increase lateral pressures acting on retaining walls. In addition, backfill behind retaining walls is typically compacted to lower levels than normal structural fill. Some settlement is typical of retaining wall backfill. Foundations within a wall backfill zone will also be subjected to settlement.

Retaining Wall Drainage. Retaining walls will require drainage in order to alleviate lateral fluid forces acting on the walls. The drains should be protected by a filter fabric to prevent internal soil erosion and potential clogging.

Mechanically Stabilized Earth Walls. Mechanically stabilized earth (MSE) retaining wall backfills should consist of clean, granular soils (i.e., sand, gravels, crushed rock). MSE walls require high-quality backfill for durability, good drainage, constructability, and good soil reinforcement interaction. These characteristics can be obtained from well-graded granular materials. MSE systems depend on friction between the reinforcing elements and the soil. In such cases, a material with high friction characteristics is specified and required. Some systems rely on passive pressure on reinforcing elements and, in those cases, the quality of backfill is still critical. These performance requirements generally eliminate predominantly fine-grained soils, particularly soils with high clay content.

Recommended soil strength parameters for use in the reinforced retaining wall design are summarized in the following tables. Soil cohesion should be assumed as zero.

Table 4 – MSE Backfill, Soil Strength Design Recommendations

Backfill Type	Design Friction Angle (Φ)	Moist Soil Unit Weight (γ)	Active Lateral Earth Pressure Coefficient ²	At-Rest Lateral Earth Pressure Coefficient ³
Select Borrow, Imported Clean Sand ¹	34 degrees	120 pcf	0.28	0.44
Crushed Rock	40 degrees	135 pcf	0.22	0.36

Table 5 – MSE Backfill, Active and At-Rest Earth Pressure Coefficients for Sloping Backfill

Backfill Type	Active Earth Pressure Coefficient 3:1 Backslope	At-Rest Earth Pressure Coefficient 3:1 Backslope	Active Earth Pressure Coefficient 2:1 Backslope	At-Rest Earth Pressure Coefficient 2:1 Backslope
Select Borrow, Imported Clean Sand ¹	0.33	0.49	0.41	0.57
Crushed Rock	0.30	0.45	0.36	0.51
Gravel Backfill for Walls	0.24	0.38	0.28	0.42

Notes:

1. Select Borrow, Imported Clean Sand: The sand should contain less than 9 or 10 percent fines by weight passing a standard No. 200 sieve.
2. Coulomb Active Lateral Earth Pressure with wall friction. The value assumes level backfill.
3. At-Rest Earth Pressure, $K_0 = 1 - \sin(\Phi)$. The value assumes level backfill.

Traffic Surcharging Loads. If traffic loads are expected within a horizontal distance from the top of the wall equal to the wall height, a uniform lateral earth pressure acting horizontally on reinforced walls equal to 60 psf should be added to earth loads acting on the wall. This surcharge load accounts for light to moderate weight automobiles and light weight trucks. Heavy truck traffic loading of wall backfill will result in high lateral wall pressures. If heavy truck traffic loading is anticipated, Ash Creek should be notified in order to provide additional recommendations for potential wall pressures.

External and Global MSE Wall Stability. MSE wall stability should be determined for overturning, bearing, and sliding stability. Appropriate factors of safety should be utilized in design. The following soil parameters should be employed in external stability checks.

Table 6 – MSE Wall External Stability, Soil Design Parameters

Parameter	Symbol	Units	Value
Gravel Backfill for Retaining Walls			
Backfill Soil Unit Weight	γ	pcf	See Table 4
Backfill Soil Friction Angle	Φ	degrees	See Table 4
Active Lateral Earth Pressure Coefficient (Coulomb with wall friction)	K_a	--	See Tables 4 & 5
At-Rest Lateral Earth Pressure Coefficient ($K_0 = 1 - \sin(\Phi)$)	K_0	--	See Tables 4 & 5
In-place Soils at Foundation Grade			
Foundation Soil Friction Angle	ϕ	degrees	28
Foundation Soil Unit Weight	γ	pcf	120
Base Sliding Coefficient (Ultimate)	d	--	0.34
Allowable Bearing Capacity for footing embedded a minimum of 3 feet	q_{all}	Ksf	2 ²
Allowable Bearing Capacity for footing embedded a minimum of 6 feet	q_{all}	Ksf	4 ³
Passive Lateral Earth Pressure Coefficient	k_p	--	2.77



Notes:

1. Ksf = Kips per square foot.
2. The bottom of footing is a minimum of 3 feet below all adjacent grades.
3. The bottom of footing is a minimum of 6 feet below all adjacent grades.

MSE Wall Foundation Embedment. To reduce long-term MSE wall stability issues associated with sloughing of existing slopes, we recommend that the toe of the MSE wall be embedded. The forward edge (toe) of wall should be set back a horizontal distance from the face of the slope a minimum of the height of the slope divided by two ($H / 2$).

Total and Differential Settlement Estimate. For MSE backfill heights of 15 feet or less in which foundations are embedded a minimum of 3 feet below all surrounding grades, our estimated total settlement is less than 1 inch. Differential settlement over either a 50-foot section or 100-foot section of MSE wall is estimated to be less than 0.5 inch.

Suitable Fill Materials. Backfill selection should be based on the ability of the material to drain and the drainage design developed for MSE walls. Weather conditions will also affect the ability to place and properly compact fill materials utilized in MSE wall construction. Additionally, for MSE walls and reinforced slopes, the susceptibility of the backfill reinforcement to damage due to placement and compaction of backfill on the soil reinforcement should be taken into account with regard to backfill selection.

Additional Design Considerations. Utility trenching should not be conducted in the reinforced zone of MSE walls. Trenching will invariably cut through reinforcement layers within the wall zone and undermine wall stability.

5.9 Pavements

The following recommendations for parking lot pavements and access driveways are specific to non-public right-of-way areas. Our designs assume that the subgrade within 8 inches of the bottom of the pavement section will be compacted to 95 percent of the material's maximum dry density in accordance with ASTM D 1557 (Modified Proctor) testing. If the road subgrade is not re-compacted to a uniform density and stiffness, the gravel base will have to be increased significantly. If re-compaction of the subgrade is not conducted, the gravel base thickness should be increased by 50 percent from those thicknesses indicated in the following table.

Specifications for pavements, base course, and sub-base should conform to Oregon Department of Transportation (ODOT) specifications. Our pavement design sections are provided in the following table.



Table 7 – Flexible Asphalt Concrete Pavement Design

Approximate Number of Trucks	Equivalent Single Axle Loads (ESALs x 1000)	Asphalt Concrete Thickness (inches)	Base Rock Thickness (inches)
Auto parking	10	2.5	10
6	25	3	10
15	66	3.5	11

Intermediate truck loading conditions and the resultant asphalt concrete and base rock sections can be interpolated from the above table. These designs are intended for use on private streets. Construction traffic should be limited to unpaved and untreated roadways, or specially constructed haul roads. If this is not possible, the pavement design selected from the above table should include an allowance for construction traffic.

Roadway-Specific Pavement Designs. We have prepared roadway-specific designs for the improvements to Main Street and the relocated Agnes Avenue. Design thicknesses are based upon the ODOT Pavement Design Guide and the 1993 edition of the AASHTO Guide for Design of Pavement Structures.

In accordance with the requirements of ODOT, the following values were used in our analyses:

Table 8 – Flexible Pavement Design Parameters

Parameter	Value
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level (%)	85
Asphalt Structural Coefficient	0.42
Aggregate Structural Coefficient	0.10
Drainage Coefficient-Asphalt	1.0
Drainage Coefficient-Aggregate	0.9

We developed design ESAL values based on the site-specific traffic study prepared by Kittelson and Associates, dated August 5, 2009, and entitled “The Cove Alternative Development Plan, Traffic Impact Analysis.” The report presents post-development peak hourly traffic data for the relocated Main Street and Agnes Avenue. For Main Street, the traffic analysis indicates a post-development peak hourly traffic of 435 vehicles. For Agnes Avenue, the traffic analysis indicates a post-development peak hourly traffic of 175 vehicles. To develop a total traffic loading we assumed a 2-percent growth rate over the design period (in accordance with ODOT recommendations). For Main Street, we assumed a traffic distribution of 6 percent trucks; for Agnes Avenue, we assumed 4 percent trucks. Axle load distributions were based upon truck factors contained in the ODOT Pavement Design Manual. ODOT recommends the use of a 20-year

design traffic level. We have calculated a 20-year design traffic level for Main Street at 1.7M ESALs and for Agnes Avenue at 420,000 ESALs.

The pavement subgrade resilient modulus (M_R) was developed from correlation with soil types present throughout the corridor. The soils present at subgrade throughout the area generally consist of sandy silt and sand fills, which can be quite variable over short distances. Based on our experience, we selected a conservative resilient modulus of 6,000 pounds per square inch (psi). To calculate the minimum asphalt thickness, we evaluated the pavement as a full-depth asphalt section, assuming a base rock subgrade modulus of 20,000 psi, in accordance with ODOT methods.

The following table presents our recommended pavement sections.

Table 9 – Flexible Pavement Designs

Roadway	Asphalt Concrete Section Thickness (inches)	Base Rock Section Thickness (inches)
Main Street	6	16
Agnes Avenue	5	11

The design does not account for free access by construction traffic over subgrade areas. If construction traffic is not controlled during site work, the impact upon subgrade soils will typically result in a significantly thicker base rock section requirement to account for loss in subgrade strength/stiffness.

5.10 Stormwater Disposal

It does not appear that surface water disposal through infiltration is feasible at this site. The fills present on the site are quite deep and are underlain by stiff to hard sandy silts. Our explorations did not encounter any soils that would be sufficiently permeable to allow for infiltration. The underlying gravel formation would likely be suitable for infiltration, but those soils appear to be located at depths in excess of 20 feet below the current ground surface grades and are incident with the groundwater table.

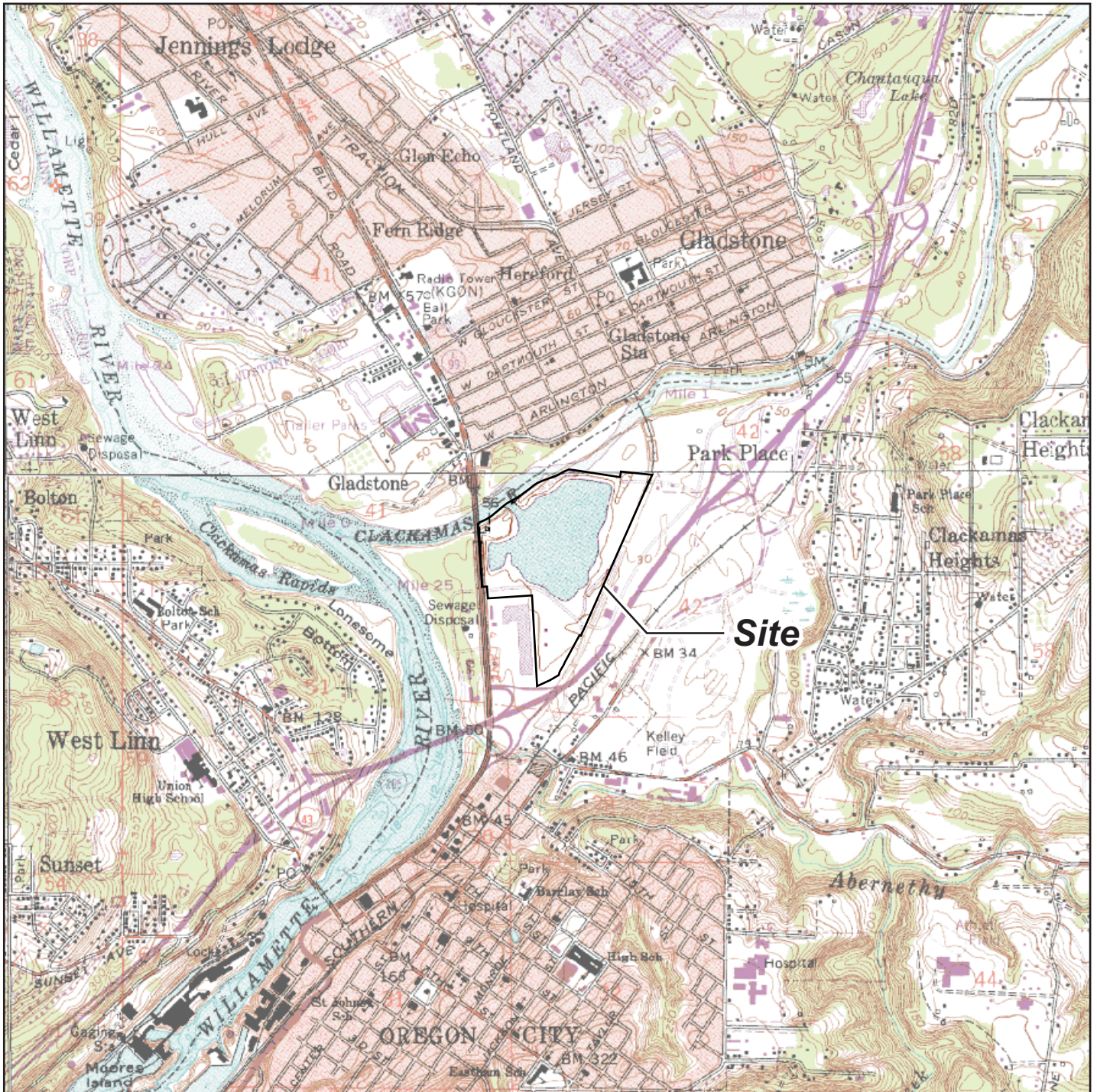
6.0 Recommendations for Additional Services

We have prepared recommendations relative to the overall site work and development of this site. As specific building plans are developed, we recommend significant geotechnical involvement in the subsequent planning and design of those structures.

7.0 Closing

This report presented Ash Creek's geotechnical engineering evaluation and recommendations for the proposed project. Subject to the recommendations provided within this report, construction of the proposed project is feasible from a geotechnical standpoint. We trust that this report meets your needs. If you have any questions, or if we can be of further assistance, please call. We look forward to working with you in the future.





Base map prepared from USGS 7.5-minute quadrangles as provided by Topozone (1981).

0 2000 4000
Scale in Feet



Site Location Map

Pacific Property Search
Clackamette Cove
Oregon City, Oregon



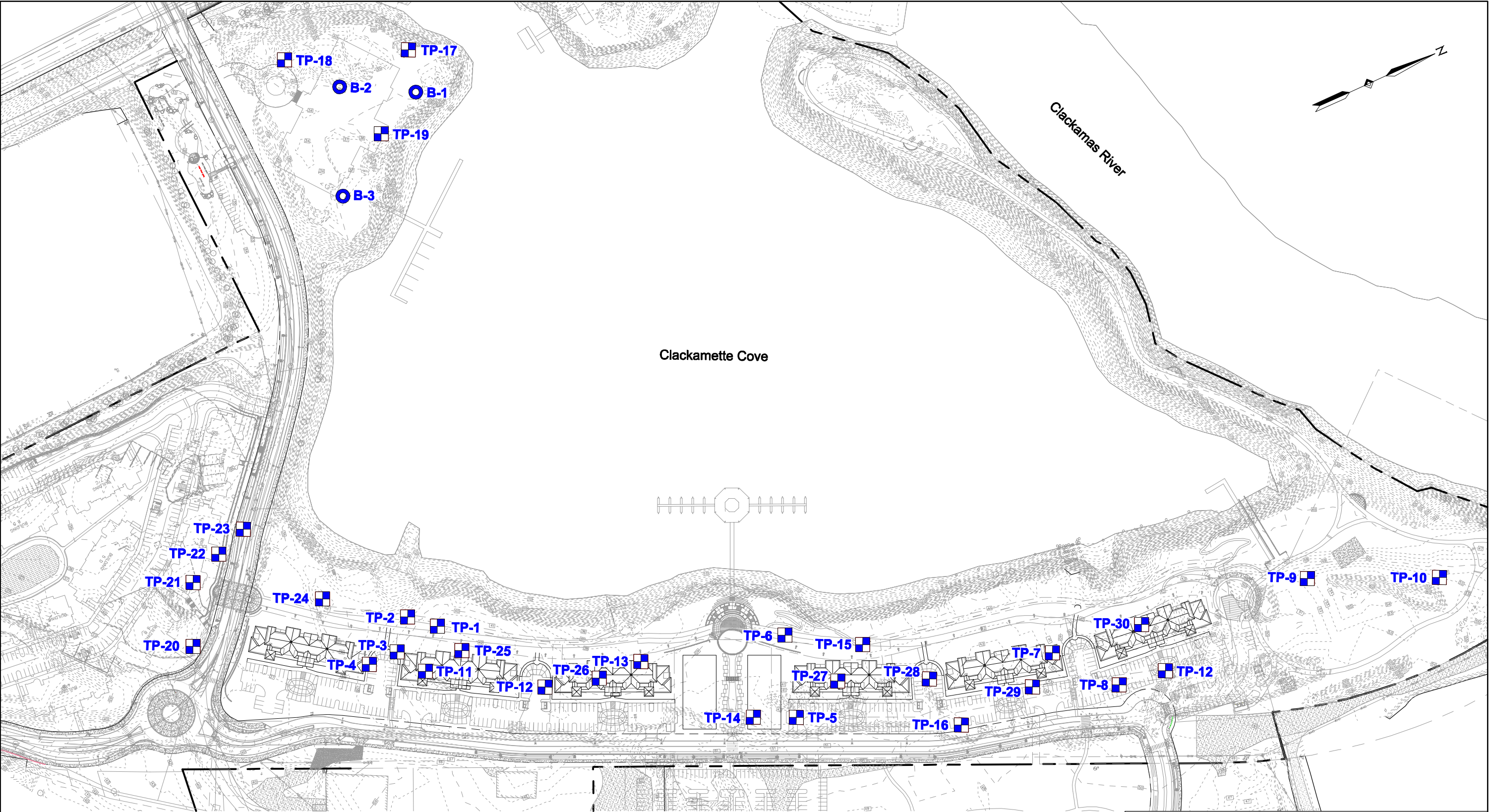
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Project Number 1195-00



May 2011

Figure

1



Legend:

- TP-1  Test Pit Location
- B-1  Boring Location

NOTE: Base map prepared from a Pacific Property Search, LLC drawing, *Site Plan, The Cove* (2010).

0 200 400
Scale in Feet

Site Vicinity Plan - Revised

Pacific Property Search
Clackamette Cove
Oregon City, Oregon



Project Number 1195-00
August 2011

Figure
2

Appendix A

Test Pit Logs

Sample Descriptions

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, and grain size, and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:

MAJOR CONSTITUENT with additional remarks; color, moisture, minor constituents, density/consistency.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and Geoprobe® explorations is estimated based on visual observation and is presented parenthetically on test pit and Geoprobe® exploration logs.

SAND and GRAVEL	Standard Penetration Resistance in Blows/Foot	SILT or CLAY	Standard Penetration Resistance in Blows/Foot	Approximate Shear Strength in TSF
<u>Density</u>		<u>Density</u>		
Very loose	0 - 4	Very soft	0 - 2	<0.125
Loose	4 - 10	Soft	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Medium stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Stiff	8 - 15	0.5 - 1.0
Very dense	>50	Very Stiff	15 - 30	1.0 - 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture.
Damp	Some perceptible moisture, probably below optimum.
Moist	Probably near optimum moisture content.
Wet	Much perceptible moisture, probably above optimum.

Minor Constituents

Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Sampling Symbols

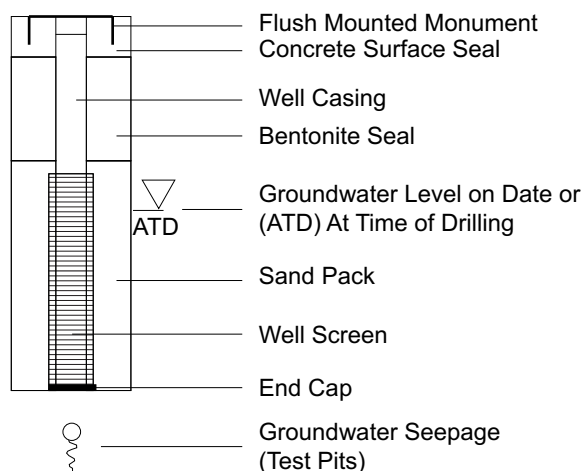
BORING AND PUSH-PROBE SYMBOLS

	Split Spoon
	Sonic
	Tube (Shelby, Push-Probe)
	Cuttings
	Core Run
	Temporarily Screened Interval
N	Standard Penetration Resistance
*	No Sample Recovery
PID	Photoionization Detector Reading
W	Water Sample
	Sample Submitted for Chemical Analysis
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

TEST PIT SOIL SAMPLES

	Grab (Jar)
	Bag
	Shelby Tube

Groundwater Observations and Monitoring Well Construction



Key to Exploration Logs

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Clackamette Cove
Oregon City, Oregon



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November 2009	

Figure
Key



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Test Pit Number TP-1

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Greg VanDeHey Soil Explorations

Date Completed: 6/6/06

Excavation Equipment Case Track-Hoe

Logged By: J. Duquette

Depth, feet

Material Description

4" to 6" silty TOPSOIL.

(Medium stiff), dry, brown, gravelly SILT. (Fill)

(Medium stiff to stiff), brown, ASPHALT DEBRIS and SILT.

(Medium stiff), dry, brown, COBBLES and SILT. (Fill)

Refusal on Concrete Slab/Concrete Debris at 9.0' BGS.
No Seepage or Groundwater Noted.

Test Pit Number TP-2

Test Pit Location: See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Greg VanDeHey Soil Explorations

Date Completed: 6/6/06

Excavation Equipment Case Track-Hoe

Logged By: J. Duquette

Depth, feet

Material Description

4" to 6" TOPSOIL.

(Stiff), dry, brown SILT, ASPHALT DEBRIS, and GRAVEL.

(Stiff), dry, brown, COBBLES and SILT with some tree branches and roots. (Fill)

Refusal on Concrete Slab/Concrete Debris at 9.0' BGS.
No Seepage or Groundwater Noted.



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Test Pit Number TP-3

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Greg VanDeHey Soil Explorations

Date Completed: 6/6/06

Excavation Equipment Case Track-Hoe

Logged By: J. Duquette

Depth, feet

Material Description

TOPSOIL.
(Dense), dry, gray, crushed ROCK. (Fill)
(Dense), dry, brown-gray SAND and COBBLES.
Large chunk of concrete at 2.0'. Some asphalt debris.

Refusal on Large Concrete Chunk Debris at 4.0' BGS.
No Seepage or Groundwater Noted.

Test Pit Number TP-4

Test Pit Location: See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Greg VanDeHey Soil Explorations

Date Completed: 6/6/06

Excavation Equipment Case Track-Hoe

Logged By: J. Duquette

Depth, feet

Material Description

TOPSOIL.
(Dense), dry, brown-gray, SILT and COBBLES.

(Medium dense), dry, blue-gray SILT and COBBLES. Trace organic debris with an organic odor.

(Medium stiff), dry, blue-gray SILT with a little gravel. Trace organic debris with an organic odor. (Fill)

Intermittent sticks/branches from 8' to 13'.

Test Pit Terminated at 13.0' BGS in Blue-gray SILT. (Fill)
No Seepage or Groundwater Noted.



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Test Pit Number TP-5

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Greg VanDeHey Soil Explorations

Date Completed: 6/6/06

Excavation Equipment Case Track-Hoe

Logged By: J. Duquette

Depth, feet

Material Description

TOPSOIL.

(Stiff), damp, brown, gravelly SILT. (Fill)

Concrete slab.

(Soft), red, moist to damp, silty CLAY with trace organics.

Scraps of steel chains.

(Soft to medium stiff), damp, layers of red, silty CLAY and blue-gray SILT with occasional cobbles. (Fill)

Hit 12" ribbed steel pipe.

Test Pit Terminated at 10.0' BGS.

Light Seepage at 3.0' BGS.

Test Pit Number TP-6

Test Pit Location: See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Greg VanDeHey Soil Explorations

Date Completed: 6/6/06

Excavation Equipment Case Track-Hoe

Logged By: J. Duquette

Depth, feet

Material Description

TOPSOIL.

(Medium stiff), dry, gray-brown SILT with some gravel.

(Very dense), dry SILT and GRAVEL/COBBLES with trace organics.

Very slow digging to 4.5'

Refusal at 4.5' BGS in (Very dense), silty GRAVEL and COBBLES.

No Seepage or Groundwater Noted.



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Test Pit Number TP-7

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Greg VanDeHey Soil Explorations

Date Completed: 6/6/06

Excavation Equipment Case Track-Hoe

Logged By: J. Duquette

Depth, feet

Material Description

TOPSOIL.

(Very dense), dry, brown and gray, SAND and GRAVEL with a little silt.

(Dense), dry, gray, silty SAND. (Fill)

(Very dense), dry, gray, silty SAND and GRAVEL.

Trace wood and root fragments.

Test Pit Terminated at 8.0' BGS.

Slow, Hard Digging Over Full Depth of Test Pit.

No Seepage or Groundwater Noted.

Test Pit Number TP-8

Test Pit Location: See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Greg VanDeHey Soil Explorations

Date Completed: 6/6/06

Excavation Equipment Case Track-Hoe

Logged By: J. Duquette

Depth, feet

Material Description

TOPSOIL.

(Medium stiff), dry, gray-brown SILT with some gravel.

(Very dense), dry to damp, gray, sandy GRAVEL and COBBLES.

(Medium stiff), dry, blue-gray SILT with an organic odor.

Test Pit Terminated at 13.5' BGS in (Soft to medium stiff), blue-gray SILT.

Light Seepage at 5.0' BGS.



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Test Pit Number TP-9

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Greg VanDeHey Soil Explorations

Date Completed: 6/6/06

Excavation Equipment Case Track-Hoe

Logged By: J. Duquette

Depth, feet

Material Description

TOPSOIL.

(Soft), damp, red wood debris and SILT. (Fill)

(Soft), damp, red-brown, organics and clayey SILT to silty CLAY with some wood debris.

5

Log or wood debris.

(Dense), dry, pink SANDSTONE. (Fill)

10

(Soft to very soft), damp, blue-gray SILT with large amounts of organic branches, roots, and wood debris. (Fill)

Test Pit Terminated at 13.5' BGS.
No Seepage or Groundwater Noted.

Test Pit Number TP-10

Test Pit Location: See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Greg VanDeHey Soil Explorations

Date Completed: 6/6/06

Excavation Equipment Case Track-Hoe

Logged By: J. Duquette

Depth, feet

Material Description

TOPSOIL.

(Soft), damp, red-brown, wood debris and SILT.

(Dense), dry, light-gray GRAVEL.

(Soft), damp to moist, red-brown, clayey SILT to silty CLAY with trace to a little GRAVEL or ROCK fragments.

5

(Soft), damp to moist, blue-gray SILT with organic material.

10

(Soft), moist, tan CLAY.

Test Pit Terminated at 14.0' BGS in (Soft to Medium stiff), Blue-gray SILT. Light Seepage at 12.0' BGS.



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Test Pit Number TP-11

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Robinson Construction Co.

Date Completed: 1/7/07

Excavation Equipment CAT 330 Track Hoe

Logged By: S. Albright

Depth, feet

Material Description

(Very dense), moist, gray, sandy GRAVEL FILL (Crushed Rock).

(Medium dense to dense), moist to wet, gray, silty SAND with gravel.

Bottom of Test Pit at 10.5' BGS.
No Seepage or Groundwater Noted.

Test Pit Number TP-12

Test Pit Location: See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Robinson Construction Co.

Date Completed: 1/7/07

Excavation Equipment CAT 330 Track Hoe

Logged By: S. Albright

Depth, feet

Material Description

(Very dense), moist, gray, sandy GRAVEL FILL (Crushed Rock).

Very heavy seepage from 3.0' to 4.0'.

(Soft to medium stiff), moist to wet, brown and gray, clayey SILT FILL.

(Medium stiff to stiff), moist to wet, tan to brown SILT with some clay. Light seepage at 8.0'.

Bottom of Test Pit at 12.0' BGS.
No Groundwater Noted.



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Test Pit Number TP-13

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Robinson Construction Co.

Date Completed: 1/7/07

Excavation Equipment CAT 330 Track Hoe

Logged By: S. Albright

Depth, feet

Material Description

(Very dense), moist, gray, sandy GRAVEL FILL (Crushed Rock).

(Medium stiff), moist, gray, sandy SILT with gravel. Mild organic odor.

Bottom of Test Pit at 11.0' BGS.
No Seepage or Groundwater Noted.

Test Pit Number TP-14

Test Pit Location: See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Robinson Construction Co.

Date Completed: 1/7/07

Excavation Equipment CAT 330 Track Hoe

Logged By: S. Albright

Depth, feet

Material Description

(Soft), moist to wet, brown to red, clayey SILT FILL with cobbles, gravel and concrete.

(Hard), gray GRAVEL and SAND FILL (Cemented). Potentially a concrete truck washout area.

Bottom of Test Pit at 13.0' BGS.
No Seepage or Groundwater Noted.



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Test Pit Number TP-15

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Robinson Construction Co.

Date Completed: 1/7/07

Excavation Equipment CAT 330 Track Hoe

Logged By: S. Albright

Depth, feet

Material Description

(Soft), moist to wet, silty CLAY FILL.

5

10

Bottom of Test Pit at 14.5' BGS. No Seepage or Groundwater Noted.

Test Pit Number TP-16

Test Pit Location: See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Robinson Construction Co.

Date Completed: 1/7/07

Excavation Equipment CAT 330 Track Hoe

Logged By: S. Albright

Depth, feet

Material Description

(Very dense), moist, gray, sandy GRAVEL FILL (Crushed Rock).

(Medium stiff), moist, gray, sandy SILT.

5

10

Bottom of Test Pit at 10.0' BGS.
No Seepage or Groundwater Noted.



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Test Pit Number TP-17

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Robinson Construction Co.

Date Completed: 1/7/07

Excavation Equipment CAT 330 Track Hoe

Logged By: S. Albright

Depth, feet

Material Description

Debris FILL. Logs, boulders, cables, chain, concrete, asphalt and random garbage in a sandy silt matrix.

5

10

Bottom of Test Pit at 14.0' BGS. No Seepage or Groundwater Noted.

Test Pit Number TP-18

Test Pit Location: See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Robinson Construction Co.

Date Completed: 1/7/07

Excavation Equipment CAT 330 Track Hoe

Logged By: S. Albright

Depth, feet

Material Description

Moist to wet, dark gray to black, silty SAND FILL. Some asphalt concrete chunks. Mild organic odor.

5

10

Bottom of Test Pit at 14.0' BGS. No Seepage or Groundwater Noted.



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Test Pit Number TP-19

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Robinson Construction Co.

Date Completed: 1/7/07

Excavation Equipment CAT 330 Track Hoe

Logged By: S. Albright

Depth, feet

Material Description

Moist to wet, dark gray to black, silty sand FILL. Some asphalt concrete chunks. Mild organic odor.

5

10

(Medium dense to dense), moist to wet, gray, silty SAND with gravels and cobbles.

Bottom of Test Pit at 14.5' BGS. No Seepage or Groundwater Noted.

Test Pit Number TP-20

Test Pit Location: See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Erickson Excavating

Date Completed: 11/6/07

Excavation Equipment Link Belt LS 2650

Logged By: J. Duquette

Depth, feet

Material Description

(Very dense), dry, silty gravel FILL. Hard digging.

5

Increasing sand content.

Becomes (very hard).

10

Test Pit Refusal at 8.5' BGS. No Seepage or Groundwater Noted.



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Test Pit Number TP-21

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Erickson Excavating

Date Completed: 11/6/07

Excavation Equipment Link Belt LS 2650

Logged By: J. Duquette

Depth, feet

Material Description

(Dense), dry, gray, sandy gravel FILL.

(Medium dense), gray, sand FILL.

(Soft), moist, gray, silty CLAY to clayey SILT. Large chunk of concrete in east pit wall.

Grab sample taken.

Light seepage from 10.0' to 11.0'.

Bottom of Test Pit at 14.5' BGS. No Groundwater Noted.

Test Pit Number TP-22

Test Pit Location: See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Erickson Excavating

Date Completed: 11/6/07

Excavation Equipment Link Belt LS 2650

Logged By: J. Duquette

Depth, feet

Material Description

Silty, sandy TOPSOIL.

(Medium dense to dense), brown/gray, dry, sand and gravel FILL with a little silt.

Chunk of rebar.
Very hard drilling.

Test Pit Refusal at 3.5' BGS.
No Seepage or Groundwater Noted.



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Test Pit Number TP-23

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: Erickson Excavating

Date Completed: 11/6/07

Excavation Equipment Link Belt LS 2650

Logged By: J. Duquette

Depth, feet

Material Description

TOPSOIL.
(Medium dense), gray/brown, dry, sand and gravel FILL with some silt.

Test Pit Refusal on Concrete at 3.5' BGS.
No Seepage or Groundwater Noted.



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Test Pit Number TP-24

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: N. L. Prouty Excavating

Date Completed: 4/21/2011

Excavation Equipment John Deere 120C Trackhoe

Logged By: J. Duquette

Depth, feet

Material Description

Silty, sandy TOPSOIL (~4").

Gravelly SILT (FILL); gray-brown, dry, medium stiff.

Gravelly SILT (FILL); gray, dry, medium stiff.

Pea GRAVEL (FILL); gray, wet, medium dense.
Some caving and sloughing.

Gravelly SILT (FILL); gray, moist to slightly moist, medium stiff. Pieces of rebar and some wood debris.

Silty GRAVEL and COBBLE (FILL); gray, wet, dense.

Bottom of Test Pit at 18.0' BGS.

Heavy Seepage from 2.0 to 4.0' BGS.

Heavy Seepage or Groundwater from ~12.0 to 13.0' BGS.



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Test Pit Number TP-25

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: N. L. Prouty Excavating

Date Completed: 4/21/2011

Excavation Equipment John Deere 120C Trackhoe

Logged By: J. Duquette

Depth, feet

Material Description

GRAVEL (FILL); gray, dry, dense (4").
Silty GRAVEL and COBBLE (FILL); brown, dry, dense.

Color grades to gray below 4'. Severe caving/sloughing on test pit walls from 4 to 15'.

Bottom of Test Pit at 15.0' BGS.
No Seepage or Groundwater Noted.



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Test Pit Number TP-26

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: N. L. Prouty Excavating

Date Completed: 4/21/2011

Excavation Equipment John Deere 120C Trackhoe

Logged By: J. Duquette

Depth, feet

Material Description

GRAVEL (FILL); gray, dry, dense (6").

Screenings; dry, gray, medium dense.

SILT (FILL); gray, dry, stiff.

Silty GRAVEL and COBBLE (FILL); gray, dry, dense. Some caving.

SILT (FILL); brown, dry, medium stiff to stiff.

Bottom of Test Pit at 18.0' BGS.
No Seepage or Groundwater Noted.



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Test Pit Number TP-27

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: N. L. Prouty Excavating

Date Completed: 4/21/2011

Excavation Equipment John Deere 120C Trackhoe

Logged By: J. Duquette

Depth, feet

Material Description

Crushed ROCK (FILL); gray, dry, dense (3").

SILT(FILL); brown and gray, slightly moist, with some gravel and occasional chunks of concrete rubble, medium stiff.

Fine, sandy, SILT (FILL); blue-gray, dry, medium stiff.

Bottom of Test Pit at 19.0' BGS.

Seepage at ~3.0 BGS. Notable sheen on seepage.



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Test Pit Number TP-28

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: N. L. Prouty Excavating

Date Completed: 4/21/2011

Excavation Equipment John Deere 120C Trackhoe

Logged By: J. Duquette

Depth, feet

Material Description

Crushed ROCK; gray, dry, dense,

Silty GRAVEL (FILL); gray-brown, dry, with trace cobbles, very dense.

5

SILT (FILL); brown or gray, dry, stiff.

10

Fine, sandy, SILT (FILL); blue-gray, dry, stiff.

15

Bottom of Test Pit at 3.5' BGS.
Heavy Seepage from 3.0 to 4.0' BGS.

20

25

30

35



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Test Pit Number TP-29

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: N. L. Prouty Excavating

Date Completed: 4/21/2011

Excavation Equipment John Deere 120C Trackhoe

Logged By: J. Duquette

Depth, feet

Material Description

Fine, sandy, SILT to silty, fine SAND; blue-gray, dry, stiff.

Cemented GRAVEL; gray, dry, very dense. (Very hard, very slow digging).

Test Pit Refusal on Cemented Gravel at ~6.5' BGS.
No Seepage or Groundwater Noted.



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Test Pit Number TP-30

Test Pit Location See Figure 2

Surface Elevation: Not Measured

Excavation Contractor: N. L. Prouty Excavating

Date Completed: 4/21/2011

Excavation Equipment John Deere 120C Trackhoe

Logged By: J. Duquette

Depth, feet

Material Description

Silty, gravelly TOPSOIL.

Silty GRAVEL; gray, slightly moist, with some cobbles, dense.

SILT; blue-gray, wet, trace gravel, very soft.

Fine, sandy SILT; blue-gray, slightly moist, medium stiff.

Bottom of Test Pit at 16.0' BGS.

Heavy Seepage from ~2.0 to 12.0' BGS.