



Real-World Geotechnical Solutions
Investigation • Design • Construction Support

June 16, 2021
Project No. 21-5808

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**SUBJECT: REPORT OF GEOTECHNICAL FILL EVALUATION OF LOTS 28 THROUGH 36
BELLA RIDGE LOOP SUBDIVISION
BELLA RIDGE LOOP
CLATSOP COUNTY, OREGON**

Reference: GeoPacific Engineering, Inc., *Geotechnical Engineering Report*, Bella Ridge Apartment Site, 92257 Lewis and Clark Road, Clatsop County, Oregon, GeoPacific Project Number 16-4212, dated May 23, 2016.

This report presents the results of a geotechnical exploration conducted by GeoPacific Engineering, Inc. (GeoPacific) for the above-referenced project. We previously performed a geotechnical exploration of the site and presented the results of our exploration in the above-referenced report, dated May 23, 2016. Since the completion of that report, the plans for site development changed and fill was placed without to support a new subdivision. It is our understanding that no geotechnical construction monitoring services, such as stripping observations, density testing, or proofrolls, were performed during mass grading of the site. The purpose of our work was to evaluate the extent and suitability of fill material placed in the 9 lots located along the eastern side of the site, designated Lots 28 through 36.

SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The site is roughly 10 acres, irregular in shape and located on the southeast side of Lewis and Clark Road in Clatsop County, Oregon (Figure 1). The site has been mass-graded and a road and underground utilities have been constructed for the development. Before these advancements, topography of the site mostly sloped east and north at about 10 percent grade with localized steeper areas of up to 50 percent, mostly surrounding the homesite. Site vegetation consisted primarily of pasture and a few shrubs and trees along the existing driveway and home.

Mass grading of the site involved maximum cuts and fills on the order of about 10 feet. Since mass grading has been completed, grades in the eastern portion of the site are now relatively flat from the road for distances of about 20 to 110 feet and then slope down to drainage areas at the eastern property line. Additionally, the site sloped down to a low area between Lots 30 and

31. Vegetation in the eastern portion of the site currently consists of grass and some shrubs in several areas.

The proposed development on lots 28 through 36 consists of the construction of single-family residential structures on each lot.

SUBSURFACE CONDITIONS

Our site-specific exploration for this report was conducted on May 25, 2021. A total of 8 exploratory test pits (designated TP-1 through TP-8) were excavated with a trackhoe to depths ranging from 3.5 to 11 feet at the approximate locations indicated on Figure 2. It should be noted that our explorations were located in the field by pacing or taping distances from apparent property corners and other site features shown on the plans provided. As such, the locations of the explorations should be considered approximate. The test pits were placed on the lot lines where possible to avoid compromising the soil beneath the proposed building footprints.

A GeoPacific engineer continuously monitored the field exploration program and logged the test pits. Soils observed in the explorations were classified in general accordance with the Unified Soil Classification System. During exploration, our engineer also noted geotechnical conditions such as soil consistency, moisture and groundwater conditions. Logs of test pits are attached to this report. The following report sections are based on the exploration program and summarize subsurface conditions encountered at the site.

Table 1 – Depth of Fill at Exploration Locations

Exploration Designation	Depth of Fill (ft)
TP-1	3.5
TP-2	5.5
TP-3	5.5
TP-4	7.5
TP-5	5.5
TP-6	10.5
TP-7	3
TP-8	1.5

Topsoil: We observed a topsoil horizon consisting of brown to dark brown, highly organic SILT (ML) with fine roots throughout directly underlying the ground surface in test pits TP-1 and TP-4. The topsoil layer was soft and extended to depths ranging from 8 and 20 inches, respectively.

Silty Gravel, Cobbles, and Boulders - Fill: Underlying the topsoil layer in test pits TP-1 and TP-4, and directly underlying the ground surface in test pits TP-2, TP-3, TP-6 and TP-8 was silty GRAVEL (GM) fill material with cobbles and occasional boulders. In test pit TP-2, we observed boulders up to 12 inches in diameter. In test pit TP-3, we observed boulders up to 30 inches in diameter. In test pit TP-4, we observed boulders up to 18 inches in diameter.

The fill material consisting of gravel, cobbles, and boulders was generally medium dense to dense, where encountered. However, in test pit TP-3, the fill material was loose and we

observed significant caving of the sidewalls. Fill material consisting of silty gravel, cobbles, and boulders extended to depths of 16 inches to 6.5 feet in the locations encountered.

Reused Native Soil - Fill: Directly underlying the ground surface in test pits TP-5 and TP-7 and underlying the Silty GRAVEL (GM) fill in test pits TP-1, TP-2, TP-3, TP-4 and TP-6, we encountered fill consisting of various soil types. In test pits TP-1, TP-2, TP-3, and TP-4, the fill consisted of Clayey SILT (ML). In test pits TP-5, TP-6, and TP-7, the fill consisted of layers of SILT with Sand (ML), Clay (CL), Gravelly SILT (ML), and Clayey SILT (ML). Based on information provided by the client and the earthwork contractor, this fill was comprised of reused native soil from other areas of the site. The layer of reused native soil was between 1 and 8.5 feet thick. Generally, the reused native soil was stiff to hard. However, we did observe one layer of soft fill material from 3 to 4.5 feet in test pit TP-6. The total depths of fill material encountered in our test pits is summarized on Table 1.

Table 1 – Depth of Fill at Exploration Locations

Exploration Designation	Depth of Fill Material Consisting of Gravel, Cobbles, and Boulders (ft)	Total Depth of Fill Material (ft)
TP-1	1.5	3.5
TP-2	3	5.5
TP-3	4.5	5.5
TP-4	6.5	7.5
TP-5	N/A	5.5
TP-6	2	10.5
TP-7	N/A	3
TP-8	1.5	1.5

Native Topsoil Horizon: We observed a topsoil horizon consisting of brown, dark brown, or gray SILT (ML) and Clayey SILT (ML) with varying levels of fine roots in all test pits except test pit TP-7. Our observations indicate that this layer was underneath the previously existing topsoil, and that the previously existing topsoil was stripped off before the fill was placed. The top of the topsoil horizon was encountered at depths between 1.5 and 10.5 feet. The layer was generally between 6 inches and 4 feet thick, extended to depths between 3 and 9.5 feet below the ground surface or to test pit termination.

Native Soil: Native CLAY (CL) to clayey SILT (ML) was encountered in test pits TP-1, TP-3, TP-4, TP-5, and TP-7. Native SILT with sand (ML) was encountered in test pit TP-8. The native soil generally consisted of stiff, gray to light gray CLAY (CL) and stiff, brown Clayey SILT (ML). In test pit TP-8, the native soil consisted of SILT with Sand (ML) which was stiff and orange with gray. Native soils extended beyond the maximum depths of our explorations in all of our test pits.

Soil Moisture and Groundwater

On May 25, 2021, the soil moisture conditions observed in test pits were generally damp to wet. We observed groundwater seepage in test pits TP-2, TP-3, TP-4, and TP-5 at depths between 7 and 10 feet. Seepage was visually estimated as less than 1 gallon per minute. It is anticipated that groundwater conditions will vary depending on the season, local subsurface conditions, changes in site utilization, and other factors.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our geotechnical investigation, the proposed construction of single-family residences on lots 28 through 36 appears to be geotechnically feasible, provided that the recommendations of this report are incorporated into the design and construction phases of the project. In general, our test pits indicate that lots 28 through 36 were adequately stripped of vegetation and down to competent native soils prior to mass grading, and that the fill material was adequately placed and compacted.

In our opinion, there are 4 major geotechnical issues for the construction of single-family residences on lots 28 through 36.

- 1) The presence of loose cobbles and boulders on the south side of lot 31. In test pit TP-3, located on the south side of lot 31, we encountered loose gravel, cobbles, and boulders to a depth of 4.5 feet. This material was too loose to be considered engineered fill and is not considered suitable to support a structure. This material will either need to be compacted in place, which would require large, heavy compaction equipment such as a diesel plate compactor or a hoe pack, or should be removed and replaced with engineered fill. If the gravel, cobbles, and boulders are to be compacted in place, a geotechnical engineer should provide construction observation services during compaction. Also, at least 12 inches of $\frac{3}{4}$ "-0 crushed aggregate should be placed and compacted over the top of that remaining material to at least 95 percent of the Standard Proctor (ASTM D698). If the loose gravel, cobbles, and boulders are to be removed, a geotechnical engineer should inspect the exposed subgrade after removal and should observe the placement and compaction of the engineered fill material used as backfill.
- 2) In test pit TP-2, we observed boulders up to 12 inches in diameter. In test pit TP-3, we observed boulders up to 30 inches in diameter. In test pit TP-4, we observed boulders up to 18 inches in diameter. We typically do not recommend particles larger than 6 inches in diameter within 4 feet of finish grade. Large cobbles and boulders can complicate utility trench excavations and the preparation of foundation subgrade for houses. Where encountered in excavations, large cobbles and boulders will likely need to be overexcavated and the resulting voids filled in with granular engineered fill material. Potential developers or home builders should be informed that some large cobbles and boulders may be encountered in utility trenches and/or house digouts.
- 3) While the fill material observed in our test pits was generally stiff to hard, we observed a layer of soft fill material from 3 to 4.5 feet in test pit TP-6. We also observed soft fill material to a depth of about 18 inches in test pit TP-7. If these layers of soft material are at or near the foundation subgrade elevation, then they may need to be overexcavated. Foundation subgrade should be inspected by a geotechnical engineer prior to installing formwork and rebar.

- 4) It appears that some contour grading has occurred on lots 35 and 36 to create a shallow drainage. There may be some soft soils near the ground surface as a result of the contour grading. Excavation depths more than 18 inches may be required to reach suitable foundation subgrade in the area of contour grading on lots 35 and 36 and also on or near existing fill slopes. Adjacent to existing fill slopes, footing-to-slope setback distances of at least 10 feet should be maintained, subject to field verification by a geotechnical engineer during construction.

In general, we expect that the fill material will be suitable for the support of residential foundations and walls with bearing loads of 1,500 psf or less. We recommend each lot excavation be observed by GeoPacific once the potential subgrade material is exposed to confirm its suitability.

UNCERTAINTIES AND LIMITATIONS

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

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

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

We appreciate this opportunity to be of service.

Sincerely,

GEOPACIFIC ENGINEERING, INC.



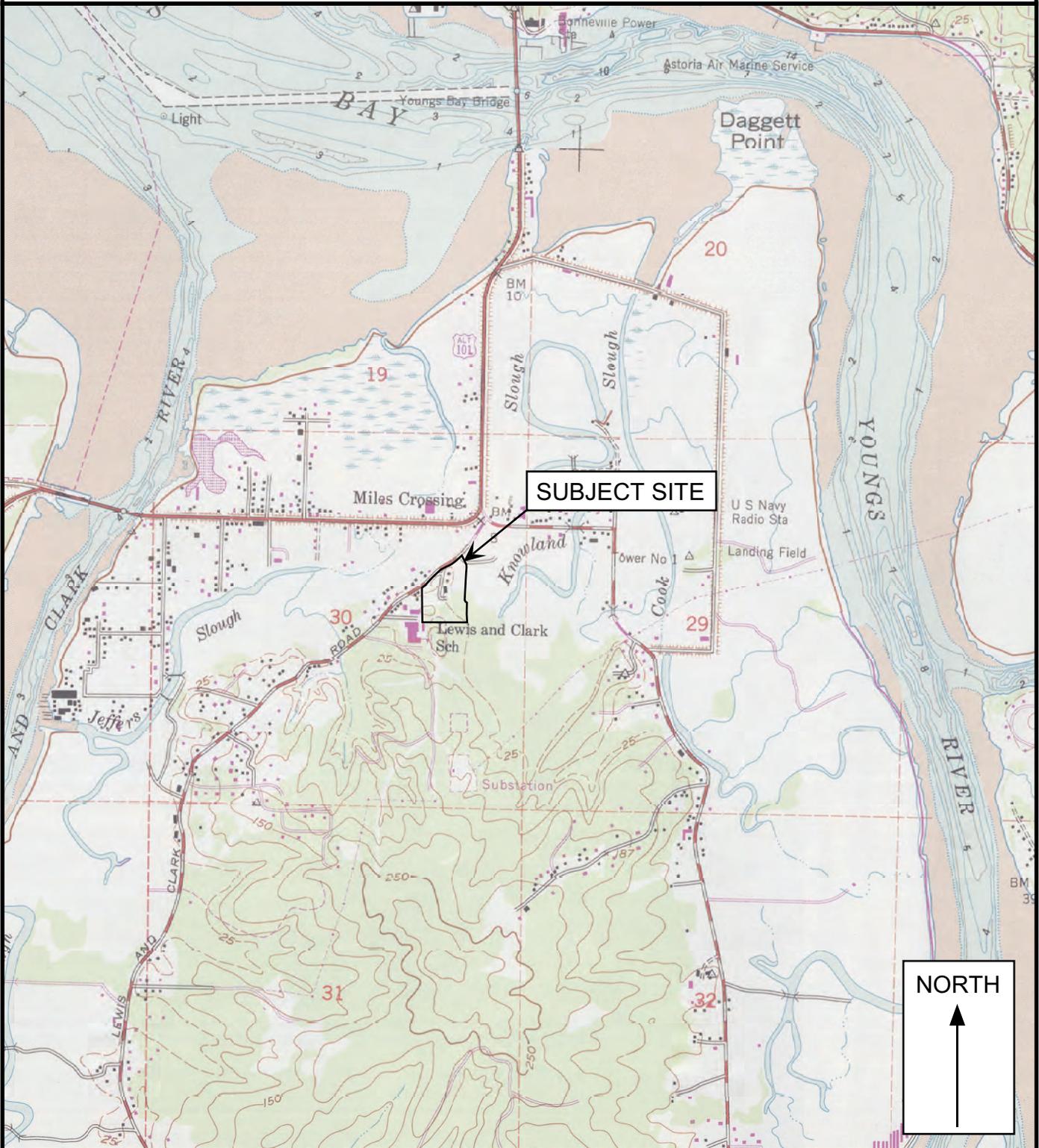
Benjamin G. Anderson, P.E.
Associate Engineer

Attachments: Figure 1 - Vicinity Map
Figure 2 - Site Plan and Exploration Locations
Test Pit Logs (TP-1 through TP-8)



14835 SW 72nd Avenue
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VICINITY MAP



Legend

Approximate Scale 1 in = 2,000 ft

Date: 06/16/21
 Drawn by: BGA

Base map: U.S. Geological Survey 7.5 minute Topographic Map Series, Astoria, Oregon Quadrangle, 1949 (Photorevised 1984)

Project: Bella Ridge Fill Evaluation
 Clatsop County, Oregon

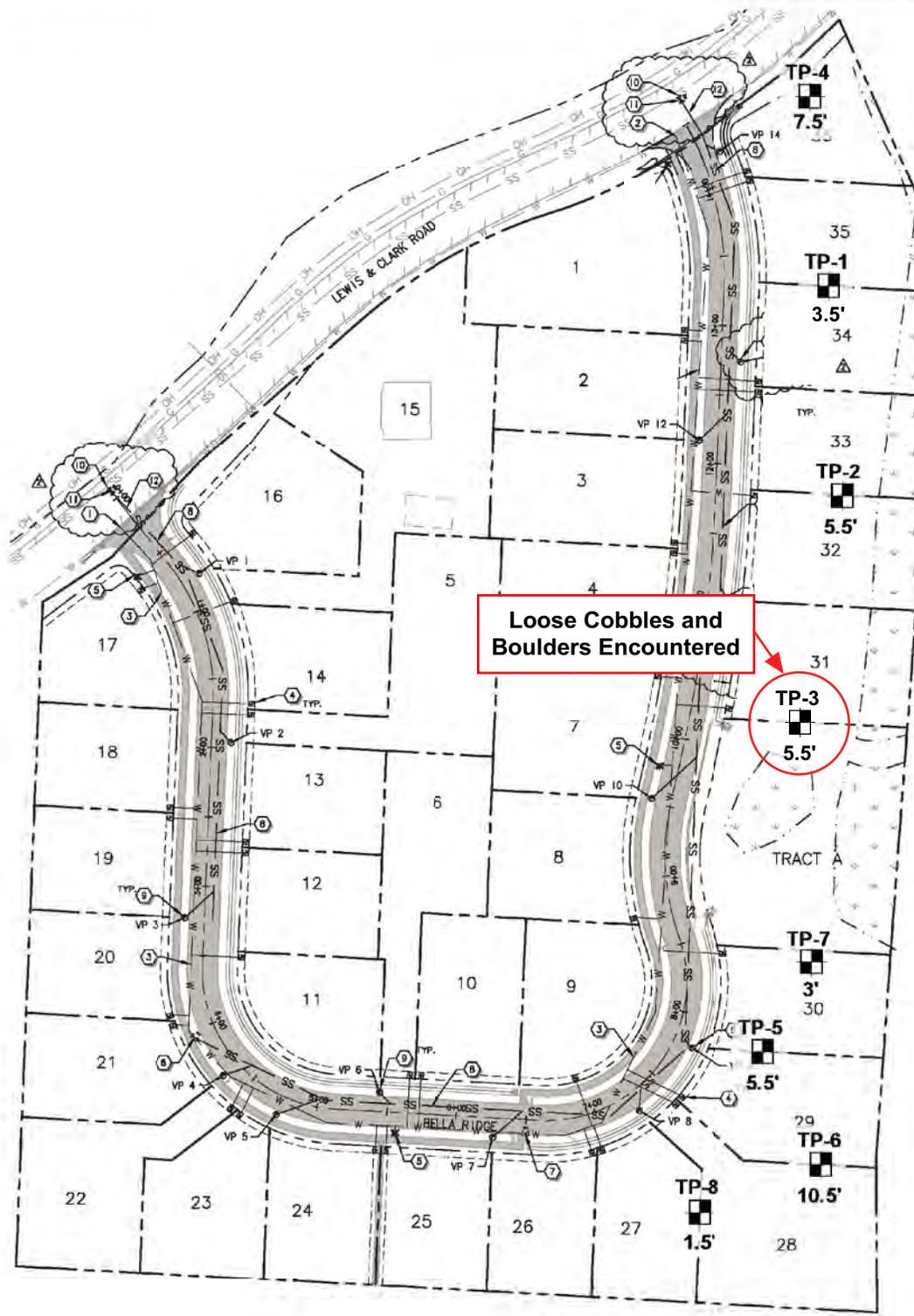
Project No. 21-5808

FIGURE 1



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SITE PLAN AND EXPLORATION LOCATIONS



Legend
 TP-1 Test Pit Designation, Approximate Location, and Depth of Existing Fill Material
 5'

Date: 05/28/21
 Drawn by: ABC
 0 120'
 APPROXIMATE SCALE 1"=120'

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 Clatsop County, Oregon

Project No. 21-5808

FIGURE 2



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TEST PIT LOG

Project: Bella Ridge Loop Fill Evaluation Astoria, Oregon	Project No. 21-5808	Test Pit No. TP-1
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Depth (ft)	Pocket Penetrometer (tons/ft ²)	Sample Type	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Water Bearing Zone	Material Description
1	4.5+			30.2		Highly organic SILT (OL-ML), brown, fine roots throughout, soft, moist (Topsoil)
2	4.5+					Silty GRAVEL (GM), brown, some fine roots throughout, dense, damp (Fill)
3	4.5+			31.8		Clayey SILT (ML), brown with orange and gray, stiff, moist (Fill)
4						Clayey SILT (ML), dark brown, medium stiff, moist (Topsoil Horizon)
5						CLAY (CL), light gray, stiff, moist (Native Soil)
6						<p>Test pit terminated at 5.5 feet</p> <p>Note: No groundwater seepage encountered. Caving observed from 0.7 to 1.5 feet below ground surface.</p>
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LEGEND

 Bag Sample	 Bucket Sample	 Shelby Tube Sample	 Seepage	 Water Bearing Zone	 Water Level at Abandonment
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Date Excavated: 05/25/2021
 Logged By: ABD and BGA
 Surface Elevation:



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TEST PIT LOG

Project: Bella Ridge Loop Fill Evaluation Astoria, Oregon	Project No. 21-5808	Test Pit No. TP-2
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Depth (ft)	Pocket Penetrometer (tons/ft ²)	Sample Type	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Water Bearing Zone	Material Description
1	4		30.1	30.1		Silty GRAVEL (GM), brown, angular, cobbles and boulder up to 12 inches in diameter, fine roots throughout upper 10 inches, dense, moist (Fill)
2						Grades to medium dense below 2 feet, debris encountered at 2 feet
3						Clayey SILT (ML), yellowish brown with orange and gray, medium stiff, moist (Fill)
4						
5						
6						SILT (ML), dark gray, occasional fine roots, soft to medium stiff, wet (Topsoil Horizon)
7						Test Pit Terminated at 7 Feet.
8	<p>Note: Groundwater seepage encountered at 7 feet below ground surface. Discharge visually estimated at <1 gallons per minute. Caving observed from 0 to 3 feet below ground surface.</p>					
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10						
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LEGEND

 Bag Sample	 Bucket Sample	 Shelby Tube Sample	 Seepage	 Water Bearing Zone	 Water Level at Abandonment
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Date Excavated: 05/25/2021
 Logged By: ABD and BGA
 Surface Elevation:



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TEST PIT LOG

Project: Bella Ridge Loop Fill Evaluation Astoria, Oregon	Project No. 21-5808	Test Pit No. TP-3
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Depth (ft)	Pocket Penetrometer (tons/ft ²)	Sample Type	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Water Bearing Zone	Material Description
1						Silty GRAVEL, COBBLES, and BOULDERS (GM), brown, boulders up to 30 inches in diameter, angular, loose, damp (Fill)
2						
3						
4						3/4-inch metal conduit encountered at 4.5 feet.
5						Clayey SILT (ML), brown, stiff, moist, (Fill)
6						SILT (ML), dark gray, occasional fine roots, stiff, moist (Topsoil Horizon)
7						CLAY (CL), gray, stiff, moist (Native Soil) 2 pieces of woody debris approximately 4 inches in diameter and 18 inches in length encountered at 7.5 feet.
8						Test Pit Terminated at 8 Feet.
9						
10						Note: Groundwater seepage encountered at 8 feet below ground surface. Discharge visually estimated as <1 gallons per minute. Caving observed from 0 to 4.5 feet below ground surface. Caving extended 2.5 feet from side wall
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LEGEND

 Bag Sample	 Bucket Sample	 Shelby Tube Sample	 Seepage	 Water Bearing Zone	 Water Level at Abandonment
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Date Excavated: 05/25/2021
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TEST PIT LOG

Project: Bella Ridge Loop Fill Evaluation Astoria, Oregon	Project No. 21-5808	Test Pit No. TP-4
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Depth (ft)	Pocket Penetrometer (tons/ft ²)	Sample Type	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Water Bearing Zone	Material Description
1						Highly organic SILT (OL-ML), dark brown, fine roots throughout, soft, damp (Topsoil)
2						Silty GRAVEL, COBBLES and BOULDERS (GM), brown, boulders up to 18 inches in diameter, medium dense, damp, (Fill)
3						
4						
5						
6						
7						Clayey SILT (ML), brown, stiff, damp (Fill)
8						SILT (ML), dark gray, stiff, moist (Topsoil Horizon)
9						
10						CLAY (CL), gray, stiff, moist (Native Soil)
11						Test Pit Terminated at 10 Feet.
12						Note: Groundwater seepage encountered at 8 feet below ground surface. Discharge visually estimated at <1 gallons per minute. Minor caving observed from 1.5 to 6.5 feet below ground surface.
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LEGEND

 Bag Sample	 Bucket Sample	 Shelby Tube Sample	 Seepage	 Water Bearing Zone	 Water Level at Abandonment
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Date Excavated: 05/25/2021
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TEST PIT LOG

Project: Bella Ridge Loop Fill Evaluation Astoria, Oregon	Project No. 21-5808	Test Pit No. TP-5
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Depth (ft)	Pocket Penetrometer (tons/ft ²)	Sample Type	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Water Bearing Zone	Material Description
1	4.5					SILT with sand (ML), orange, stiff, damp (Fill)
2			29.1			Clay (CL), gray with orange and white, very stiff to hard, moist (Fill)
3			21.3			Grades to light gray at 2 feet Grades to dark brown at 3 feet
4						Grades to gray at 4 feet
5						
6						Silt (ML), dark brown, fine roots throughout, slight organic odor, stiff, moist (Topsoil Horizon)
7						
8						
9						
10						Clay (CL), gray, stiff, moist (Native Soil)
11						Test Pit Terminated at 10 Feet.
12						Note: Groundwater seepage encountered at 10 feet below ground surface. Discharge visually estimated at <1 gallons per minute. No significant caving observed.
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LEGEND

 Bag Sample	 Bucket Sample	 Shelby Tube Sample	 Seepage	 Water Bearing Zone	 Water Level at Abandonment
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TEST PIT LOG

Project: Bella Ridge Loop Fill Evaluation Astoria, Oregon	Project No. 21-5808	Test Pit No. TP-6
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Depth (ft)	Pocket Penetrometer (tons/ft ²)	Sample Type	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Water Bearing Zone	Material Description
1						Silty GRAVEL with cobbles (GM), brown, fine roots throughout upper 6 inches, medium dense, damp (Fill)
2	2.5			27.2		SILT with sand (ML), orange, stiff, damp (Fill)
3	2.0					Gravelly SILT (ML), brown, soft, moist (Fill)
4	1.5			35.4		SILT with sand (ML), orange, soft, moist (Fill)
5						SILT (ML), brown with orange and gray, stiff, moist (Fill)
6						
7						
8						Grades to medium stiff at 8 feet.
9						
10						
11						SILT (ML), dark gray, stiff, moist (Topsoil Horizon)
12						Test Pit Terminated at 11 Feet.
13						Note: No seepage or groundwater encountered. Minor caving observed from 0 to 2 feet below ground surface.
14						
15						
16						
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LEGEND

 Bag Sample	 Bucket Sample	 Shelby Tube Sample	 Seepage	 Water Bearing Zone	 Water Level at Abandonment
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Date Excavated: 05/25/2021
 Logged By: ABD and BGA
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TEST PIT LOG

Project: Bella Ridge Loop Fill Evaluation Astoria, Oregon	Project No. 21-5808	Test Pit No. TP-7
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Depth (ft)	Pocket Penetrometer (tons/ft ²)	Sample Type	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Water Bearing Zone	Material Description
1	3.0			26.2		SILT with sand (ML), orange, very soft, damp (Fill)
2	3.0					Clayey SILT (ML), brown, stiff, moist (Fill)
3	3.0					SILT with sand (ML), gray, stiff, moist (Fill)
4				37.7		Clayey SILT (ML), brown, stiff, moist (Native Soil)
5						<p>Test Pit Terminated at 4 Feet.</p> <p>Note: No seepage or groundwater encountered. No significant caving observed.</p>
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LEGEND

 Bag Sample	 Bucket Sample	 Shelby Tube Sample	 Seepage	 Water Bearing Zone	 Water Level at Abandonment
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Date Excavated: 05/25/2021
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TEST PIT LOG

Project: Bella Ridge Loop Fill Evaluation Astoria, Oregon	Project No. 21-5808	Test Pit No. TP-8
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Depth (ft)	Pocket Penetrometer (tons/ft ²)	Sample Type	In-Situ Dry Density (lb/ft ³)	Moisture Content (%)	Water Bearing Zone	Material Description
1				52.0		Silty GRAVEL (GM), brown, cobbles and boulders up to 14 inches in diameter, medium dense, moist (Fill)
2	4.0					SILT (ML), dark brown, fine roots throughout upper 6 inches, stiff, moist (Topsoil Horizon)
3	>4.5					SILT with sand (ML), gray and orange, stiff, moist (Native Soil)
4						<p>Test Pit Terminated at 3.5 Feet.</p> <p>Note: No seepage or groundwater encountered. Minor caving observed from 0 to 1.5 feet below ground surface.</p>
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LEGEND

 Bag Sample	 Bucket Sample	 Shelby Tube Sample	 Seepage	 Water Bearing Zone	 Water Level at Abandonment
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Date Excavated: 05/25/2021
 Logged By: ABD and BGA
 Surface Elevation: