Appendix C. Water Quality Resource Area Development Permit Application

Water Quality Resource Area

Boardman Wetland Design Project

Clackamas County, Oregon

February 14, 2017

Contents

Tables

Appendices

Abbreviations and Acronyms

EPSC	Erosion Prevention Control Plan
HCA	Habitat Conservation Area
M	Medium Density
Metro	Portland Metropolitan region
OLWSD	Oak Lodge Water Services District
PEM	Palustrine Emergent
PPWF	Primary Protect Water Feature
R	Residential
UGB	urban growth boundary
VC	vegetated corridor
WQRA	Water Quality Resource Area
ZDO	Zoning and Development Ordinance

1 Introduction

The application for a Water Quality Resource Area (WQRA) Development Permit has been prepared for the Oak Lodge Water Services District (OLWSD) Boardman Wetland Design Project (project) in compliance with requirements outlined in Section 709 of the Clackamas County Zoning and Development Ordinance (ZDO). The project area lies within the Portland Metropolitan region (Metro) urban growth boundary (UGB) in the northwestern portion of Clackamas County, Oregon, east of Oregon Route 99E, and north of the City of Gladstone (Figure 1, all figures are located in Appendix A). The 8.4-acre Boardman Wetlands are bordered by SE Boardman Avenue to the north, SE Cook Street to the east, SE Jennings Avenue to the south, and SE Addie Street to the west (Figure 2). The Boardman Creek drainage basin, comprised of the South and North Boardman basins, covers approximately 1,327 acres. The basin consists of 21 miles of piped creek and 4 miles of open stream. Boardman Creek enters the wetland area from a culvert beneath SE Jennings Avenue, flows approximately 1,500 feet northwest through the central portion of the wetland and exits the area via a culvert beneath SE Boardman Avenue. Boardman Creek discharges the Boardman Wetlands, flows along the Trolley Trail, through Stringfield Family Park, and enters the Willamette River at Walta Vista Street. The majority of Boardman Creek is piped beneath existing development in the area. The Boardman Wetlands and Boardman Creek are primary protected water features according to 709.02(B) and 709.02(C), respectively. These features are also mapped as primary protected water resources on the Title 3 map for Section 2e2e18 from Metro's Regional Land Information.

OLWSD is proposing improvements to wetland and utility function within the 8.4-acre Boardman Wetlands. The project would replace the sanitary sewer line and manholes, provide wetland enhancement and functional uplift for approximately half of the wetland site, and develop a public boardwalk trail system through the wetland. OLWSD has a sanitary sewer maintenance easement through the site and recently purchased approximately half of the wetland area and two adjacent residential lots on SE Addie Street. Both residential lots will be re-developed to provide parking and an outdoor classroom for use by the community and the nearby schools; however, the majority of development will occur outside of the WQRA. The proposed project activities would not result in removal of WQRA area and would not change the existing WQRA category.

2 Water Quality Resource Area

Subsection 709.06(B)(1)(a) of the Clackamas County ZDO states than a WQRA Map Verification shall be required for development that is proposed to be in the WQRA. The mapped WQRA on the Title 3 map for Township 2E, Range 2E, Section 18 shows the majority of the proposed project area is categorized as a Primary Protect Water Feature (PPWF) and as a Wetland Area (Appendix A). The WQRA mapped along Boardman Creek and the Boardman Wetlands occurs on the following taxlot parcels:

- 22E18CA02716
- 22E18CA04101
- 22E18CA04407
- 22E18CA04200
- 22E18CA04300

Per Section 709.02(E) and Table 709-1, the width of the WQRA vegetated corridor (VC) for a Primary Protected Water Resource with slopes <25% is 50 feet from the edge of bankfull stage and the delineated edge of a protected wetland (Table 1). Because the VC exhibits less than 25% canopy cover and greater than 10% surface coverage of non-native vegetation, the WQRA is considered a degraded existing vegetated corridor per Table 709-2. The corridor is dominated by residential development including impervious surfaces and landscaped lawns. In the absence of development the corridor is comprised mainly of invasive reed canary grass and Himalayan blackberry.

The Boardman Wetlands are drained by Boardman Creek which passes through the central portion of the project area and wetland. The 50-foot vegetated corridor for Boardman Creek occurs entirely within the Boardman Wetlands. A wetland delineation was performed in the project area in June 2016 by a qualified wetland specialist pursuant to the Oregon Department of State Lands wetland delineation procedures. The wetland delineation report concluded approximately 4.7 acres of Palustrine Emergent (PEM) Semipermanently Flooded wetland habitat (PEM1F) are present within the project area (Appendix B).

Table 1. Width of WQRA Vegetated Corridor

Water Resource	Protected Water Resource Type	Slope Adjacent to Protected Water Source	Starting point from Measurements from Water Resource	Width of Vegetated Corridor
Boardman Creek	Primary	<25	Edge of bankfull stage	50 feet
Delineated wetland	Primary	<25	Delineated edge of protected wetland	50 feet

Boardman Creek and the majority of the Boardman Wetlands are located in an area zoned Urban Low Density Residential R-7) while the most westerly taxlots (22E18CA04200 and 22E18CA04300) are zoned Medium Density (M) Residential (MR-1). The project area is located within the Metro UGB. The overall contiguous area of vegetative cover is low structure, non-native and invasive in nature.

3 Proposed Development within the WQRA

3.1 Sanitary Sewer Line Rehabilitation

A sanitary sewer line was installed beneath Boardman Creek in 1961 and is currently managed by OLWSD. The line has reached the end of the design life and must be replaced. The line extends approximately 1500 feet through the center of the wetland and connects three lateral lines that service adjacent residences to the main trunk line. The existing sanitary sewer line through the wetland will be replaced with a new pipeline. Proposed repair to the sanitary sewer line will be completed using trenchless technology. Three existing lateral sewer lines will be restored to the main trunk line once repairs have been made. In accordance with Section 709.04(K), this action is considered maintenance, repair or improvement of utility facilities. Because portions of the WQRA would be restored and vegetation removed will be replaced with native vegetation, the proposed sanitary sewer line rehabilitation activities would be exempt from requirements of Section 709. Ingress and egress to the site will occur from the SE Addie Street lots and via the OLWSD easement located on the SE Jennings and SE Boardman Streets. The proposed action will be localized to OLWSD's sewer line easement and will not intrude further into surrounding WQRA and will not be discussed further in this application.

3.2 Wetland Enhancement

The majority of the WQRA is dominated by non-native, invasive plant species. The proposed wetland enhancement component of the project includes removing some of the invasive and non-native communities, and planting mixes of native trees and herbaceous vegetation designed to function in riparian and buffer/upland areas as well as riparian fringe and seasonally flooded areas. A series of features will be constructed throughout the wetland enhancement area for the purposes of enhancing hydrologic function. These features include hummocks and hollows, a small pond and a simulated beaver dam foundation. An existing beaver dam located on Boardman Creek in the northern portion of the project area would be removed. Although the mapped WQRA will experience temporary impacts during restoration work, the acreage of the WQRA will not be impacted and restoration activities are expected to increase the overall function of the wetland and its associated surface water features. The purpose of the proposed restoration is to enhance Boardman Wetlands and Boardman Creek, and is part of local efforts to enhance the Boardman-Rinearson Wetland Complex. Restoration work is exempt from the requirements of Section 709 as outlined in 709.04(E); therefore, these restoration activities will not be discussed further in this application.

3.3 Public Space Development

A component of the proposed project is to provide recreation and educational opportunities for the surrounding communities. The project proposes to develop a public space to provide parking and an outdoor classroom for the surrounding community and nearby Candy Lane Elementary School (see Appendix C for plan set). This development will occur on taxlots 22E18CA04200 and 22E18CA04300 located on SE Addie Street.

The majority of this development will occur outside the WQRA. The project proposes to construct an elevated boardwalk path that circumnavigates the wetland feature. Approximately 1800 feet of boardwalk would be constructed within WQRA categorized as a Primary Protected Water Resource. Due to the elevated boardwalk design and construction method, permanent impacts to the WQRA only include the area occupied by each helical screw pile. Because the boardwalk will be founded with helical screw piles, decking can be constructed from an elevated position, eliminating the need for temporary construction impacts within WQRA. The boardwalk alignment was chosen to minimize impacts to high quality wetland features. There would be up to two public ingress/egress routes to the boardwalk from taxlot 22E18CA04200 on SE Addie Street. The two pervious pavement paths connecting the boardwalk to the parking area will be 4-foot and 8-foot wide. Path construction includes excavating soils to a depth of approximately 6-8 inches, backfilling with crushed rock, and placing forms pervious pavers. Rockwalls will be installed in the WQRA to create viewing and resting opportunities for users of the public space (see Appendix C for plan set).

3.4 Project Effects

Development within the WQRA will be avoided to the extent possible; however, the project will result in temporary and permanent impacts to the WQRA. Approaches were implemented during the project design phase to minimize development impacts resulting from the footprint of boardwalk and trail system. During the design phase several alternatives were evaluated and subsequently dismissed due to the higher level of impacts. A path constructed at grade would have required substantial grading and fill within the WQRA and would have resulted in reducing water quality functions within the WQRA. A floating boardwalk design was also dismissed. This design option would have allowed the boardwalk to rest on the ground surface during periods of lower water disrupting the natural physical processes necessary for healthy plant survival and increasing the design footprint. The proposed elevated boardwalk allows those critical functions to be preserved while eliminating the need for grading and thereby minimizing the footprint of the design (Appendix C).

The project design team evaluated several path alignment alternatives through and around the wetland area using a wetland habitat map (Figure 4, Appendix A), created early during project development. This wetland habitat map highlighted areas of Oregon Ash, spirea, willow, and reed canary grass. The project team utilized this information to formulate a path alignment that would minimize impacts to the higher quality wetlands containing Oregon ash, spirea, and willow. The project also includes an extensive planting plan around the boardwalk within the WQRA. Several native plant pallets will be used to increase plant success and overall plant diversity. The diverse plants include species adapted to upland, riparian, emergent wetlands and open water environments can be found on the planting plan sheets found in Appendix C.

Although impact-reduction approaches would be incorporated, minor temporary and permanent impacts to the WQRA are anticipated during construction of the boardwalk and trail system, and during placement of rock walls (Appendix C).

Table 2. Summary of Project-related Impacts

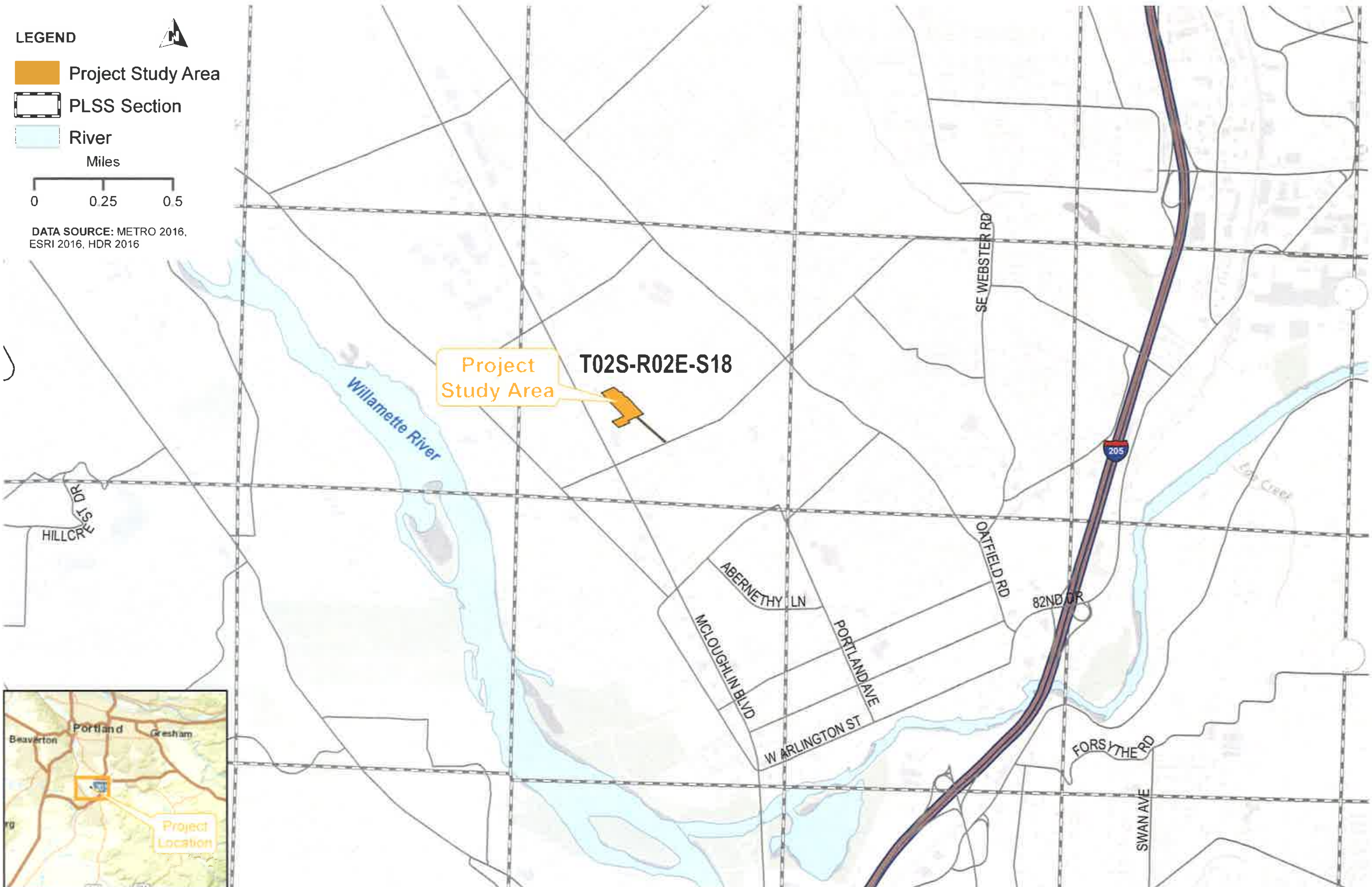
Construction Element	Impact Type	Location	Acreage	Square Feet
Boardwalk	Permanent	PPWF	0.007	284
Rockwalls	Permanent	PPWF	0.002	108
	Temporary	PPWF	0.019	836
	Permanent	Corridor	0.005	241
	Temporary	Corridor	0.033	1444
Pervious Path	Permanent	PPWF	0.008	344
	Temporary	PPWF	0.016	706
	Permanent	Corridor	0.025	1100
	Temporary	Corridor	0.037	1616

Overall, proposed project activities will create functional uplift in the WQRA by increasing canopy cover, reducing non-native and invasive plant species, and planting native communities that represent the vegetative composition though would naturally occur on site.

4 Project Mitigation

All temporary and permanent impacts to trees, vegetation, and soils will be mitigated on site in accordance with section 709.10 of the Clackamas County ZDO. Boardwalk design, layout, and installation technique will minimize impacts and limit disturbance to vegetation and soils in riparian and upland areas while still achieving overall project goals. Construction footprints and impacts would be minimized by developing and implementing a Construction Management Plan (Appendix C) and an Erosion Prevention and Sediment Control (EPSC) Plan (Appendix C) as outlined in 709.08. A construction work easement would be clearly marked and those areas of the WQRA not authorized for disturbance would be identified on project plans and in the field. At a minimum, the areas of the WQRA proposed to be graded for utility and restoration work will be delineated with silt fencing. All stormwater inlets will be protected for the duration of the project and will remain in place after construction activities are completed until soils on site have stabilized. The work area around the manhole within the wetland will be isolated and dewatered. Water removed from the work area will be pumped north and discharged in an area outside the WQRA. When not in use, equipment (excavators, graders, pavers, cement mixers, personnel vehicles, etc.) and material will be staged and/or stockpiled outside the WQRA on the SE Addie Street residential tax lots, 22E18CA04200 and 22E18CA04300. Project personnel and equipment ingress and egress for the site will occur mainly on the SE Addie Street lots, as well as through the OLWSD easements from SE Jennings Avenue (Figure 2). Native landscaping materials will be used and will be harvested locally where possible. Trees within the WQRA not proposed for removal during restoration work would be protected from impacts from construction equipment and native soils will be conserved onsite. Areas within the degraded WQRA that are disturbed and undisturbed by construction will be mitigated using a mix of native vegetation that would naturally occur in riparian, upland and seasonally or permanently flooded wetlands (see planting plans, Appendix C). All debris will be removed from the project area and bare areas will be vegetated with native vegetation. Approximately 13,500 trees and herbaceous vegetation starts will be planted throughout the entire 4.7-acre wetland area as part of the proposed project. Monitoring of planting establishment will be conducted by OLWSD during until plant establishment is complete and invasive plant communities have been reduced to ensure the survivorship of newly planted native species. By implementing the mitigation and construction best management practices outlined above, the boardwalk and trail system will not impact the overall ecological function, size or value of the WQRA.

Appendix A. Figures



PROJECT LOCATION

FIGURE 1

BOARDMAN WETLAND DESIGN

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HDR

HABITAT CONSERVATION AND WATER QUALITY RESOURCE AREAS

FIGURE 2

BOAI WETLAND DESIGN

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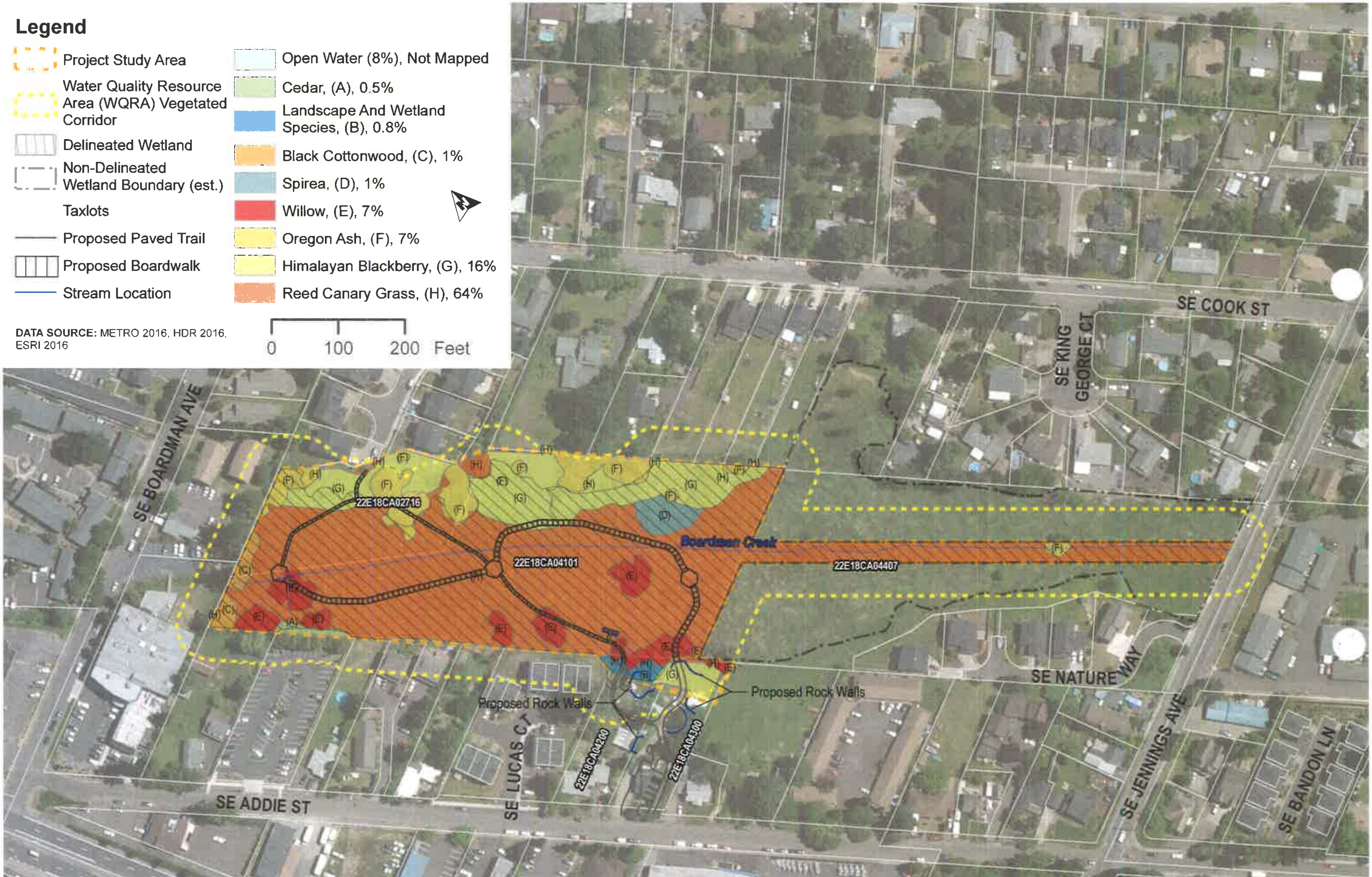
Figure 3. Habitat Conservation Area Map



HDR

WETLAND AND VEGETATION INVENTORY

FIGURE 4

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BOA... WETLAND DESIGN

Appendix B. Wetland Delineation

To eliminate redundant information in the Site Design Review Application, the Wetland Delineation Report has been omitted from the Water Quality Resource Area Report.

Please see Appendix E of the Site Design Review Application for a copy of the Report.

Appendix C. Civil Design Plans

To eliminate redundant information in the Site Design Review Application, the Civil Design Plans have been omitted from the Water Quality Resource Area Report.

Please see Appendix G of the Site Design Review Application for copies of the plans.

Appendix D. Geotechnical Report

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

ALASKA
CALIFORNIA
COLORADO
FLORIDA
MISSOURI
OREGON
WASHINGTON DC
WASHINGTON STATE
WISCONSIN

September 7, 2016

Amy Dammarell, PE
HDR, Inc.
1001 SW 5th Avenue, Suite 1800
Portland, OR 97204-1134

**RE: DRAFT PRELIMINARY GEOTECHNICAL REPORT
BOARDMAN WETLAND COMPLEX
OAK LODGE SANITARY DISTRICT
CLACKAMAS COUNTY, OREGON**

Dear Ms. Dammarell:

Oak Lodge Sanitary District (OLSD) and its engineering consultant, HDR, Inc. (HDR), plan to replace a gravity sanitary sewer line and construct a pathway within the Boardman Wetland in Clackamas County, Oregon. The wetland is located within a residential block between SE Boardman and SE Jennings Avenues to the north and south, and between SE Addie and SE Cook Streets to the west and east. The project location is shown on the Vicinity Map, Figure 1. As a subconsultant to HDR, Shannon & Wilson, Inc. is providing geotechnical engineering services to support the project. The existing sewer line alignment is shown on the Site and Exploration Plan, Figure 2. Preliminary plans indicate that the proposed sewer line will generally follow the existing alignment. However, we understand that the design team is considering alternative alignments that will skirt the wetland. The layout of the proposed pathway is not known at this time. This Geotechnical Engineering Report presents a summary of our field explorations, laboratory test results, and preliminary geotechnical engineering evaluations and recommendations.

SCOPE OF SERVICES

Our services were performed in accordance with the scope of services described in our Task Order, 10040058-01, with HDR, dated August 25, 2016. These services included the following outline of activities, assessments, and recommendations:

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LAKE OSWEGO, OREGON 97035-3480
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- Perform a site reconnaissance to observe the existing site geologic conditions, including locating borings and hand auger borings (or test pit excavations) in the field.
- Drill two borings.
- Perform three test pits within the Boardman Wetland.
- Perform one suite of corrosivity tests.
- Perform preliminary geotechnical evaluations, including the following:
    - Characterize the subsurface soil conditions.
    - Develop design and construction recommendations for sewer pipeline and manholes.
    - Develop design and construction recommendations for pedestrian bridge and boardwalk foundations.
- Prepare this Preliminary Geotechnical Report as part of the project study.

PROJECT UNDERSTANDING

Site Description

The project site is currently a wetland surrounded by residential property (with the exception of the East Side Athletic Club located to the northwest of the site). The wetland is vegetated with grass, low brush, and scattered trees. The wetland is fed via local storm lines and a 5-foot by 7-foot box culvert located at the south end of the wetland and drained at north end via an open channel. Topography at the site is relatively flat with elevations ranging from 70 to 72 feet. The existing sewer line, installed in 1961, runs down the center of the wetland. The existing sewer line is 14 inches in diameter and is embedded 14 to 15 feet below ground surface. There are four manholes located within the wetland and two manholes located in Boardman and Jennings Avenue.

Project Description

The OLSD plans to replace the existing sewer line and construct a pathway through the wetland that includes two pedestrian bridges. We understand that the proposed sewer line will tie into the existing manholes located at Boardman and Jennings Avenue. Preliminary plans indicate that the proposed sewer line will generally following the existing alignment. However, we understand that the design team is considering alternative alignments that will skirt the wetland. The existing manholes located within the wetland will be removed; up to two new manholes will be included in the new alignment. The proposed sewer line is 14 inches in diameter and embedded 14 to 15 feet below ground surface. The manholes will extend up to 2 feet below the pipeline, 16 to 17 feet below ground surface.

The OLSD plans to construct a pathway through the wetland. We understand that the design team is considering either a precast concrete or wood pathway supported on piles or a pathway paved with asphalt concrete constructed on fill material. Two pedestrian bridges will be included as a part of the pathway. The majority of the pathway will have only pedestrian traffic. However, we understand that a portion of the pathway will support vehicles used to access the manholes for maintenance. We understand that these vehicles will include 70,000-pound vacuum trucks.

GEOLOGIC SETTING

The project site is located in the Portland Basin, at the northeastern end of the Willamette Valley. Base-rock at the project site is composed of lava flows of the middle Miocene Age (approximately 17 to 6 million years old) Columbia River Basalt Group (CRBG). The CRBG is overlain at the project site by coarse grained alluvial deposits derived from late Pleistocene glacial-outburst floods of the upper Columbia River drainage. In the Portland Basin, flood deposits that blanket the basin floor consist largely of unconsolidated gravel and sand, although silty and clayey phases have also been mapped (Trimble, 1963; Madin, 1990; Beeson and others, 1989).

FIELD EXPLORATIONS & LABORATORY TESTING

Field Explorations

Our subsurface exploration program consisted of two geotechnical borings and three test pits. The borings, designated B-1 and B-2, were drilled in the north East Side Athletic Club parking lot and in the Addie Acres property on July 19, 2016. The test pits, designated TP-1 through TP-3, were excavated within the wetland on July 20, 2016. The location of these explorations are shown on the Figure 2, Site and Exploration Plan. Borings B-1 and B-2 extended to depths of 20 and 21.5 feet, respectively. Test pits were advanced to a depth of approximately 10 feet. A drive probe was used to extend the explored depths to between 14.2 and 14.8 feet. Details of the drilling and sampling procedures, as well as detailed logs of the materials encountered in the borings, are presented in Appendix A, Field Exploration Program.

Laboratory Testing

During the field explorations, representative samples were taken at selected depths and sealed for further examination in our laboratory. The laboratory testing program consisted of visual classifications for all applicable samples, natural moisture contents, and Atterberg limit determination tests. Analytical laboratory testing was also performed and included pH of Soil, Oxidation-Reduction Potential (Redox Potential), Soil Resistivity, and Sulfides tests. All test procedures were performed in accordance to applicable ASTM International Standards. Descriptions of the procedures and the results of laboratory tests completed on the soil samples are included in Appendix B.

SUBSURFACE CONDITIONS

Soils

Our interpretation of subsurface conditions at the project site is based on our explorations and regional information from published sources. Based on these data, we have grouped the materials underlying the site into three generalized units: Marsh Deposits, Catastrophic Flood Deposits Fine-Grained Facies, and Catastrophic Flood Deposits Coarse-Grained Facies. Fill was also encountered in Borings B-1 and B-2, and consisted of 4 inches of asphalt concrete over 8 inches of base aggregate in Boring B-1 and 6 inches of base aggregate Boring B-2.

In general, the Marsh Deposits consisted of wet, very soft, organic soil with medium to high plasticity. Moisture contents ranged from 39 to 107 percent and averaged 69 percent. A single field Standard Penetration Test value (SPT N-Values) was measured at 0 blows per foot (bpf). The thickness of the unit encountered was 4 feet in Boring B-1 and more than 10 feet in the test pits (TP-1 through TP-3). Test Pits TP-1 through TP-3 were terminated in this unit.

Catastrophic Flood Deposits Fine-Grained Facies (Fine-Grained CFD) were observed in Borings B-1 and B-2. Boring B-1, which is located within the wetland channel, encountered the Fine-Grained CFD from a depth of 5 to 15 feet. The lower half of the unit consisted of silty gravel. Boring B-2, which is located outside the wetland, encountered the Fine-Grained CFD near the ground surface to a depth of 12 feet. The Fine-Grained CFD encountered in Boring B-1 consisted of clay and silt, and in Boring B-2 the unit consisted of silty sand and poorly graded sand with silt. Field SPT N-Values ranged from 0 to 3 bpf in the clays and silt and averaged about 2 bpf. In the sands field SPT N-Values ranged from 3 to 31 and averaged about 9 bpf.

Catastrophic Flood Deposits Coarse-Grained Facies (Coarse-Grained CFD) were observed in Borings B-1 and B-2 below depths of 15 and 12 feet, respectively. Both borings were terminated in this unit. The soil encountered in this unit generally consisted of medium dense to very dense silty gravel with cobbles and boulders

We based these generalized geologic units on engineering properties and their distribution in the subsurface. Variations in subsurface conditions may exist away from the location of the boring. Contacts between the units may be more gradational than shown.

Groundwater

The borings were drilled using mud rotary drilling techniques, which make it difficult to discern the depth to groundwater, if it is encountered. No instrumentation or observation wells were installed in the borings. Groundwater/water levels observed in the test pits ranged from 6 inches above to less than 12 inches below the ground surface. Groundwater levels should be expected to vary seasonally relative to the static water level of Boardman Wetland.

BURIED PIPELINE DESIGN RECOMMENDATIONS

Bedding

The pipe bedding should be constructed with imported, well-graded, clean crushed rock material suitable for compaction and allowing for flexible joints. The on-site excavation spoils, predominantly fine-grained, organic silts, will not be suitable for use as bedding material. The bedding material should consist of imported, ¾-inch minus crushed well-graded aggregate in accordance with Oregon Standard Specification for Construction (OSSC, 2015), Section 02630.10. Provided that the subgrade consists of competent coarse grained catastrophic flood deposits, the minimum thickness of bedding below the invert of the pipeline should be 6 inches.

High groundwater is present across the site. To stabilize the subgrade and provide a drainage layer for sumping, we recommend the installation of a crushed rock drainage layer at least 12 inches thick be installed below the pipe to facilitate dewatering. The drainage layer should be constructed with open, free-draining crushed rock materials with a 1½-inch to 3/4-inch gradation conforming to OSSC Section 00430.11. We understand that the pipeline will be embedded 14 to 15 feet below ground surface. Based on our explorations, we anticipate that the pipe bedding will be founded in the Coarse-Grained CFD. During construction, if organic, soft, or disturbed subgrade soils are encountered at the subgrade elevation, subgrade stabilization (subgrade overexcavation/replacement) will be required and will result in a thicker drainage.

Additionally, we recommend the use of a non-woven geotextile against the trench surfaces (subgrade and sides), completely surrounding the drainage layer and pipe zone material, to prevent the migration of native soil into the drainage layer and pipe zone material. The non-woven geotextile should conform to the geotextile properties presented in OSSC Section 02320, Table 02320-4 (Separation).

Pipe Zone

For the pipe zone material, ¾-inch minus crushed dense-graded aggregate in accordance with OSSC Section 02630.11, should be used. Typically, the pipe zone materials should extend at least 6 inches above the top of the pipe, or as determined by the manufacturer. Pipe zone compaction should be to at least 85 percent of maximum density as determined by ASTM D1557 (modified proctor).

Trench Backfill

Except for settlement-sensitive areas, such as structure or pavement areas, the pipeline trench backfill may consist of the excavated native soil. However, based on the soils encountered in the field explorations, the excavated native soil will generally consist of very wet and/or organic material that cannot be compacted and, as result, will settle significantly over time. To compensate for future settlement of the native soil trench backfill, we recommend mounding the surface of the trench backfill at least 12 inches. If future settlement is acceptable, mounding the surface of the trench backfill is not necessary.

If backfill is placed in settlement-sensitive areas, we recommend trench backfill meet OSSC 00405.14 (Class B Backfill), ¾-inch or 1-inch minus crushed aggregate. We recommend the backfill be compacted be to at least 85 percent of maximum density as determined by ASTM D1557 (modified proctor).

MANHOLE DESIGN RECOMMENDATIONS

Foundation Recommendations

To stabilize the subgrade and provide a drainage layer for sumping, we recommend that the footprint of the manhole be over-excavated a minimum 12 inches and extend a minimum 6 inches beyond the edge of the manhole foundation. The over-excavated material should be replaced with an engineered free-draining crushed rock materials with a 1½-inch to 3/4-inch gradation conforming to OSSC Section 00430.11, underlain by a layer of non-woven geotextile fabric conforming to OSSC, Section 02320, Table 02320-4 (Separation).

If the recommended crushed rock fills are constructed as described above, the proposed structures can be supported on conventional shallow foundations founded on the crushed rock mat with a net allowable bearing capacity of 2,000 psf. A total static settlement of less than 1 inch and a differential settlement on the order of 50 percent of the total settlement are estimated with the proposed structures supported on the crushed rock layer. Our settlement estimate assumes that no disturbance to the foundation soil subgrade would be allowed during excavation and fill placement.

Lateral Earth Pressures on Embedded Walls

The lateral earth pressures on embedded walls for manholes were evaluated as equivalent fluid pressures. In our analysis, we assume that the embedded walls will be designed as non-yielding walls under static loading conditions and will have a level backfill surface. We anticipate that the contractor will excavate for the manholes using shoring box methods or sheet piles. Therefore, we anticipate that backfill will be only be required within 3 feet of the embedded walls. We developed lateral earth pressures assuming strengths for undisturbed native soil. The backfill should consist of ¾, 1, or 1½-inch minus crushed dense-graded aggregate in accordance with OSSC, Section 02630.11 compacted to within 85 percent of maximum density as determined by ASTM D1557 (modified proctor). For design, groundwater level should be at the ground surface or at the maximum anticipated water level in wetland.

Recommended lateral earth pressure values, as equivalent fluid pressures, are presented on Figure 3. In Figure 3, H is defined as the total height of the buried wall and q is the surcharge load, with q in units of pounds per square foot.

Uplift Design and Potential Flotation Effects

We recommend that manholes be designed for uplift. The water table should be assumed to be at the ground surface or at the highest anticipated water level in the wetland. Uplift resistance should be based on the dead weight of the manhole. If additional resistance is needed, consideration should be given to extending the foundation beyond the manhole sidewalls and using the dead weight of the backfill material directly above the foundation as described above. For imported crushed rock backfill below the groundwater, a buoyant unit weight of 63 pcf should be used. The upper 12 inches of the backfill should be ignored.

WETLAND PATHWAY

Pathway & Pedestrian Bridge Foundations

Due to the very soft organic material, if the pathway and pedestrian bridges are supported on shallow foundations, significant settlement will occur. The pathway and bridges should be supported by deep foundations such as helical piles, driven pin piles, or drilled micropiles. Considering the site subsurface soil conditions, the piles should penetrate through the Marsh Deposits and soft Fine-Grained CFD and found into the competent, non-compressible, medium dense to very dense Coarse-Grained CFD located at approximately 15 feet below the ground surface.

Based preliminary descriptions of the pathway and bridges, we anticipate that the factored load on the piles will be less than 20 kips. This load magnitude is more suitable for helical piles or driven pin piles, especially when these piles can be founded on competent soil deposits for end bearing (in this case, the medium dense to very dense Coarse-Grained CFD). For drilled micropiles, the capacities are generated from shaft friction or bonding, not from the end bearing due to the very small pile tip area. Therefore, a relatively large embedment depth into the competent bearing stratus will be needed for the development of sufficient shaft friction or bonding.

Considering these factors, helical piles or driven 6- to 10-inch pin piles are the recommended pile to utilize the end bearing from the Coarse-Grained CFD below a depth of 15 feet.

Fill Pathway

We understand that the design team is considering a pathway paved with asphalt concrete constructed on fill material. Due to the very soft organic material, significant settlement will occur over the lifetime of the pathway. The majority the settlement will occur during construction and during the following year. After this initial period of settlement, secondary settlement caused by degradation of organic materials will continue to occur. Significant maintenance, including placement of fill to level the pathway and repairs to the pavement, will be required on a yearly basis. Because significant maintenance is required throughout the lifetime of the pathway, we do not recommend this alternative.

CONSTRUCTION CONSIDERATIONS

General

Based on our field investigation, laboratory testing, and engineering analysis results, it is our opinion the primary geotechnical construction issue at the proposed site is the excavation and groundwater control required to install the proposed sewer line.

Excavation and Groundwater Control

The majority of the excavation will be performed through the wetland. As discussed in the Groundwater section, groundwater was observed at the ground surface during our field explorations performed in July 2016. It is possible that water levels may rise higher than observed during explorations.

Seepage was observed in Test Pit TP-1 at approximately 4 feet below ground surface; however, the test pit did not fill with water during the excavation. Surface water was observed in the adjacent wetland channel at approximately 12 inches below ground surface at Test Pit TP-1. Test Pits TP-2 and TP-3 were performed in locations where water was at or above the ground surface. Once Test Pits TP-2 and TP-3 were started, water filled the excavation immediately. However, we estimate that the majority of the water that filled the excavation was surface water. Based on observations we made during the excavation of the test pits, the permeability in the Marsh Deposits and Fine-Grained CFD is likely relatively low. The Coarse-Grained CFD encountered in our explorations appeared to have a matrix of sand and silt. Therefore, we anticipate that the permeability is significantly greater than the marsh deposits, but low when compared to open gravels. The Coarse-Grained CFD and its permeability should be expected to vary significantly.

We recommend that the earthwork contractor be responsible for the design of the shoring and dewatering systems as well as the treatment and disposal of collected water. However, for planning and preliminary cost estimating purposes, we recommend the following:

The surface water in the wetland should be blocked so it does not flow directly into the pipeline and manhole excavations. Based the subsurface conditions observed in our explorations and our preliminary evaluation, we recommend the use of a sheet pile shoring system. Sheet piles should be driven into the Coarse-Grained CFD. We anticipate that groundwater seepage can be controlled with pumping from localized, well-designed/constructed, filtered sumps. To stabilize the subgrade and provide a workable condition for the manholes and pipeline installation, the sumping system should be operated within the drainage layer discussed above. The sump pumps should be installed at sufficient spacing to keep the groundwater level below the surface of the drainage layer. If sheet piles are not used, we anticipate that an external dewatering system, consisting of wells or wellpoints, will be required.

Trenchless Construction/Rehabilitation

We understand that design team is considering the use of trenchless construction methods such as pipe jacking, directional drilling, pipe ramming, and auger boring. These methods involve either drilling or driving through the native soil. Based on the subsurface conditions encountered in our field explorations, we anticipate that the proposed sewer line will be embedded in the Coarse-Grained CFD, which consist of gravel with silt, cobbles, and boulders. Because of the cobbles and boulders and the variable nature of the material, the risk during construction is significantly elevated. We do not recommend the use of these trenchless construction methods.

The design team is also considering trenchless rehabilitation methods such as pipe bursting and cure-in-place pipe (CIPP). Because these methods do not required drilling or driving through the native soil, there is significantly less risk in construction. Based on the geotechnical risks during construction, we recommend these trenchless rehabilitation methods over the trenchless construction methods discussed above.

Erosion Control

Erosion of the soil at the site will occur as exposed surfaces are disturbed due to construction activities and exposure to climatic conditions. Excavated surfaces should be protected by a weather-resistant cover or erosion-control product, if left exposed. Temporary erosion and runoff control measures should be in place prior to and during construction. Erosion-control measures should remain in place and be maintained by the Contractor until disturbed areas are stabilized. The expected erosion control work consists of furnishing, installing, maintaining, removing, and disposing of water sediments and should be executed in accordance with OSSC, Section 00280.

LIMITATIONS

The analyses, conclusions, and recommendations contained in this report are based on site conditions as they presently exist, and further assume that the explorations are representative of the subsurface conditions throughout the site. That is, the subsurface conditions everywhere are not significantly different from those disclosed by the explorations. If subsurface conditions different from those encountered in the explorations are encountered or appear to be present during construction, we should be advised at once so that we can review these conditions and reconsider our recommendations, where necessary. If there is a substantial lapse of time between the submission of this report and the start of construction at the site, or if conditions have changed because of natural forces or construction operations at or adjacent to the site, we recommend that we review our report to determine the applicability of the conclusions and recommendations.

Within the limitations of scope, schedule, and budget, the analyses, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practice in this area at the time this report was prepared. We make no other warranty, either express or implied. These conclusions and recommendations were based on our understanding of the project as described in this report and the site conditions as observed at the time of our explorations.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by merely taking soil samples from test borings. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

This report was prepared for the exclusive use of the HDR and Oak Lodge Sanitary District in the design of the sewer line and pathway. The data and report should be provided to the contractors for their information, but our report, conclusions, and interpretations should not be construed as a warranty of subsurface conditions included in this report.

The scope of our present 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, groundwater, or air, on or below or around this site, or for the evaluation or disposal of contaminated soils or groundwater, should any be encountered.

Shannon & Wilson has prepared and included in Appendix C, "Important Information About Your Geotechnical/Environmental Report," to assist you and others in understanding the use and limitations of our reports.

Sincerely,

SHANNON & WILSON, INC.

Ian C. LaVielle, PE
Senior Engineer

Risheng "Park" Piao, PE, GE
Vice President | Geotechnical Engineer

ICL:RPP/hrj:aeb

Enclosures: Figure 1 – Vicinity Map
Figure 2 – Site and Exploration Plan
Figure 3 – Lateral Earth Pressure Distribution
Appendix A – Field Exploration Program
Appendix B – Laboratory Testing
Appendix C – Important Information About Your Geotechnical/Environmental Report

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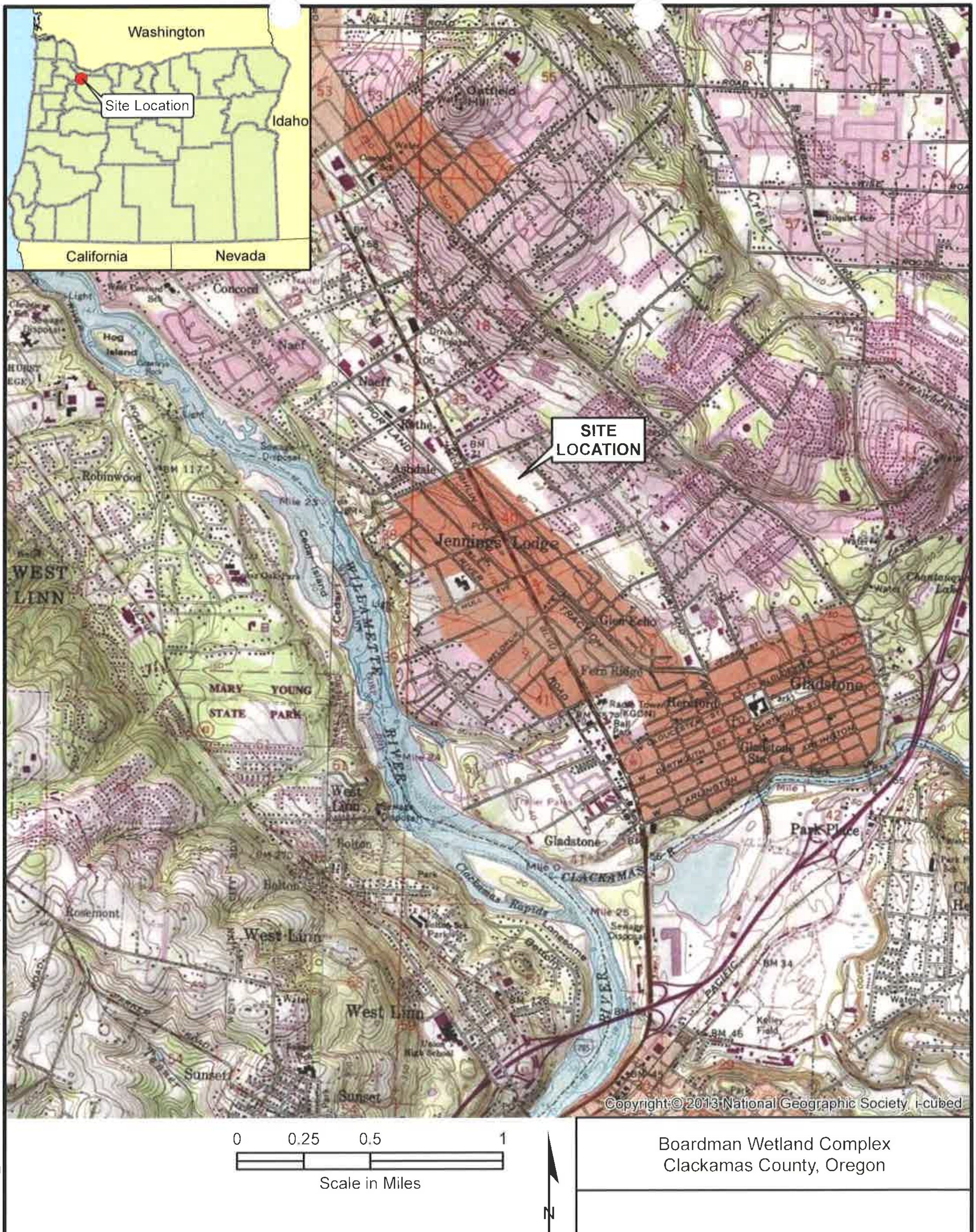

Boardman Wetland Complex
Clackamas County, Oregon

VICINITY MAP

September 2016 24-1-04055-001

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FIG. 1

Filename: T:\Projects\24-1\4055_Boardman Wetland Complex\Avmxd\VicinityMap.mxd Date: 8/18/2016 Login: aeh

LEGEND

B-1 Designation and Approximate Location of Boring

TP-1 Designation and Approximate Location of Test Pit

Proposed Addie Acres

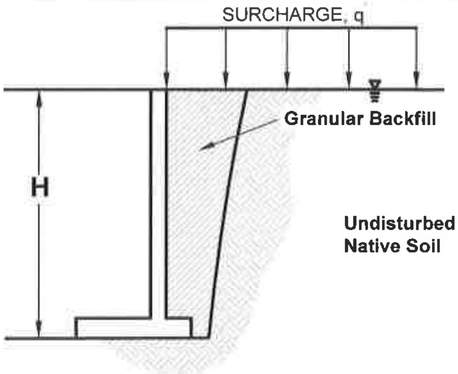
0 100 200 400

Scale in Feet

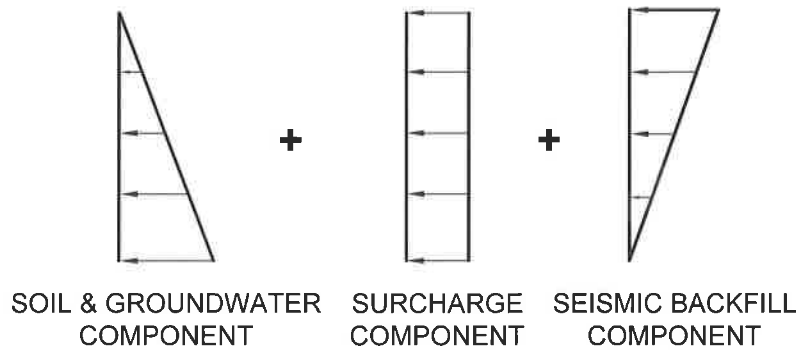
NOTES

1. Existing facilities from file "Boardman Wetland Complex. provided by HDR on July 11, 2016.

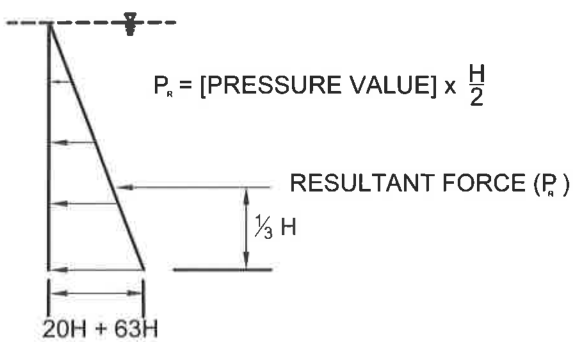
Filename: T:\Projects\24-14055_Boardman Wetland Complex\Avmxd\SitePlan.mxd Date: 8/18/2016 Login: aeh



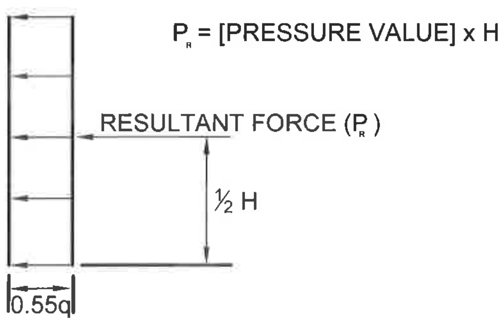
TOTAL LATERAL EQUIVALENT FLUID PRESSURES



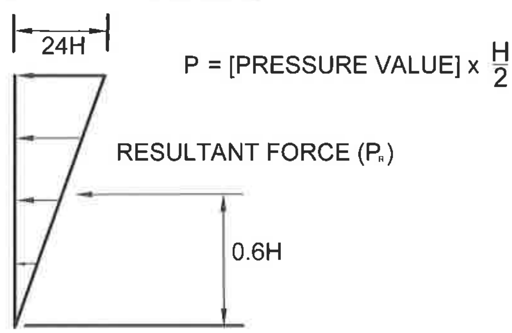
SOIL & GROUNDWATER COMPONENT



SURCHARGE COMPONENT



SEISMIC COMPONENT



Note:

1. Backfill unit weight of 110 pcf
2. Backfill friction angle is 27 deg.
3. Wall backfill is assumed to be less than 3 feet of granular material placed against undisturbed native soil.
4. Seismic pressures provided for peak ground acceleration associated with the 2,500 year earthquakes (IBC).

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LATERAL EARTH PRESSURE DISTRIBUTION

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FIG. 3

File: I:\WIP\Projects\24-1 Portland\4000\4055 Boardman Wetland Complex\Graphics\CAD\Lateral Earth Pressures.dwg Date: 09-06-2016 Author: icl

APPENDIX A

FIELD EXPLORATION PROGRAM

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FIGURES

APPENDIX A

FIELD EXPLORATION PROGRAM

A.1 INTRODUCTION

The field exploration program for the Boardman Wetland Complex Project consisted of two borings, designated B-1 and B-2, completed on July 19, 2016 and three test pits, designated TP-1 through TP-3, completed on July 20, 2016. The locations shown in Figure 2, Site and Exploration Plan.

A.2 FIELD OPERATIONS

A.2.1 Drilling

Shannon & Wilson subcontracted exploration drilling to Western States Soil Conservation, Inc. of Hubbard, Oregon. The borings were drilled truck-mounted CME 75 rotary drill rigs. Borings were advanced using only open-hole mud-rotary tri-cone drilling techniques.

Borings were backfilled in accordance with Oregon Department of Water Resources, using bentonite chips or bentonite grout. Borings that penetrated pavement sections were finished at the surface with asphalt emulsion cold patch comparable in thickness to the layers encountered during drilling.

A.2.2 Test Pits

Test pit excavations were completed by Dan Fischer Excavation of North Plains. The excavations were made with a mini excavator. Test pits were generally 10 feet long, 2 feet wide, and were excavated to depths of approximately 10 feet below the ground surface. Test pits were backfill with uncompacted spoils.

A.2.3 Field Supervision

A Shannon & Wilson engineer or geologist was present during all exploratory drilling and excavating activities to observe and record soil conditions, collect samples and prepare field descriptions of the soils penetrated in the borings and test pits.

A.2.4 Disturbed Sampling

Disturbed soil samples were obtained in the borings at 2.5- to 5.0-foot depth intervals using a standard 2-inch O.D. split spoon sampler in conjunction with Standard Penetration Testing (SPT). In accordance with ASTM D1586, the Standard Penetration Test procedure consists of driving the sampler 18 inches into the soil using a 140 pound hammer dropped 30 inches. The number of blows required to drive the sampler the last 12 inches is defined as the standard penetration resistance, or N-value. The N-value provides a measure of in-situ relative density of granular soils, such as sand and gravel, and the consistency of cohesive soils, such as silt and clay. Samples were sealed to retain moisture and transported to our office for examination and testing.

Shannon & Wilson, Inc. (S&W), uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following pages. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.

S&W INORGANIC SOIL CONSTITUENT DEFINITIONS

CONSTITUENT[2]	FINE-GRAINED SOILS (50% or more fines)[1]	COARSE-GRAINED SOILS (less than 50% fines)[1]
Major	***Silt, Lean Clay, Elastic Silt,*** or ***Fat Clay***[3]	***Sand*** or ***Gravel***[4]
Modifying (Secondary) Precedes major constituent	30% or more coarse-grained: ***Sandy*** or ***Gravelly***[4]	More than 12% fine-grained: ***Silty*** or ***Clayey***[3]
Minor Follows major constituent	15% to 30% coarse-grained: ***with Sand*** or ***with Gravel***[4]	5% to 12% fine-grained: ***with Silt*** or ***with Clay***[3]
	30% or more total coarse-grained *and* lesser coarse-grained constituent is 15% or more: ***with Sand*** or ***with Gravel***[5]	15% or more of a second coarse-grained constituent: ***with Sand*** or ***with Gravel***[5]

[1]All percentages are by weight of total specimen passing a 3-inch sieve.
[2]The order of terms is: *Modifying Major with Minor.*
[3]Determined based on behavior.
[4]Determined based on which constituent comprises a larger percentage.
[5]Whichever is the lesser constituent.

MOISTURE CONTENT TERMS

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

STANDARD PENETRATION TEST (SPT) SPECIFICATIONS

Hammer:	140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diam. cathead 2-1/4 rope turns, > 100 rpm
Sampler:	10 to 30 inches long Shoe I.D. = 1.375 inches Barrel I.D. = 1.5 inches Barrel O.D. = 2 inches
N-Value:	Sum blow counts for second and third 6-inch increments. Refusal: 50 blows for 6 inches or less; 10 blows for 0 inches.

NOTE: Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.

PARTICLE SIZE DEFINITIONS

DESCRIPTION	SIEVE NUMBER AND/OR APPROXIMATE SIZE
FINES	< #200 (0.075 mm = 0.003 in.)
SAND	
Fine	#200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.)
Medium	#40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.)
Coarse	#10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.)
GRAVEL	
Fine	#4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.)
Coarse	3/4 to 3 in. (19 to 76 mm)
COBBLES	3 to 12 in. (76 to 305 mm)
BOULDERS	> 12 in. (305 mm)

RELATIVE DENSITY / CONSISTENCY

COHESIONLESS SOILS		COHESIVE SOILS	
N, SPT, BLOWS/FT.	RELATIVE DENSITY	N, SPT, BLOWS/FT.	RELATIVE CONSISTENCY
< 4	Very loose	< 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very dense	15 - 30	Very stiff
		> 30	Hard

WELL AND BACKFILL SYMBOLS

Bentonite Cement Grout	Surface Cement Seal
Bentonite Grout	Asphalt or Cap
Bentonite Chips	Slough
Silica Sand	Inclinometer or Non-perforated Casing
Gravel	Vibrating Wire Piezometer
Perforated or Screened Casing	

PERCENTAGES TERMS [1, 2]

Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

[1]Gravel, sand, and fines estimated by mass. Other constituents, such as organics, cobbles, and boulders, estimated by volume.

[2]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

Boardman Wetland Complex
Clackamas County, Oregon

SOIL DESCRIPTION AND LOG KEY

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FIG. A1
Sheet 1 of 3

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
(Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488)

MAJOR DIVISIONS			GROUP/GRAPHIC SYMBOL		TYPICAL IDENTIFICATIONS
COARSE-GRAINED SOILS *(more than 50% retained on No. 200 sieve)*	Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)*	Gravel *(less than 5% fines)*	GW		Well-Graded Gravel; Well-Graded Gravel with Sand
			GP		Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel *(more than 12% fines)*	GM		Silty Gravel; Silty Gravel with Sand
			GC		Clayey Gravel; Clayey Gravel with Sand
	Sands *(50% or more of coarse fraction passes the No. 4 sieve)*	Sand *(less than 5% fines)*	SW		Well-Graded Sand; Well-Graded Sand with Gravel
			SP		Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand *(more than 12% fines)*	SM		Silty Sand; Silty Sand with Gravel
			SC		Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS *(50% or more passes the No. 200 sieve)*	Silts and Clays *(liquid limit less than 50)*	Inorganic	ML		Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL		Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
		Organic	OL		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
	Silts and Clays *(liquid limit 50 or more)*	Inorganic	MH		Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
			CH		Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
		Organic	OH		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
HIGHLY-ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT		Peat or other highly organic soils (see ASTM D4427)

FILL	Placed by humans, both engineered and nonengineered. May include various soil materials and debris.		The Fill graphic symbol is combined with the soil graphic that best represents the observed material

NOTE: No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

NOTES

1. Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, Sand with Silt)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the *CL-ML* area of the plasticity chart.

2. Borderline symbols *(symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand)* indicate that the soil properties are close to the defining boundary between two groups.

3. The soil graphics above represent the various USCS identifications (i.e., *GP*, *SM*, etc.) and may be augmented with additional symbology to represent differences within USCS designations. *Sandy Silt (ML)*, for example, may be accompanied by the *ML* soil graphic with sand grains added.

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SOIL DESCRIPTION AND LOG KEY

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FIG. A1
Sheet 2 of 3

GRADATION TERMS

Poorly Graded	Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested.
Well-Graded	Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested.

CEMENTATION TERMS[1]

Weak	Crumbles or breaks with handling or slight finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

PLASTICITY[2]

DESCRIPTION	VISUAL-MANUAL CRITERIA	APPROX. PLASITICTY INDEX RANGE
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.	< 4%
Low	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.	4 to 10%
Medium	A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.	10 to 20%
High	It take considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.	> 20%

ADDITIONAL TERMS

Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

PARTICLE ANGULARITY AND SHAPE TERMS[1]

Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width/thickness ratio > 3.
Elongated	Length/width ratio > 3.

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[2]Adapted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

ACRONYMS AND ABBREVIATIONS

ATD	At Time of Drilling
approx.	Approximate/Approximately
Diam.	Diameter
Elev.	Elevation
ft.	Feet
FeO	Iron Oxide
gal.	Gallons
Horiz.	Horizontal
HSA	Hollow Stem Auger
I.D.	Inside Diameter
in.	Inches
lbs.	Pounds
MgO	Magnesium Oxide
mm	Millimeter
MnO	Manganese Oxide
NA	Not Applicable or Not Available
NP	Nonplastic
O.D.	Outside Diameter
OW	Observation Well
pcf	Pounds per Cubic Foot
PID	Photo-Ionization Detector
PMT	Pressuremeter Test
ppm	Parts per Million
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
rpm	Rotations per Minute
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
q_u	Unconfined Compressive Strength
VWP	Vibrating Wire Piezometer
Vert.	Vertical
WOH	Weight of Hammer
WOR	Weight of Rods
Wt.	Weight

STRUCTURE TERMS[1]

Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
Slickensided	Fracture planes appear polished or glossy; sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

Boardman Wetland Complex
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SOIL DESCRIPTION AND LOG KEY

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FIG. A1
Sheet 3 of 3

Total Depth:	20 ft.	Northing:	~	Drilling Method:	*Mud Rotary*	Hole Diam.:	5 in.
Top Elevation:	~	Easting:	~	Drilling Company:	*Western States*	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	*CME 75 Truck Rig #1*	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:	*Hammer Efficiency = 92.6%*		

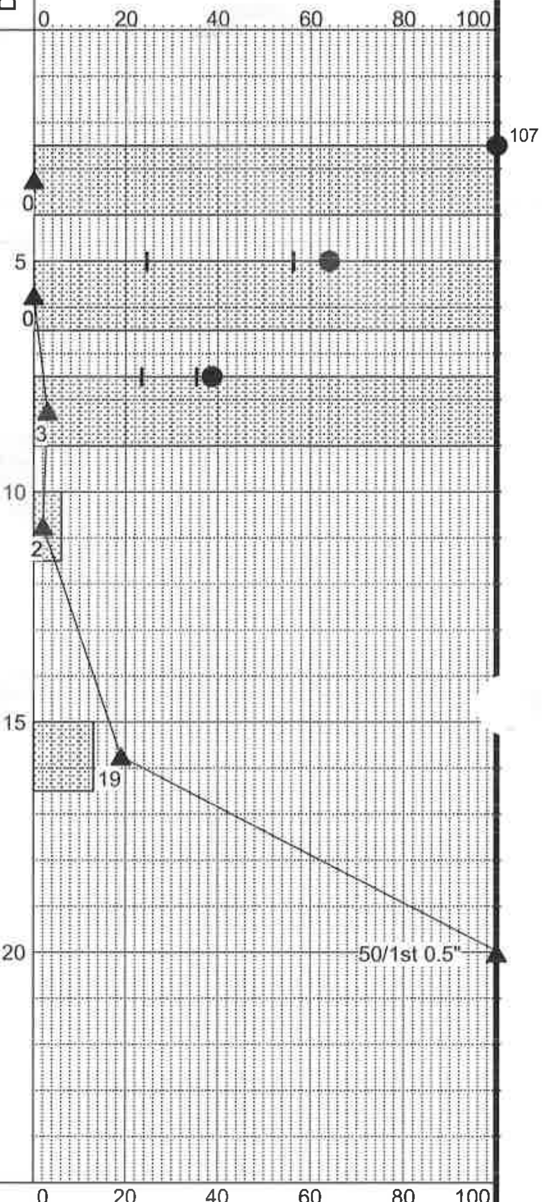
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.

Soil Description	Elev. Depth (ft.)	Samples
Asphalt Concrete	0.3	
Base Aggregate	1.0	
Very soft, dark brown, *Organic Soil (OH)*; moist to wet; medium to high plasticity; trace rootlets. **MARSH DEPOSITS**		S-1
Very soft, gray, *Fat Clay (CH)*; wet; high plasticity. **CATASTROPHIC FLOOD DEPOSITS FINE-GRAINED FACIES**	5.0	S-2
Very soft, gray, *Lean Clay (CL)*; wet; medium plasticity. *Material change at 9 ft based on drill action.*	7.0	S-3
Very soft, gray, *Elastic Silt (MH)*; moist to wet; interbeded with gray, *Silty Gravel (GM)*; wet; 5- to 8-inch-thick gravel layers inferred from drill action.	9.0	S-4
Medium dense, dark gray, *Poorly Graded Gravel with Silt with cobbles and boulders (GP-GM)*; fine to coarse subangular to subrounded gravel; trace fine to coarse sand. **CATASTROPHIC FLOOD DEPOSITS COARSE-GRAINED FACIES** *Possible boulder from 18 to 20 ft based on drill action.*	15.0	S-5
Completed: July 19, 2016	20.0	S-6

Symbol | Ground Water | Depth, ft.

PENETRATION RESISTANCE, N (blows/ft.)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

⌶ Standard Penetration Test

● % Water Content
Plastic Limit ├──┤ Liquid Limit

NOTES
1. Refer to KEY for explanation of symbols, codes, abbreviations, and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. Group symbol is based on visual-manual identification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Boardman Wetland Complex
Clackamas County, Oregon

LOG OF BORING B-1

September 2016 24-1-04055-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A2

REV 3

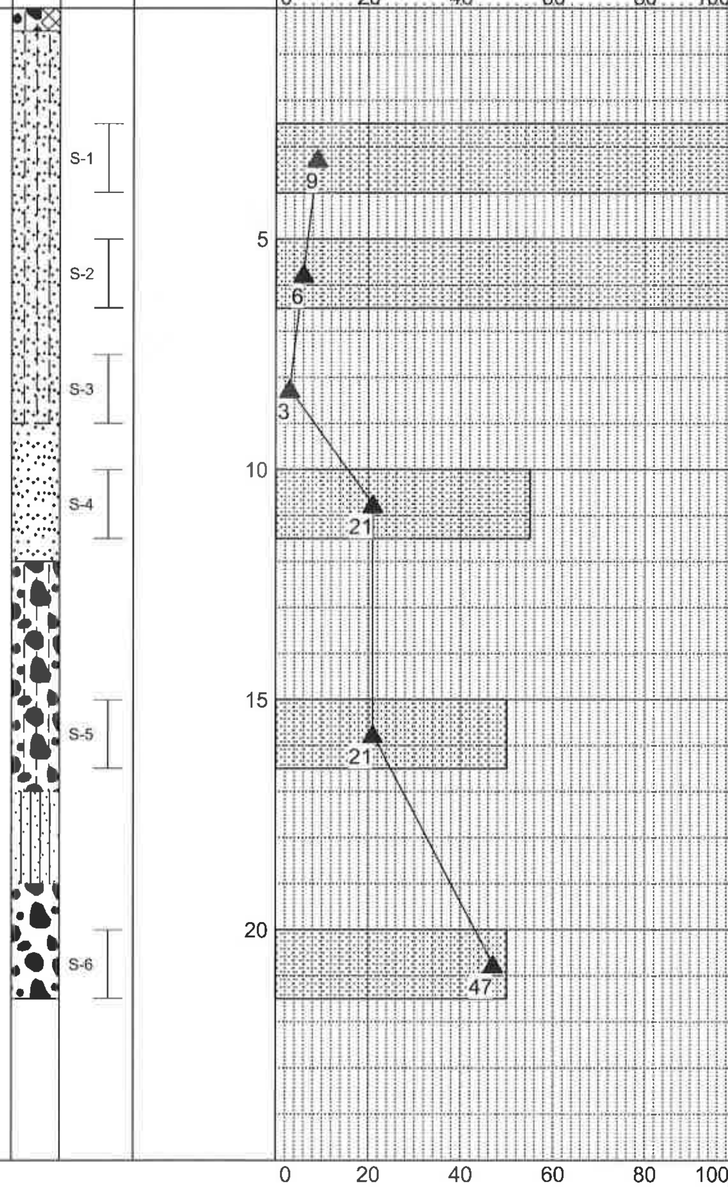
MASTER_LOG_E 24-1-04055.GPJ SW2013LIBRARYPDX.GLB SHANWIL_PDX.GDT 9/4/16 Log: JJW Rev: KEE Typ: JJW/AEH

Total Depth:	21.5 ft.	Northing:	~	Drilling Method:	Mud Rotary	Hole Diam.:	5 in.
Top Elevation:	~	Easting:	~	Drilling Company:	Western States	Rod Type:	NWJ
Vert. Datum:		Station:	~	Drill Rig Equipment:	CME 75 Truck Rig #1	Hammer Type:	Automatic
Horiz. Datum:		Offset:	~	Other Comments:	Hammer Efficiency = 92.6%		

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between soil types, and the transitions may be gradual.*	Elev. Depth (ft.)	Samples
Brown, *Silty Gravel (GM)*; moist; fine to coarse angular to subangular gravel; nonplastic fines. **FILL**	0.5	
Loose to very loose, brown, *Silty Sand (SM)*; moist to wet; fine to medium sand; nonplastic to low plasticity fines. **CATASTROPHIC FLOOD DEPOSITS SAND FACIES** *Material change at 9 ft based on drill action.*	9.0	S-1, S-2, S-3
Medium dense, red-brown, *Poorly Graded Sand with Silt (SP-SM)*; wet; fine to medium sand; nonplastic fines.	12.0	S-4
Medium dense, dark gray and brown, *Silty Gravel with Sand (GM)*; wet; fine to coarse subangular to subrounded gravel; medium sand; low to medium plasticity fines. **CATASTROPHIC FLOOD DEPOSITS COARSE-GRAINED FACIES**	17.0	S-5
Softer fine-grained layer from 17 to 19 ft inferred from drill action and cuttings.	19.0	
Dense, gray, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; wet; fine to coarse subangular to subrounded gravel; fine to coarse sand; low plasticity fines.	21.5	S-6
Completed: July 19, 2016		

Symbol | Samples | Ground Water | Depth, ft.

PENETRATION RESISTANCE, N (blows/ft.)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

⌶ Standard Penetration Test

⊡ Recovery (%)

● % Water Content

Plastic Limit |——| Liquid Limit

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations, and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. Group symbol is based on visual-manual identification and selected lab testing.
4. The hole location and elevation should be considered approximate.

Boardman Wetland Complex
Clackamas County, Oregon

LOG OF BORING B-2

September 2016 — 24-1-04055-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A3

REV 3

MASTER_LOG_E 24-1-04055.GPJ SW2013LIBRARYPDX.GLB SHANWIL_PDX.GDT 9/4/16 Log: JJW Rev: KEE Typ: JJW/AEH

SOIL PROFILE DESCRIPTION	Depth (ft)	Symbol	Samples	Type	Ground Water	NOTES
Brown, *Organic Soil (OL)*; moist; nonplastic; little to some organics.	0.5		S-1	G		
Dark gray, *Organic Soil to Silt (OL/ML)*; moist to wet; low plasticity; trace to few organics.			S-2	G		
MARSH DEPOSITS					Seepage	
Dark brown, *Organic Soil (OL)*; moist to wet; nonplastic; few to some woody organic debris including partially decomposed grasses and wood fragments.	4.5		S-3	G		
			S-4	G		
Gray mottled, *Organic Soil to Silt (OL/ML)*; wet; nonplastic to low plasticity; few to little organics with wood fragments; heterogeneous soil with mixed brown *Organic Soil* and gray *Silt*.	8.8		S-5	G		
Drive Probe - Not Sampled	9.3					
Drive probe refusal at 14.8 ft.	14.8					
Completed: July 20, 2016						

TEST PIT PHOTOS

NOTES

1. The description in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
2. Refer to Soil Classification and Log Key for explanation of "Symbols" and Definitions.
3. Group symbol is based on visual-manual identification.
4. Where possible, a 1/2-inch-diameter, steel T-bar probe was used to estimate the density of soil.

LEGEND

- Seepage
- G Grab Sample

Boardman Wetland Complex
Clackamas County, Oregon

LOG OF TEST PIT TP-1

September 2016 24-1-04055-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A4

FIG. A4

REV 3

SOIL PROFILE DESCRIPTION	Depth (ft)	Symbol	Samples	Type	Ground Water	NOTES
Dark brown, *Organic Soil (OL)*; wet; nonplastic to low plasticity; few to some organics.			S-1	G	Seepage	
			S-2	G		
MARSH DEPOSITS	4.8					
Brown, *Organic Soil (OL)*; wet; nonplastic; little to some partially decomposed grass and wood fragments.			S-3	G		
			S-4	G		
Drive Probe - Not Sampled	10.0					
Drive probe refusal at 14.2 ft.	14.2					
Completed: July 20, 2016						

TEST PIT PHOTOS

NOTES

1. The description in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
2. Refer to Soil Classification and Log Key for explanation of "Symbols" and Definitions.
3. Group symbol is based on visual-manual identification.
4. Where possible, a 1/2-inch-diameter, steel T-bar probe was used to estimate the density of soil.

LEGEND

- Seepage
- G Grab Sample

FIG. A5

Boardman Wetland Complex
Clackamas County, Oregon

LOG OF TEST PIT TP-2

September 2016 24-1-04055-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A5

REV 3

SOIL PROFILE DESCRIPTION	Depth (ft)	Symbol	Samples	Type	Ground Water	NOTES
Dark to light brown, *Organic Soil (OL)*; wet; nonplastic to low plasticity; few to some partially decomposed grass and wood debris.			S-1	G	Seepage	
			S-2	G		
MARSH DEPOSITS						
Blue-gray mottled, *Organic Soil to Silt (OL/ML)*; wet; nonplastic to low plasticity; heterogeneous soil with mixed brown *Organic Soil* and gray *Silt*.	8.0		S-3	G		
Drive Probe - Not Sampled	9.8					
Drive probe refusal at 14.4 ft.	14.4					
Completed: July 20, 2016						

TEST PIT PHOTOS

NOTES

1. The description in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
2. Refer to Soil Classification and Log Key for explanation of "Symbols" and Definitions.
3. Group symbol is based on visual-manual identification.
4. Where possible, a 1/2-inch-diameter, steel T-bar probe was used to estimate the density of soil.

LEGEND

- Seepage
- G Grab Sample

Boardman Wetland Complex
Clackamas County, Oregon

LOG OF TEST PIT TP-3

September 2016 24-1-04055-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A6

REV 3

FIG. A6

APPENDIX B

LABORATORY TESTING

TABLE OF CONTENTS

FIGURES

ATTACHMENT

APPENDIX B

LABORATORY TESTING

B.1 GENERAL

This appendix contains descriptions of the procedures and the results of laboratory tests completed on the soil samples obtained from the explorations for the Boardman Wetland Complex. The geotechnical soil-testing program included visual-manual classification, moisture content determination, and Atterberg limits. Laboratory testing was performed at the Shannon and Wilson Laboratory in Lake Oswego, Oregon. Analytical testing was perform for corrosion susceptibility by Specialty Analytical or Clackamas, Oregon. Test methods were performed in accordance with applicable ASTM International (ASTM) standards.

B.2 GEOTECHNICAL SOIL TESTING

B.2.1 Visual-Manual Classification

Selected soil samples recovered from the borings were visually reclassified in our laboratory using a system based on the International ASTM Designation: D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Other terminology, such as the relative density or consistency of soil deposits, is used in general accordance with current local engineering practice. In determining the soil type (gravel, sand, silt or clay), the term that best describes the major portion of the sample is used. Modifying terms to further describe the soil samples are defined in Figure A1. Physical characteristics of the samples were noted, and field classifications were modified as necessary during laboratory Visual-Manual Classification.

B.2.2 Moisture Content Determination

The water content of selected soil samples recovered from the field explorations was determined in general accordance with ASTM D2216, Standard Method of Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass. Comparison of water content of a soil with its index properties can be useful in characterizing soil unit weight, consistency, compressibility, and strength. Water contents are plotted on the boring logs presented in Appendix A.

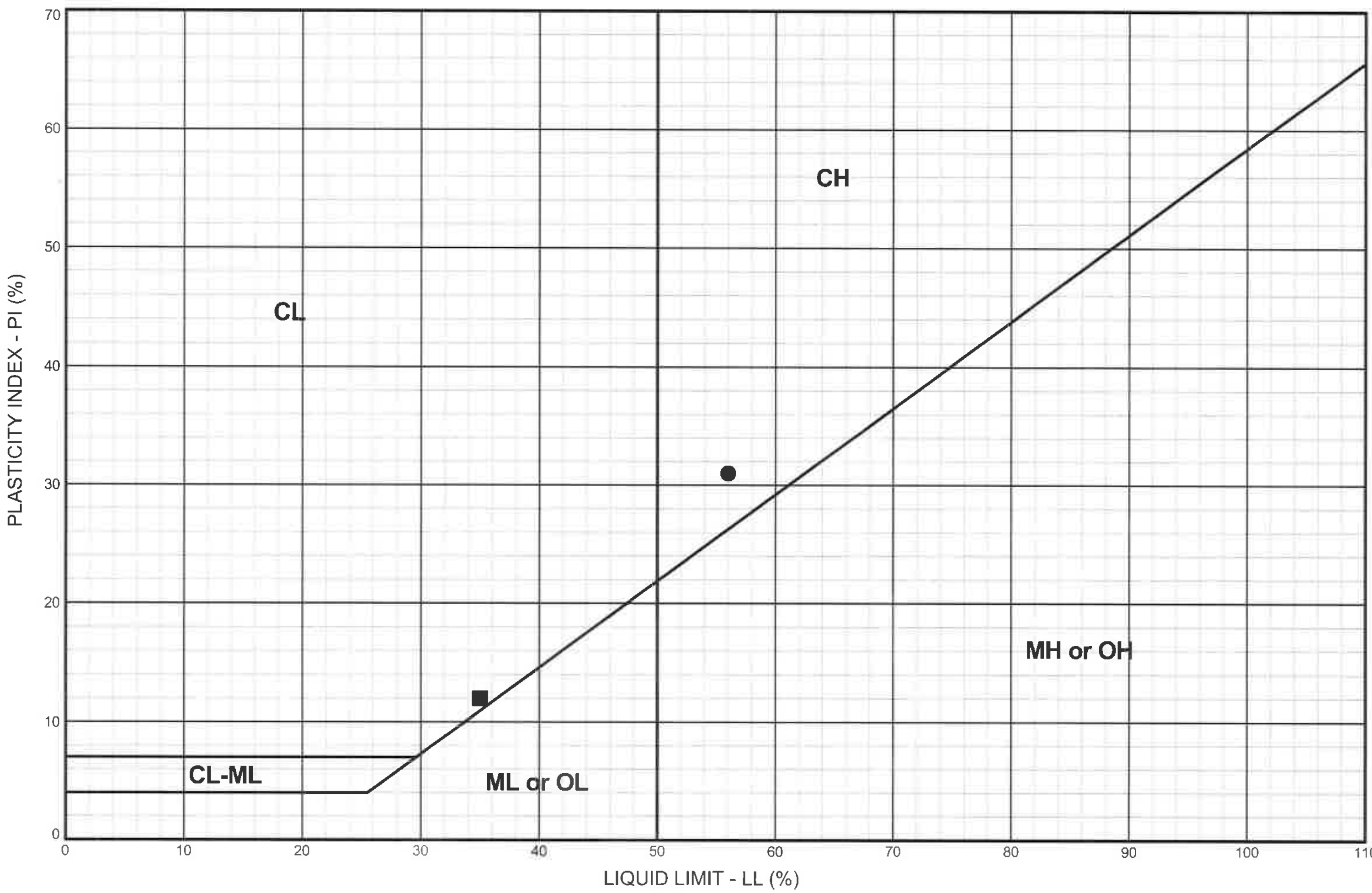
B.2.3 Atterberg Limits

Atterberg limits were determined on selected samples in accordance with ASTM D4318. This analysis yields index parameters of the soil that are useful in soil identification, as well as in a number of analyses, including liquefaction analysis. An Atterberg limit test determines a soil's liquid limit (LL) and plastic limit (PL). These are the maximum and minimum moisture contents at which the soil exhibits plastic behavior. A soil's plasticity index (PI) can be determined by subtracting PL from LL. The LL, PL, and PI of tested samples are presented on the Figure B1, Atterberg Limits Results. The results are also shown graphically on the boring logs presented in Appendix A. We define the soil plasticity terms as follows:

- Nonplastic refers to soils with a PI less than 4,
- Low plasticity soils have a PI range of 4 to 10,
- Medium plasticity soils have a PI range of 10 to 20, and
- High plasticity soils have a PI greater than 20.

B.3 ANALYTICAL TESTING

Analytical testing included pH of Soil, Oxidation-Reduction Potential (Redox Potential), Soil Resistivity, and Sulfides. Analytical laboratory testing results are included as an attachment to this appendix. Analytical testing was performed by Specialty Analytical of Clackamas, Oregon.



NOTES

1) Atterberg limits tests were performed in general accordance with ASTM D4318 unless otherwise noted in the report.

2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 4%)
- Low Plasticity (4 to 10%)
- Medium Plasticity (10 to 20%)
- High Plasticity (> 20%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-1, S-2	5.0	*CH*	*Fat Clay*	56	25	31	64	
■ B-1, S-3	7.5	*CL*	*Lean Clay*	35	23	12	39	

Boardman Wetland Complex
Clackamas County, Oregon

ATTERBERG LIMITS RESULTS

September 2016 — 24-1-04055-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. B1

Specialty Analytical

11711 SE Capps Road, Ste B
Clackamas, Oregon 97015
TEL: 503-607-1331 FAX: 503-607-1336
Website: www.specialtyanalytical.com

August 12, 2016

Ian LaVielle
Shannon & Wilson
3990 SW Collins Way
Ste. 100
Lake Oswego, OR 97035

TEL: (503) 223-6147
FAX: (503) 223-6140

RE: Boardman Wetland Complex

Dear Ian LaVielle: Order No.: 1608031

Specialty Analytical received 1 sample(s) on 8/4/2016 for the analyses presented in the following report.

There were no problems with the analysis and all data for associated QC met EPA or laboratory specifications, except where noted in the Case Narrative, or as qualified with flags. Results apply only to the samples analyzed. Without approval of the laboratory, the reproduction of this report is only permitted in its entirety.

If you have any questions regarding these tests, please feel free to call.

Sincerely,

Marty French
Lab Director

Specialty Analytical

Date Reported: 12-Aug-16

CLIENT:	Shannon & Wilson	**Collection Date:**	
Project:	Boardman Wetland Complex		
Lab ID:	1608031-001		
Client Sample ID:	TP-2, S-4 (9-9.5)	**Matrix:**	SOIL

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
PH OF SOIL-CORROSION TESTING		**T289-91**				Analyst: **EFH**
pH	5.56			pH Units	1	8/12/2016 8:52:11 AM
ORP POTENTIAL OF SOIL		**G200**				Analyst: **JRC**
Oxidation-Reduction Potential	220	0		mv	1	8/5/2016 4:23:22 PM
SOIL RESISTIVITY		**T288-91**				Analyst: **mlove**
Minimum Soil Resistivity	4650	1.00		ohm-cm	1	8/10/2016 11:44:17 AM
SULFIDE		**SW9030**				Analyst: **EFH**
Sulfide	155	20.0		mg/Kg	1	8/12/2016 8:40:28 AM

QC SUMMARY REPORT

WO#: **1608031**

12-Aug-16

Specialty Analytical

Client: Shannon & Wilson

Project: Boardman Wetland Complex **TestCode:** PH_AASHTO

Sample ID: **1608031-001ADUP** SampType: **DUP** TestCode: **PH_AASHTO** Units: **pH Units** Prep Date: RunNo: **26212**

Client ID: **TP-2, S-4 (9-9.5)** Batch ID: **R26212** TestNo: **T289-91** Analysis Date: **8/12/2016** SeqNo: **352983**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
pH	5.54							5.560	0.360	20	

Qualifiers:

B	Analyte detected in the associated Method Blank	H	Holding times for preparation or analysis exceeded	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted reco

QC SUMMARY REPORT

WO#: **1608031**

12-Aug-16

Specialty Analytical

Client: Shannon & Wilson

Project: Boardman Wetland Complex

TestCode: REDOX_ASTM

Sample ID: **1608030-001ADUP** SampType: **DUP** TestCode: **REDOX_AST** Units: **mv** Prep Date: RunNo: **26211**

Client ID: **ZZZZZZ** Batch ID: **R26211** TestNo: **G200** Analysis Date: **8/5/2016** SeqNo: **352976**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Oxidation-Reduction Potential	290	0						291.2	0.586	20	

Qualifiers:

B	Analyte detected in the associated Method Blank	H	Holding times for preparation or analysis exceeded	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted reco

QC SUMMARY REPORT

WO#: **1608031**

12-Aug-16

Specialty Analytical

Client: Shannon & Wilson

Project: Boardman Wetland Complex **TestCode:** **SULFIDE_S**

Sample ID: **1608031-001ADUP** SampType: **DUP** TestCode: **SULFIDE_S** Units: **mg/Kg** Prep Date: RunNo: **26213**

Client ID: **TP-2, S-4 (9-9.5)** Batch ID: **R26213** TestNo: **SW9030** Analysis Date: **8/12/2016** SeqNo: **352980**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfide	77.3	20.0						154.6	66.7	20	RMI

Qualifiers:

B	Analyte detected in the associated Method Blank	H	Holding times for preparation or analysis exceeded	ND	Not Detected at the Reporting Limit
O	RSD is greater than RSDlimit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted reco

KEY TO FLAGS

Rev. May 12, 2010

A	This sample contains a Gasoline Range Organic not identified as a specific hydrocarbon product. The result was quantified against gasoline calibration standards
A1	This sample contains a Diesel Range Organic not identified as a specific hydrocarbon product. The result was quantified against diesel calibration standards.
A2	This sample contains a Lube Oil Range Organic not identified as a specific hydrocarbon product. The result was quantified against a lube oil calibration standard.
A3	The result was determined to be Non-Detect based on hydrocarbon pattern recognition. The product was carry-over from another hydrocarbon type.
A4	The product appears to be aged or degraded diesel.
B	The blank exhibited a positive result great than the reporting limit for this compound.
CN	See Case Narrative.
D	Result is based from a dilution.
E	Result exceeds the calibration range for this compound. The result should be considered as estimate.
F	The positive result for this hydrocarbon is due to single component contamination. The product does not match any hydrocarbon in the fuels library.
G	Result may be biased high due to biogenic interferences. Clean up is recommended.
H	Sample was analyzed outside recommended holding time.
HT	At clients request, samples was analyzed outside of recommended holding time.
J	The result for this analyte is between the MDL and the PQL and should be considered as estimated concentration.
K	Diesel result is biased high due to amount of Oil contained in the sample.
L	Diesel result is biased high due to amount of Gasoline contained in the sample.
M	Oil result is biased high due to amount of Diesel contained in the sample.
MC	Sample concentration is greater than 4x the spiked value, the spiked value is considered insignificant.
MI	Result is outside control limits due to matrix interference.
MSA	Value determined by Method of Standard Addition.
O	Laboratory Control Standard (LCS) exceeded laboratory control limits, but meets CCV criteria. Data meets EPA requirements.
Q	Detection levels elevated due to sample matrix.
R	RPD control limits were exceeded.
RF	Duplicate failed due to result being at or near the method-reporting limit.
RP	Matrix spike values exceed established QC limits; post digestion spike is in control.
S	Recovery is outside control limits.
SC	Closing CCV or LCS exceeded high recovery control limits, but associated samples are non-detect. Data meets EPA requirements.
*	The result for this parameter was greater that the maximum contaminant level of the TCLP regulatory limit.

APPENDIX C

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Attachment to and part of Report 24-1-04055-001

Date: September 7, 2016
To: Amy Dammarell, PE
HDR, Inc.

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors which were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

Appendix E. Wetland Delineation Report

WETLAND DELINEATION / DETERMINATION REPORT COVER FORM

This form must be included with any wetland delineation report submitted to the Department of State Lands for review and approval. A wetland delineation report submittal is not "complete" unless the fully completed and signed report cover form and the required fee are submitted. Attach this form to the front of an unbound report or include a hard copy of the completed form with a CD/DVD that includes a single PDF file of the report cover form and report (minimum 300 dpi resolution) and submit to: **Oregon Department of State Lands, 775 Summer Street NE, Suite 100, Salem, OR 97301-1279.** A single PDF attachment of the completed cover from and report may be e-mailed to **Wetland_Delineation@dsl.state.or.us**. For submittal of PDF files larger than 10 MB, e-mail instructions on how to access the file from your ftp or other file sharing website. Fees can be paid by check or credit card. Make the check payable to the Oregon Department of State Lands. To pay the fee by credit card, call 503-986-5200.

☒ Applicant ☐ Owner Name, Firm and Address:
Oaks Lodge Sanitary District
Attn: Jason Rice
14611 SE River Road
Oak Grove, Oregon 97267

Business phone # **(503) 353-4202**
Mobile phone # (optional) **(503) 490-0016**
E-mail: **jlrice@olsd.net**

☒ Authorized Legal Agent, Name and Address:
Oaks Lodge Sanitary District
Attn: Jason Rice
14611 SE River Road
Oak Grove, Oregon 97267

Business phone # **(503) 353-4202**
Mobile phone # **(503) 490-0016**
E-mail: **jlrice@olsd.net**

I either own the property described below or I have legal authority to allow access to the property. I authorize the Department to access the property for the purpose of confirming the information in the report, after prior notification to the primary contact.

Typed/Printed Name: **Jason Rice** Signature: ______________________
Date: **11/09/16** Special instructions regarding site access: **None**

Project and Site Information (using decimal degree format for lat/long.,enter centroid of site or start & end points of linear project)

Project Name: **Boardman Wetland Design**	Latitude: **45.394** Longitude: **-122.612**
Proposed Use: **OLSD is proposing wetland enhancement, construction of a public boardwalk system, and sewer rehabilitation or replacement**	Tax Map # **22E18CA**
Project Street Address (or other descriptive location): **Boardman Wetlands: project site bordered by SE Boardman Avenue to the north, SE Cook Street to the west, SE Jennings Avenue to the south and SE Addie Road to the west.**	Township **2S** Range **2E** Section **18** QQ **N/A** Tax Lot(s) **02716, 04101, 04407, 04200, 04300** Waterway: **Boardman Creek** River Mile: **XX**
City: **Milwaukie** County: **Clackamas**	NWI Quad(s): **Gladstone**

Wetland Delineation Information

Wetland Consultant Name, Firm and Address:
Jennifer Maze
Michael Witter
HDR Engineering, Inc.
1001 SW 5th Avenue, Suite 1800
Portland, Oregon 97204

Phone # **(503) 423-3774**
Mobile phone # **N/A**
E-mail: **jennifer.maze@hdrinc.com**

The information and conclusions on this form and in the attached report are true and correct to the best of my knowledge.

Consultant Signature: [signature] Date: **01/09/16**

Primary Contact for report review and site access is ☒ Consultant ☐ Applicant/Owner ☐ Authorized Agent

Wetland/Waters Present? ☒ Yes ☐ No Study Area size: **5.5 acres** Total Wetland Acreage: **4.7 acres**

Check Box Below if Applicable:

- ☐ R-F permit application submitted
- ☐ Mitigation bank site
- ☒ Wetland restoration/enhancement project (not mitigation)
- ☐ Industrial Land Certification Program Site
- ☐ Reissuance of a recently expired delineation
  Previous DSL # Expiration date _____

Fees:

- ☒ Fee payment submitted **$ 419**
- ☐ Fee ($100) for resubmittal of rejected report
- ☐ No fee for request for reissuance of an expired report

Other Information:

	Y	N	
Has previous delineation/application been made on parcel?	☐	☒	If known, previous DSL #
Does LWI, if any, show wetland or waters on parcel?	☐	☒	

For Office Use Only

DSL Reviewer: ______________	Fee Paid Date: ____ / ____ / ____	DSL WD # ______________
Date Delineation Received: ____/ ___ / ____	DSL Project # ______________	DSL Site # ______________
Scanned: ☐ Final Scan: ☐	DSL WN # ______________	DSL App. # ______________