APPENDIX C
DAHL BEACH LEVEL 1 ASSESSMENT

DAHL BEACH MITIGATION SITE LEVEL I SEDIMENT EVALUATION TERMINAL 4 PHASE I REMOVAL ACTION PORTLAND, OREGON

Prepared for

Port of Portland
P.O. Box 3529
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For Submittal to

Portland District
U.S. Army Corps of Engineers
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September 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

BMP	best management practice
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
DEQ	Oregon Department of Environmental Quality
ECSI	Environmental Cleanup Site Information
I-205	Interstate 205
LWD	large woody debris
NFA	No Further Action
ng/kg	nanogram per kilogram
NGVD	National Geodetic Vertical Datum
NPDES	National Pollutant Discharge Elimination System
ODFW	Oregon Department of Fish and Wildlife
OHWM	ordinary high water mark
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
Port	Port of Portland
RM	river mile
SCO	Sediment Cleanup Objectives
SEF	Sediment Evaluation Framework
Site Inspection	Blue Heron Paper Mill Site Inspection
T4	Terminal 4 (Port of Portland)
TEQ	toxic equivalent
TOC	total organic carbon
UPL	Upper Prediction Limit
WOTUS	Waters of the United States
WPCP	Water Pollution Control Plant
WQSIS	Water Quality Source Information System

1 SUMMARY

The Port of Portland (Port) is proposing to restore two areas within Dahl Beach Park to mitigate unavoidable impacts to Waters of the United States (WOTUS) and to offset impacts to federally listed species incurred at the Port's Terminal 4 (T4) facility. Both areas are owned by the City of Gladstone and are managed as park lands. This report provides a Level 1 sediment evaluation that can be used to determine if there is a need for further sediment evaluation prior to initiating the mitigation work.

Dahl Beach Park is located on the northeast side of the confluence of the Clackamas and Willamette rivers in Gladstone, Oregon, between river miles (RMs) 24.5 and 24.7 on the Willamette River. The proposed mitigation project is composed of the following two components:

- Removal of a portion of an asphalt concrete lower parking area and associated riprap, and restoration of the shoreline in the southwest portion of the park
- Removal of a failed sheetpile bulkhead and associated riprap and restoration of the shoreline near the northwest end of the park, approximately 700 feet downstream from the lower parking lot

Figure 1 provides an aerial overview of Dahl Beach Park, including the lower parking area and failed bulkhead restoration areas. Figure 2 provides ground-level photographs of existing sediment conditions at the proposed restoration sites. Anthropogenic materials, including sheetpiling, riprap, asphalt concrete, and underlying fill material, are proposed to be removed as part of the restoration action. The riprap armoring associated with the parking area will be recycled or repurposed outside of WOTUS. Native sediments will be removed and re-used either on site and re-contoured to form a more natural shoreline or at an appropriate location in the project vicinity. Native trees and shrubs will be established and wood structures will be incorporated into the restoration as possible and appropriate to stabilize the shoreline and provide habitat improvements.

Multiple lines of evidence demonstrate that sediments at the project site should qualify for beneficial use as habitat material based on a "very low" ranking (formerly exclusionary status), according to the guidelines provided in the Sediment Evaluation Framework (SEF; USACE et al. 2009). These lines of evidence include the following:

- **Lack of Fines and Organic Carbon.** Fine-grained sediments and total organic carbon (TOC) are scarce at the site due to the high-energy environment surrounding the confluence of the Clackamas and Willamette rivers. The fines content of river sediments in the vicinity of Dahl Beach Park is between 2.6% and 6.2%, and the TOC content is between 0.2% and 0.4% (Ecology and Environment 2008). According to the SEF Ranking Definitions (Table 4-2 of USACE et al. 2009), sediment containing less than 20% fines and less than 0.5% TOC, and which is removed from known or historical sources of contamination, is generally consistent with a "very low" ranking.
- **Lack of Potential Sources and Exposure Pathways.** There are no stormwater conveyances in Dahl Beach Park and in most of the contiguous Meldrum Bar Park to the north (Brown and Caldwell 2014). Stormwater runoff is evidently managed on site through natural processes such as infiltration, evapotranspiration, and diffuse overland flow. Historical photographs indicate the site has been used for open space, parkland, and agriculture for many decades, and has evaded commercial and industrial development. Although a number of potentially contaminated sites were identified in state and federal databases in upland and inland locations in Gladstone and Oregon City, potential releases from these sites, if any, would be routed to discharge points that are substantially removed from the Dahl Beach area.
- **No Exceedances of SEF Screening Levels.** Five surface sediment samples collected in the site vicinity as part of the Blue Heron Paper Mill Site Inspection (Site Inspection; Ecology and Environment 2008) provide quantitative data on sediment quality near the site and meet SEF recency criteria for "very low" ranked sites. There were no exceedances of SEF screening levels in any of the existing sediment samples. Metals were two to ten times lower than their corresponding SEF screening levels. Polycyclic aromatic hydrocarbons (PAHs) were occasionally detected at concentrations two orders of magnitude lower than SEF screening levels. There were no detections of volatile organic compounds, chlorinated pesticides, or polychlorinated biphenyl (PCB) Aroclors, and dioxin/furan concentrations were within the range of background levels for the Willamette River.

In summary, this Level 1 evaluation provides several corroborating lines of evidence to support a determination that sediments in the Dahl Beach mitigation site are commensurate with a “very low” site ranking. There is no reason to believe contamination is present and no additional sediment testing is warranted. Site sediments are therefore suitable for use as habitat material during regrading of the restoration areas to form a more natural shoreline or to be placed on the beach in surrounding areas to keep the material within the system. Controlling sediment erosion and turbidity will be the primary environmental concerns during construction, and these can be controlled through project permits using standard upland and in-water best management practices (BMPs).

2 PROJECT DESCRIPTION

2.1 Project Location

Dahl Beach Park is located on the northeast side of the confluence of the Clackamas and Willamette rivers in Gladstone, Oregon. It is located between RMs 24.5 and 24.7 on the east bank of the Willamette River (Figure 1) in Section 19, Township 2S, Range 2E, and in the Tanner Creek-Willamette River and Rock Creek-Clackamas River watersheds. Two proposed mitigation sites are described in this report with coordinates as follows:

Site	Latitude	Longitude	Comment
Parking Lot Site	45.373189	-122.607108	See Section 2.3.1
Bulkhead Site	45.374406	-122.610036	See Section 2.3.2

2.2 Project Purpose

The purpose of the project is to restore two portions of Dahl Beach Park to offset impacts to WOTUS and impacts to federally listed species incurred by remedial actions at the Port's T4 facility. The two restoration areas at Dahl Beach Park total 0.52 acres and are owned by the City of Gladstone and managed as park lands.

The Dahl Beach mitigation areas would provide the following environmental benefits to offset impacts at T4:

- T4 mitigation actions at Dahl Beach will remain within the tidally influenced lower Willamette River, providing improved habitat in an important location for aquatic organisms, including salmonids listed under the Endangered Species Act (ESA)
- Mitigation actions will mainly be conducted between elevations +14 and +22 feet National Geodetic Vertical Datum (NGVD), below the ordinary high water mark (OHWM) at +25.4 NGVD; these elevations overlap with the elevations of impact at T4
- The proposed projects complement nearby restoration efforts including the Rinearson Natural Area restoration and the Dahl Beach off-channel habitat improvement projects funded by the Oregon Watershed Enhancement Board

2.3 Project Design Concept

The proposed mitigation includes restoration of the lower parking area in Dahl Beach Park at the mouth of the Clackamas River, and restoration of a failed bulkhead approximately 700 feet downstream. The restoration actions include removal of typical anthropogenic materials (surficial asphalt concrete, parking lot ballast, riprap, and decrepit sheetpiling), restoration of shoreline contours, and establishment of native trees and shrubs. Large woody debris (LWD) will be incorporated into the shoreline as possible during restoration of the parking area to provide improved habitat. Anthropogenic materials removed from the restoration area will be recycled or repurposed, further reducing the impacts of the proposed work.

Figure 2 shows the general shoreline conditions at the two proposed restoration sites during a site walk conducted on August 25, 2015. Both sites are characterized by coarse-grained, steeply sloping beaches of gravel, cobble, and riprap. Note that the sheetpile bulkhead has completely failed and serves no function.

2.3.1 Dahl Beach Parking Area

The first area identified for mitigation is the lower Dahl Beach Park parking area (Figure 1). This area includes 0.26 acres of asphalt concrete and riprap at the confluence of the Clackamas and Willamette rivers at the south end of Dahl Beach Park. The lower parking area is used primarily for seasonal fishing access, and is frequently submerged by high flows in the winter and spring.

The restoration of the lower parking area will include the following components:

- Removing the asphalt concrete surface, riprap, and gravel ballast
- Contouring the bank to a more natural profile
- Planting native species
- Placing LWD

All components of the restoration will improve habitat quality and ecosystem function in the area. Because the lower parking area is below the OHWM, restoration activities will be subject to Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act.

Figure 3 provides the conceptual design for the restoration of the lower Dahl Beach Park parking area, and Figure 4 provides longitudinal and transverse cross sections of the lower parking lot mitigation area.

2.3.2 Bulkhead Area

The 0.26-acre bulkhead area at the north end of Dahl Beach Park, consisting of decrepit sheetpile, riprap, and cobbles, is the second proposed mitigation area (Figure 1). The bulkhead spans both low and high flow elevations and is the cause of localized erosion and degraded habitat conditions. Figure 2 shows a portion of the failed bulkhead and riprap proposed for removal. An over-steepened alluvial cut bank above the bulkhead evidently provides a local source of gravel and cobble to the shoreline in this area.

The restoration of the failed bulkhead will include the following components:

- Removing all artificial structures including sheetpiling and riprap
- Contouring the river bank to a natural profile
- Planting native vegetation

All components of the mitigation will improve habitat quality and ecosystem function in the area. Due to the location of the failed bulkhead below the OHWM, mitigation activities will be subject to Section 10 of the River and Harbors Act and Section 404 of the Clean Water Act.

2.3.3 Project Quantities

The estimated removal quantities for the two combined mitigation projects are as follows:

- 150 cubic yards (cy) of asphalt
- 200 cy of non-native fill material, including riprap
- 190 linear feet (lf) of sheet piling
- 400 lf of metal cable

In addition, it is estimated that approximately 3,100 cy of native sediment will be regraded on site. Excess native sediment from regrading activities (approximately 2,000 cy of rock and sand) will be placed on beach areas within and adjacent to the sites. These estimated quantities are preliminary and may be revised as the details of the design are developed.

3 PRELIMINARY CONSTRUCTION METHODS

It is anticipated that the proposed restoration activities will be performed in the dry during low river levels, to the extent practicable, using conventional earthmoving equipment such as excavators and bulldozers. Anthropogenic materials (asphalt concrete in the lower parking lot, parking lot base fill material, decrepit sheetpiling, and riprap) will be removed from the mitigation areas. These anthropogenic materials will be recycled or repurposed outside WOTUS.

The proposed work is not a sediment removal action. The shoreline will be re-contoured to a natural profile such that native soils and sediments will be re-used on site or on nearby beaches for habitat material to the extent practicable. There will be no open-water disposal of site sediments in either the Clackamas or Willamette rivers.

3.1 Schedule

Site construction is anticipated to occur in summer 2016 during the in-water work window established by the Oregon Department of Fish and Wildlife (ODFW) for the Lower Willamette River, which occurs from July 1 through October 31. However, the project schedule is dependent on regulatory approvals.

3.2 Environmental Conservation Measures

All or a majority of the mitigation work is expected to be conducted in the dry during the ODFW in-water work window, which coincides with seasonal low water conditions. Therefore, the proposed work is expected to have a low risk for impacting aquatic environments in the Clackamas and Willamette rivers. Because the project sediments are uncontaminated based on the evidence presented in Section 4, BMPs will be focused primarily on erosion and sediment control and minimizing river turbidity impacts.

It is anticipated that detailed BMPs for minimizing turbidity will be developed as part of the Section 401 Water Quality Certification process when construction methods are more fully defined. The following BMPs, or similar, will likely be considered for erosion and sediment control during implementation of the mitigation project:

- Use of downslope perimeter controls, such as silt fences or straw wattles
- Stock pile management
- Slope stabilization measures, such as erosion control fabric or mulching
- Visual and, if necessary, instrumented turbidity monitoring
- Contractor Spill Prevention, Control, and Countermeasure Plan

4 REVIEW OF EXISTING INFORMATION

4.1 Site Use and History

Dahl Beach Park comprises two tax lots totaling 18.99 acres within the city limits of Gladstone, Oregon, and the Metro Urban Growth Boundary. The Clackamas River forms the approximate boundary between the cities of Gladstone to the north and Oregon City to the south. The City of West Linn is located to the west across the Willamette River.

The project site is surrounded on all sides by park lands, undeveloped open space, or submerged aquatic lands. To the north and east of the site is Dahl Beach Park and the contiguous Meldrum Bar Park, which includes a small golf course and a complex of sport fields. To the west is the Willamette River and undeveloped Goat Island, and to the south is the Clackamas River and Clackamette Park in Oregon City.

4.1.1 Site Zoning

The shoreline adjacent to the proposed restoration areas is zoned as open space. Areas to the north of Dahl Beach Park are zoned as multifamily residential and open space. At the east end of Dahl Beach Park, approximately one-quarter mile upstream from the project site, the business district along Mcloughlin Boulevard (Highway 99E) is zoned for general commercial use. Across the Clackamas River from Dahl Beach Park is Clackamette Park; east of Clackamette Park is a large area zoned for mixed use in downtown Oregon City. The nearest land zoned for industrial use is located nearly a mile upstream of the site along the Interstate 205 (I-205) corridor in Oregon City. In summary, the project site is surrounded by relatively low-impact land uses (predominantly open space and some multi-family residential) and substantial buffer zones separating the site from commercial uses along Highway 99E and industrial uses near I-205.

4.1.2 Current Site Use

Currently, Dahl Beach Park is used primarily for recreation and river access. The park includes three parking lots (including the lower parking lot, a portion of which is proposed for removal and restoration), forested areas, and a mixed beach and cobble shoreline. The park shoreline borders both the Clackamas and Willamette rivers at their confluence. The ease of access to these waters has made Dahl Beach Park popular with fishers and other water enthusiasts. The closest boat launch for recreational boaters is in Clackamette Park; however, this launch was recently closed for safety concerns because the strong and erosive river currents along this cut bank have undermined and destabilized the launch.

4.1.3 Storm Sewer Outfalls

The storm sewer system for the City of Gladstone is described in Brown and Caldwell (2014). There are no storm sewers in Dahl Beach Park and a majority of the contiguous Meldrum Bar Park to the northwest. Stormwater is evidently managed on site in the parklands through infiltration, evapotranspiration, and diffuse overland flow.

The nearest major storm sewer outfall from the City of Gladstone discharges to the Clackamas River on the upstream side of the Highway 99E bridge, approximately 2,000 feet upstream from the site. Other municipal outfalls, including one that appears to capture stormwater runoff from the residential areas east of the park lands, discharge to Rinearson Creek, which is confluent with the Willamette River approximately 4,000 feet downstream from the site. Because of the significant separation distances, these stormwater outfalls are not expected to have any discernible impact on sediment quality at the project site.

4.1.4 Historical Aerial Photographs

Historical photographs dating to 1936 provide insight into land use activity in and around Dahl Beach Park. Representative historical photographs from 1936, 1948, 1964, and 1973 are shown in Figure 5.

In the 1936 photograph, there are linear features cross-cutting the sediment shoals in the mouth of the Clackamas River. These features may be indicative of earth moving equipment, possibly for the purpose of aggregate mining. This is the only photograph that shows evidence of direct anthropogenic disturbance of the river sediments.

The shoreline in the area of Dahl Beach Park appears to be relatively dynamic over time with shifting bedforms in the mouth of the Clackamas River, although some of these changes may be exaggerated by differing river levels at the time the photographs were taken. By 1973, the shoreline appears to have become more stabilized and resembles its current form (compare with Figure 1).

The prevailing land use in the vicinity of the site during much of this photographic history is devoted to open space and agriculture, with some commercial activity beginning to appear along Highway 99E by 1948. The golf course was first evident in 1964, built on former agricultural land. Clackamette Cove was excavated between 1956 (image not shown) and 1964, but the outlet to the Clackamas River was not dredged until sometime between 1964 and 1973. The development of paved roads and structures in the park, as well as the multifamily residential development to the east of the park, evidently occurred post-1980.

In summary, the historical site photographs show no evidence of high-impact industrial or commercial activity in Dahl Beach Park where the mitigation project is proposed, with the possible exception of some aggregate mining in the Clackamas River mouth in 1936.

4.2 Potential Sources in the Site Vicinity

A search of the Oregon Department of Environmental Quality (DEQ) Environmental Cleanup Site Information (ECSI) and Water Quality Source Information System (WQSIS) databases was completed for the area within approximately 1 mile of Dahl Beach Park. Results from these queries identify possible sources of contamination that could impact sediments in the proposed restoration areas. A search of the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database for federal Superfund sites was also conducted for the cities of Gladstone, Oregon City, and West Linn.

4.2.1 ECSI Database Search Results

A search of the ECSI database returned 24 results within the 1-mile search area, as summarized in Figure 6. A description of these sites is included for completeness; however, none of the sites has a direct pathway for impacting Dahl Beach sediments because any potential contaminant releases would be routed well upstream or well downstream of the project area based on the configuration of the natural drainages and the municipal stormwater conveyance system (see Section 4.1.3).

Auto Dealers and Repair Facilities. Approximately one-half to three-quarters of a mile north of Dahl Beach Park along Highway 99E are nine auto dealers and repair facilities that were included in a cleanup program at one point in time. Eight of the nine sites have been issued No Further Action (NFA) determinations. Thomason Subaru is considered a suspect site. Further site screening was recommended by the DEQ in 1997, but no other information is available.

Walgreens-Gladstone Development Site. Approximately one-quarter mile east of the site, on the southeast corner of W. Arlington Street and Highway 99, is the Walgreens-Gladstone Development site. This site has been shown to have elevated metals in groundwater associated with the placement of non-native fill materials. The Walgreens-Gladstone Development site is considered a suspect site and was added to the ECSI database in 2010. Additional site screening was recommended by the DEQ.

Clackamette Cove Area. The Clackamette Cove area was used for agriculture until the mid-1950s, when sand and gravel mining commenced along with asphalt and concrete production. The mining initially created a lake, which then became a cove in the 1960s when an outlet to the Clackamas River was dredged. Sand and gravel operations were continued by various entities until they were shut down in 1986, and the area has largely been vacant since that time. Historical site operations and proximity to the Old Rossman Landfill (see next site description) resulted in moderate levels of contamination in soil and groundwater in the uplands near the cove. However, contaminants of concern have not been detected in water samples collected from the shoreline of the cove. In recent years, Oregon City has been working with developers to plan a multi-use community development on the cove consisting of apartments, offices, restaurants, and other public amenities.

Old Rossman Landfill. To the northeast of Clackamette Cove, an unlined municipal waste landfill (Old Rossman Landfill) was operated between 1960 and 1969 on previous agricultural land. In 1970, a sand and gravel mining company built an asphalt plant, cement plant, and rock crusher near or on top of the landfill. Low levels of metals, volatiles, semivolatiles, pesticides, and PCBs have been detected sporadically in groundwater throughout the footprint of the landfill, but contaminants diminish rapidly in the downgradient direction toward Clackamette Cove. East of this site, the newer and larger Rossman Landfill operated under a permit from the DEQ Solid Waste Program from 1969 to 1983. A gasoline release occurred on the north end of the property in 1986 from an above-ground storage tank or its associated piping. Local ordinances have been put in place to protect the public from contaminated groundwater. The Rossman Landfill is currently under post-closure monitoring and no unacceptable impacts to Clackamette Cove have been detected.

Abernethy Creek Drainage Basin. Several sites were identified on the south side of I-205. These sites are within the Abernethy Creek drainage basin, which discharges to the Willamette River approximately one-half mile upstream from the project site (URS 2008). These sites are sufficiently separated that they pose no significant concern for site sediment quality. Several sites in this area have received NFA determinations, including the former Al's Machine Shop, Bud's Radiator, and Landeen Welding. The Old Standard Oil Bulk Plant, Old Shell Bulk Plant, Old Rossman Landfill (see previous site description), and Stimson Lumber sites are listed as active sites in the cleanup database. The Old Standard Oil and Old Shell Bulk Plants are both associated with soil contamination found during road construction. The Old Standard Oil site has been cleaned up and reduced to a low priority site. No actions are planned for the contamination at the Old Shell Bulk Plant. The DEQ recommended that the site undergo a preliminary assessment in 1993, but no other information is available. The Stimson Lumber site is associated with pentachlorophenol contamination in soil and groundwater. A remedy was completed under Stimson oversight in 2005, and a final closure report has been submitted. Prior to issuing an NFA determination, a formal ICP agreement is needed between the current property owner, Oregon City, and the DEQ.

West Linn. Across the Willamette River in West Linn are two sites identified in the ECSI database. These sites are the Gross Property Disposal Site and the Thrifty Cleaners. Both of these sites have been issued NFA determinations.

4.2.2 WQSIS Database Search Results

The search of the WQSIS database returned nine results within the search area, as shown in Figure 7. Eight of these sites are operating under active permits. One site north of Dahl Beach Park is not active. To the east of Dahl Beach Park on the north side of the Clackamas

River are the Parker Fill and Gladstone/Clackamas River Tigard Pipeline sites, which both hold stormwater National Pollutant Discharge Elimination System (NPDES) permits. To the south across the Clackamas River are The Cove, Tri-City Service District, Heritage Rock, Metro South Station, Park Place Development, and Miles Fiberglass and Plastics. All of these sites hold stormwater NPDES permits except Tri-City Service District, which holds an individual permit as a Water Pollution Control Plant (WPCP). The Tri-City WPCP discharges treated wastewater to the Willamette River near RM 25.5, approximately three-quarters of a mile upstream from Dahl Beach Park. Discharge from the Tri-City WPCP is not expected to impact sediments near the proposed restoration areas since it has been treated to meet water quality criteria at the edge of a permitted 300-foot mixing zone, whereas the mitigation areas are several thousand feet downstream.

4.2.3 CERCLIS Database Search Results

A search of the CERCLIS database was performed for the cities of Gladstone, Oregon City, and West Linn. This search returned only one result: the Oregon City Mercury Site. This site is unique in that small amounts of elemental mercury were discovered at a private residence south of I-205. The site was removed from the National Priorities List in 2011 after completion of a cleanup action led by the U.S. Environmental Protection Agency.

4.3 Summary of Existing Sediment Quality Data

The physical and chemical characteristics of sediments near Dahl Beach Park are evaluated in this section. Laboratory testing results from five surface sediment samples collected in 2007 are available for site characterization, as shown in Figure 8. These samples are within the 10-year recency requirement set forth in the SEF for "very low" ranked sediments (USACE et al. 2009).

The surface sediment samples were collected by Ecology and Environment as part of a Site Inspection for the Blue Heron Paper Company in Oregon City (Ecology and Environment 2008). The Blue Heron Paper Company is located at RM 26.5 on the Willamette River, immediately downstream of Willamette Falls and approximately 2 miles upstream from Dahl Beach Park. During the Site Inspection, several downstream surface sediment samples were collected from 0 to 10 centimeters to assess contaminant migration off site. Samples were analyzed for grain size, TOC, metals, volatile organic compounds, semivolatile organic compounds, PAHs, pesticides, PCBs, and dioxins/furans. The samples used in this Level 1 evaluation include four samples between RM 24.1 and 25.4 on the Willamette River (WR03SD, WR04SD, WR06SD, and WR07SD), and one sample in the mouth of the Clackamas River (CR01SD). Physical and chemical testing results are summarized in Table 1 and in the following sections.

4.3.1 Sediment Physical Properties

The sediment deposits at Dahl Beach Park were assessed by an Oregon Registered Geologist on August 25, 2015. Sediments in the project areas are mainly composed of sand, gravel, cobble, and riprap with very low fines content (Figure 2), estimated at a few percent fines. The sediments are indicative of a high-energy environment situated on the outside bend of the Willamette River and subject to vigorous currents at the confluence of the Clackamas and Willamette rivers. There is an eroded cut bank at the bulkhead removal area where alluvial gravels are exposed in a 5- to 10-foot-high escarpment; these alluvial gravel deposits are contributing material to the local beaches. Sandy beaches are found in some of the more protected shoreline areas, again with very low fines content.

Physical testing of sediments from the Blue Heron Site Inspection confirm that sediments in the site vicinity are described as clean sand and gravelly sand with low fines content and low organic carbon (Table 1). The fines content of nearby sediments ranged from 2.6% to 6.2%. The TOC content ranged from 0.16% to 0.37%. The SEF suggests that a "very low" ranking may be associated with clean sediments containing less than 20% fines and less than 0.5% TOC. The fines and TOC content of sediments in the site vicinity are well below these SEF guidelines, providing physical evidence that site sediments are unlikely to be contaminated.

4.3.2 Sediment Chemical Analyses

Sediment analytical results from the Blue Heron Site Inspection were compared to SEF screening levels to help determine whether a Level 2 evaluation is warranted for the Dahl Beach Park mitigation areas. The SEF 2006 Interim Freshwater screening levels posted on the Portland District website provided the primary line of evidence for this analysis. The SEF screening levels were supplemented with the Sediment Cleanup Objectives (SCO) of the

Washington State Sediment Management Standards (Ecology 2013) because the SCO include criteria for some additional chemicals that do not have SEF screening levels. A compilation of sediment analytical results and SEF/SCO screening level comparisons is provided in Table 1.

As summarized below, all chemicals were below their respective SEF (or SCO) screening levels—in many instances one or more orders of magnitude below the screening levels. These results demonstrate a consistent lack of contamination and are commensurate with a "very low" site ranking.

The results of the screening level evaluation are as follows:

- **Metals.** All metals results were well below their respective SEF screening levels. Zinc and nickel concentrations were less than 50% of the screening level. Arsenic, chromium, and copper concentrations were less than 20% of the screening level. Cadmium, lead, and mercury were less than 10% of the screening level. Silver was not detected.
- **Volatile Organics.** There were no volatile organics detected in any sediment samples in the site vicinity.
- **Semivolatile Organics.** Semivolatile organics were rarely detected (approximately 1% detection frequency) in sediment samples from the site vicinity. The rare detections were one to two orders of magnitude lower than the corresponding SEF or SCO screening levels.
- **PAHs.** Several PAHs were detected at estimated concentrations in the Clackamas River sample. PAHs were detected less frequently in Willamette River samples. PAH detections were typically two orders of magnitude lower than corresponding SEF or SCO screening levels.
- **Chlorinated Pesticides.** No chlorinated pesticides were detected in any sediment samples from the site vicinity.
- **PCBs.** No PCBs (reported as Aroclors) were detected in any sediment samples from the site vicinity.
- **Dioxins/Furans.** There are no SEF or SCO screening levels for dioxins and furans. Sediment concentrations in the site vicinity were compared to background concentrations developed for the Portland Harbor Superfund Site based on Upper Prediction Limit (UPL) statistics for upriver samples (Integral et al. 2011). The

calculated UPL for the toxic equivalent (TEQ) of 2,3,7,8-tetrachlorodibenzo-p-dioxin, based on mammalian toxicity, ranged from 2.2 to 5.7 nanograms per kilogram (ng/kg). The TEQ concentrations in the site vicinity ranged from less than 0.1 to 3.0 ng/kg, averaging 0.7 ng/kg. These dioxin/furan concentrations are therefore consistent with Willamette River background levels.

5 CONCEPTUAL SITE MODEL

This section describes the potential contaminant sources and exposure pathways for human and ecological receptors at the proposed restoration site. A diagram of the conceptual site model is provided in Table 2. Based on a lack of contamination in nearby surface sediments and a lack of complete exposure pathways to upland and inland sources, the environmental risk associated with mitigation actions (removal of structures, rock, and underlying fill material, and re-contouring of native sediment) is expected to be negligible, provided that standard sediment and erosion control BMPs are implemented.

5.1 Receptors of Interest

The Clackamas and Willamette rivers provide habitat for a diverse community of resident and migratory aquatic life and water-dependent wildlife. In addition, the project area may be used by several salmonid species listed as endangered or threatened under the federal ESA, including the following (USFWS 2015):

- Lower Columbia River (LCR) Evolutionarily Significant Unit (ESU) of Coho salmon (*Oncorhynchus kisutch*)
- LCR ESU of Chinook salmon (*O. tshawytscha*)
- Upper Willamette River (UWR) ESU of Chinook salmon (*O. tshawytscha*)
- LCR Distinct Population Segment (DPS) of steelhead (*O. mykiss*)
- UWR DPS of steelhead (*O. mykiss*)

UWR and LCR ESUs of Chinook salmon (*O. tschawytscha*), and UWR DPS) of steelhead (*O. mykiss*) are likely to occur in the project vicinity, and all have designated critical habitat up to at least Willamette Falls. LCR coho salmon (*O. kisutch*) includes a Clackamas River population that spawns in tributaries of the Willamette River below Willamette Falls but critical habitat is currently only proposed for this species. There is an experimental re-introduced population of LCR DPS of Bull trout (*Salvelinus confluentus*) within the Clackamas River that do not warrant protection under ESA.

The primary human activities at Dahl Beach Park are associated with water-dependent recreation, including sunbathing, fishing, wading, and swimming. The nearest boat launch is at the end of Meldrum Bar Park Road, approximately 2,000 feet downstream from the restoration site.

5.2 Potential Contaminant Sources

There are no complete pathways linking known contaminant sources with sediments in the Dahl Beach mitigation area. The site has been devoted to low-impact land use including parkland and sport fields in recent years, and open space and agriculture historically (Section 4.1.4).

There are no stormwater conveyance structures in Dahl Beach Park and a majority of the contiguous Meldrum Bar Park. Stormwater is evidently managed on site through natural processes such as infiltration, evapotranspiration, and diffuse overland flow (Section 4.1.3). Runoff from adjacent urban areas in the City of Gladstone is shunted to the Clackamas River approximately 2,000 feet upstream of the site, or to Rinearson Creek approximately 4,000 feet downstream of the site.

There were 24 sites identified in the ECSI database (Section 4.2.1) and 9 sites in the WQSIS database (Section 4.2.2) within 1 mile of the restoration site. Many of these sites have been issued NFA determinations. Runoff from the remaining active sites is discharged at significant distances from the Dahl Beach mitigation area and is not expected to impact sediment or water quality in the restoration area. There was one small residential mercury site identified in Oregon City in the federal CERCLIS database that was cleaned up and removed from the National Priorities List in 2011 (Section 4.2.3).

5.3 Contaminants of Concern

Surface sediment quality in the vicinity of the proposed restoration area is uniformly free of contamination, which is consistent with the lack of connection to upland and inland sources, as described in the preceding section.

Dahl Beach Park resides along a high-energy environment at the confluence of the Clackamas and Willamette rivers and on the outside bend of a Willamette River meander (Section 4.3.1). Bed sediments at the restoration site primarily comprise clean sand, gravel, cobble, and riprap, with limited fines and organic carbon, and thus very low potential for contaminant accumulation. Sediments in the site vicinity contain, on average, 4% fines and 0.22% TOC, consistent with SEF guidelines for a "very low" site ranking (i.e., less than 20% fines and less than 0.5% TOC per SEF Table 4-2; USACE et al. 2009).

There are no contaminants of concern identified in sediments in the vicinity of the Dahl Beach mitigation site (Section 4.3.2; Table 1). Metals concentrations in surface sediments are 2 to 10 times lower than their respective screening levels, PAHs and semivolatile organics are 10 to 100 times lower than their respective screening levels, and dioxin/furan concentrations are consistent with Willamette River background levels. No volatile organics, chlorinated pesticides, or PCBs were detected in existing surface sediments in vicinity of the site.

5.4 Potential Short-term Exposures

Based on the nature of the project activities and the lack of contamination in site sediment, the primary pathway of concern during construction is the potential for short-term impacts to the water column caused by sediment erosion and/or resuspension during removal of the sheetpiling, riprap, pavement, and underlying fill materials, and recontouring of native sediments. Aquatic organisms are the primary receptors of concern for this exposure pathway. While turbidity may present an aesthetic nuisance for humans, it is not a toxicity concern.

Sediment and turbidity impacts are expected to be mitigated through the use of appropriate nearshore and in-water sediment control BMPs, site monitoring, and by conducting the work in the dry to the extent practicable. In addition, any sediment that is disturbed during site mitigation activities is expected to settle and dissipate quickly due to the predominance of sand and gravel and the paucity of fines. Sediment and erosion control requirements are expected to be specified in project permitting documents, in particular, the Section 401 Water Quality Certification which will be issued by DEQ.

5.5 Potential Long-term Exposures

Existing surface sediment chemical concentrations in the site vicinity are all well below SEF screening levels, as shown in Table 1. Potentially bioaccumulative contaminants such as mercury, chlorinated pesticides, and PCBs were not detected, and dioxin/furan concentrations were consistent with Willamette River background levels. Therefore, site sediments are suitable for reuse on site and nearby as habitat material. Because site sediments are uncontaminated, there is no potential for long-term exposures associated with generated or undisturbed construction residuals.

6 CONCLUSIONS

Sediments within the proposed Dahl Beach mitigation site should be ranked "very low" according to SEF guidelines. An analysis of existing site conditions, site history, potential sources and discharge locations, and physical and chemical testing results of surface sediments in the site vicinity demonstrate a consistent lack of contamination and absence of exposure pathways. Neither a Level 2 analysis nor further analytical testing is warranted for the Dahl Beach mitigation site.

This conclusion is supported by the following lines of evidence:

- **Existing Site Conditions.** The Dahl Beach mitigation areas are characterized by relatively dynamic shorelines comprising sand, gravel, cobble, and riprap, indicative of a high-energy sedimentary regime. The site is subject to erosion from being on an outside meander (i.e., cut bank) of the Willamette River, as well as turbulence generated by the confluence of the Clackamas and Willamette rivers.
- **Historical Land Use.** The Dahl Beach Park area has been used for agriculture, open space, or parkland for its entire history. Aside from possible aggregate mining of the river bed in the 1930s, there is no evidence of commercial or industrial operations near the restoration site, other than minor paving and infrastructure to support park facilities.
- **Stormwater Runoff.** There are no storm sewers in Dahl Beach Park and a majority of the contiguous Meldrum Bar Park to the northwest. Stormwater is evidently managed on site in the parklands through natural processes such as infiltration, evapotranspiration, and diffuse overland flow. The nearest municipal stormwater outfalls from the City of Gladstone discharge approximately 2,000 feet upstream on the Clackamas River and 4,000 feet downstream on the Willamette River via Rinearson Creek. These stormwater outfalls are sufficiently removed as to pose no significant risk to site sediments.
- **Potential Contaminant Sources.** State and federal databases were consulted to identify environmental cleanup sites and discharges within 1 mile of the Dahl Beach mitigation site. No complete exposure pathways were identified, and there is no reason to believe that any upland sources have the potential to adversely impact sediment quality at the restoration site.

- **Sediment Physical Properties.** The sediments in the vicinity of Dahl Beach Park have very low fines and TOC content, and thus very limited potential for contaminant accumulation. Fines content ranges between 2.6% and 6.2%. TOC content ranges between 0.16% and 0.37%. SEF guidelines indicate sediments with less than 20% fines and less than 0.5% TOC may be appropriate for a "very low" site ranking, provided there are no significant contaminant sources in the site vicinity, and there are none (see previous bullet).
- **Sediment Chemical Analyses.** Chemical analyses were performed on five surface sediment samples collected near Dahl Beach Park in 2007 as part of the Blue Heron Paper Mill Site Investigation (Ecology and Environment 2008). Results of these analyses confirm the appropriateness of a "very low" ranking for this site and meet the SEF recency requirements for this type of ranking (i.e., 10 years). Metals were two to ten times lower than their corresponding SEF screening levels. PAHs were occasionally detected at concentrations two orders of magnitude lower than SEF or SCO screening levels. Other semivolatile compounds were rarely detected, and those rare detections were at least an order of magnitude lower than SEF or SCO screening levels. There were no detections of volatile organic compounds, chlorinated pesticides, or PCB Aroclors. Dioxin/furan TEQs were within the range of background concentrations for the Willamette River.

In summary, this Level 1 evaluation provides several corroborating lines of evidence to support a determination that sediments in the Dahl Beach mitigation areas are commensurate with a "very low" ranking. There is no reason to believe contamination is present and no additional sediment testing is warranted. Available data confirm that site sediments meet the criteria for unconfined aquatic disposal and pose no significant risk to aquatic life or human health. The sediments are therefore suitable for use as habitat material during regrading of the restoration areas to form a more natural shoreline. Controlling sediment erosion and turbidity generation will be the primary environmental concerns during construction, and these can be controlled through project permits using standard upland and in-water BMPs.

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TABLES

Table 1
Existing Surface Sediment Analytical Results

	SEF Screening Level	Washington Sediment Cleanup Objective					
		Sample ID	**CR01SD**	**WR03SD**	**WR04SD**	**WR06SD**	**WR07SD**
		Sample Date	**8/28/2007**	**8/28/2007**	**8/28/2007**	**8/29/2007**	**8/29/2007**
		Depth	**0 - 10 cm**	**0 - 10 cm**	**0 - 10 cm**	**0 - 10 cm**	**0 - 10 cm**
		Matrix	**SED**	**SED**	**SED**	**SED**	**SED**
		X	**7,661,613**	**7,657,679**	**7,658,489**	**7,661,917**	**7,660,556**
		Y	**628,978**	**630,128**	**629,227**	**626,284**	**625,318**
		River	**Clackamas**	**Willamette**	**Willamette**	**Willamette**	**Willamette**
		River Mile	**0.2**	**24.1**	**24.4**	**25.2**	**25.4**
Conventional Parameters (pct)							
Total organic carbon			**0.37**	**0.153**	**0.169**	**0.16**	**0.25**
Grain Size (pct)							
Gravel			**0.3**	0.0001 U	**9.2**	**1.8**	**12.3**
Sand, very coarse			**1.6**	0.0001 U	**7.8**	**5.2**	**1.3**
Sand, coarse			**27**	**1**	**14.7**	**21.8**	**1.6**
Sand, medium			**39.8**	**46.3**	**44.6**	**46.3**	**18.1**
Sand, fine			**17.9**	**46.9**	**19.7**	**18.3**	**46.1**
Sand, very fine			**7.1**	**3.1**	**1.4**	**4.1**	**14.6**
Silt, coarse			**2.5**	--	--	--	**1.9**
Silt, medium			**1.2**	--	--	--	**1.1**
Silt, fine			**0.9**	--	--	--	**0.7**
Silt, very fine			**0.7**	--	--	--	**0.6**
Clay >10 Phi			**0.2**	--	--	--	**0.7**
Clay, coarse			**0.4**	--	--	--	**0.5**
Clay, medium			**0.3**	--	--	--	**0.4**
Total fines			**6.2**	**2.7**	**2.7**	**2.6**	**5.9**
Metals (mg/kg)							
Aluminum			**9750 J**	**9660**	**8430**	**8100**	**11400 J**
Antimony			1.5 UJ	1.5 UJ	0.12 UJ	0.1 UJ	1.4 UJ
Arsenic	20	14	**2.3 J**	**2.1 J**	**2.3 J**	**3.7 J**	**2.2 J**
Barium			**76.5 J**	**85.4 J**	**82.1 J**	**96.5 J**	**108 J**
Beryllium			**0.38 J**	**0.31 J**	**0.27 J**	**0.47 J**	**0.33 J**
Cadmium	1.1	2.1	**0.06 J**	0.05 UJ	0.04 UJ	0.04 UJ	**0.05 J**
Calcium			--	0.0001 U	--	--	--
Chromium	95	72	**12.9 J**	**14.8 J**	**11.9 J**	**18.6 J**	**18.1 J**
Cobalt			**8.6 J**	**11.3 J**	**10.3 J**	**13.8 J**	**12.1 J**
Copper	80	400	**15.5 J**	**13.4 J**	**13.6 J**	**10.5 J**	**15.9 J**
Lead	340	360	**4.4 J**	**4.9 J**	**9.7 J**	**10.5 J**	**7.8 J**
Manganese			**288 J**	**318**	**279**	**332**	**310 J**
Mercury	0.28	0.66	**-- R**	0.02 UJ	0.02 UJ	0.02 UJ	**-- R**
Nickel	60	26	**13.3 J**	**17.9 J**	**14.5 J**	**12.3 J**	**19.4 J**
Potassium			--	--	--	--	--
Selenium		11	**0.14 J**	2.9 U	2.8 U	2.8 U	**0.13 J**
Silver	2	0.57	0.76 U	0.74 U	0.69 U	0.69 U	0.08 UJ
Thallium			1.5 U	0.02 UJ	1.4 U	1.4 U	**0.09 J**
Vanadium			**50.9 J**	**57.5 J**	**46.9 J**	**39.7 J**	**66.2 J**
Zinc	130	3200	**40.4 J**	**48.4 J**	**44 J**	**41.1 J**	**56.5 J**
Volatile Organics (µg/kg)							
1,1,1-Trichloroethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,1,2,2-Tetrachloroethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,1,2-Trichloro-1,2,2-trifluoroethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,1,2-Trichloroethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,1-Dichloroethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,1-Dichloroethene			9.8 U	--	6.6 U	7.4 U	7.2 U
1,2,3-Trichlorobenzene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,2-Dibromo-3-chloropropane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,2-Dichloroethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,2-Dichloroethene, cis-			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,2-Dichloroethene, trans-			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,2-Dichloropropane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,3-Dichloropropene, cis-			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,3-Dichloropropene, trans-			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,4-Dioxane			**-- R**	**-- R**	**-- R**	**-- R**	**-- R**
2-Butanone (MEK)			20 U	16 U	13 U	15 U	14 U
2-Hexanone (Methyl butyl ketone)			20 U	16 U	13 U	15 U	14 U
Acetone			20 U	16 U	13 U	15 U	14 U
Benzene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Bromochloromethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Bromodichloromethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Bromoform (Tribromomethane)			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Bromomethane (Methyl bromide)			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Carbon disulfide			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Carbon tetrachloride			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Chlorobenzene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Chloroethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Chloroform			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Chloromethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Cyclohexane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Dibromochloromethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U

Table 1
Existing Surface Sediment Analytical Results

		Sample ID	CR01SD	WR03SD	WR04SD	WR06SD	WR07SD
		Sample Date	8/28/2007	8/28/2007	8/28/2007	8/29/2007	8/29/2007
		Depth	0 - 10 cm	0 - 10 cm	0 - 10 cm	0 - 10 cm	0 - 10 cm
		Matrix	SED	SED	SED	SED	SED
		X	7,661,613	7,657,679	7,658,489	7,661,917	7,660,556
		Y	628,978	630,128	629,227	626,284	625,318
		River	Clackamas	Willamette	Willamette	Willamette	Willamette
		River Mile	0.2	24.1	24.4	25.2	25.4
	SEF Screening Level	Washington Sediment Cleanup Objective					
Dichlorodifluoromethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Dichloromethane (Methylene chloride)			12 U	13 U	12 U	11 UJ	17 UJ
Ethylbenzene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Ethylene dibromide			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Hexachlorobutadiene			0.09 U	0.09 UJ	0.08 UJ	0.09 UJ	0.09 U
Isopropylbenzene (Cumene)			9.8 U	8 U	6.6 U	7.4 U	7.2 U
m,p-Xylene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Methyl acetate			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Methyl isobutyl ketone (MIBK)			20 U	16 U	13 U	15 U	14 U
Methyl tert-butyl ether (MTBE)			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Methylcyclohexane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
o-Xylene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Styrene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Tetrachloroethene (PCE)			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Toluene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Trichloroethene (TCE)			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Trichlorofluoromethane			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Vinyl chloride			9.8 U	8 U	6.6 U	7.4 U	7.2 U
Semivolatile Organics (μg/kg)							
1,2,4-Trichlorobenzene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,2-Dichlorobenzene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,2-Diphenylhydrazine			24 UJ	24 U	22 U	23 U	23 U
1,3-Dichlorobenzene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
1,4-Dichlorobenzene			9.8 U	8 U	6.6 U	7.4 U	7.2 U
2,2'-Oxybis (1-chloropropane)			24 UJ	24 U	22 U	23 U	23 U
2,3,4,5-Tetrachlorophenol			24 UJ	24 U	22 U	23 U	23 U
2,3,4,6-Tetrachlorophenol			24 UJ	24 U	22 U	23 U	23 U
2,4,5-Trichlorophenol			24 UJ	24 U	22 U	23 U	23 U
2,4,6-Trichlorophenol			24 UJ	24 U	22 U	23 U	23 U
2,4-Dichlorophenol			24 UJ	24 U	22 U	23 U	23 U
2,4-Dimethylphenol			24 UJ	24 U	22 U	23 U	23 U
2,4-Dinitrophenol			120 UJ	120 UJ	110 UJ	120 UJ	110 UJ
2,4-Dinitrotoluene			24 UJ	24 U	22 U	23 U	23 U
2,6-Dinitrotoluene			24 UJ	24 U	22 U	23 U	23 U
2-Chloronaphthalene			24 UJ	24 U	22 U	23 U	23 U
2-Chlorophenol			24 UJ	24 U	22 U	23 U	23 U
2-Methylphenol (o-Cresol)			24 UJ	24 U	22 U	23 U	23 U
2-Nitroaniline			120 UJ	120 U	110 U	120 U	120 U
2-Nitrophenol			24 UJ	24 U	22 U	23 U	23 U
3,3'-Dichlorobenzidine			24 UJ	24 U	22 U	23 U	23 U
3-Nitroaniline			120 UJ	120 U	110 U	120 U	120 U
4-Bromophenyl-phenyl ether			24 UJ	24 U	22 U	23 U	23 U
4-Chloro-3-methylphenol			24 UJ	24 U	22 U	23 U	23 U
4-Chloroaniline			24 UJ	24 U	22 U	23 U	23 U
4-Chlorophenyl phenyl ether			24 UJ	24 U	22 U	23 U	23 U
4-Methylphenol (p-Cresol)		260	24 UJ	24 U	22 U	23 U	23 U
4-Nitroaniline			120 UJ	120 U	110 U	120 U	120 U
4-Nitrophenol			120 UJ	120 U	110 U	120 U	120 U
Aniline			24 UJ	24 U	22 U	23 U	23 U
Benzoic acid		2900	**27 J**	24 UJ	22 UJ	23 UJ	23 UJ
Benzyl alcohol			24 UJ	24 U	22 U	23 U	23 U
bis(2-Chloroethoxy)methane			24 UJ	24 U	22 U	23 U	23 U
bis(2-Chloroethyl)ether			24 UJ	24 U	22 U	23 U	23 U
bis(2-Ethylhexyl)phthalate	220	500	**16 J**	24 U	22 U	23 U	**24**
Butylbenzyl phthalate	260		24 UJ	24 U	22 U	23 U	23 U
Diethyl phthalate			24 UJ	24 U	22 U	23 U	23 U
Dimethyl phthalate	46		24 UJ	24 U	22 U	23 U	23 U
Di-n-butyl phthalate		380	**3.2 J**	24 U	22 U	23 U	23 U
Dinitro-o-cresol			120 UJ	120 U	110 U	120 U	120 U
Di-n-octyl phthalate	26	39	24 UJ	24 U	22 U	23 U	23 U
Hexachlorobenzene			0.47 U	24 U	22 U	23 U	0.46 U
Hexachlorocyclopentadiene			24 UJ	24 UJ	22 UJ	23 UJ	23 UJ
Hexachloroethane			0.09 U	0.09 UJ	0.08 UJ	0.09 UJ	0.09 U
Isophorone			24 UJ	24 U	22 U	23 U	23 U
Nitrobenzene			24 UJ	24 U	22 U	23 U	23 U
n-Nitrosodimethylamine			24 UJ	24 U	22 U	23 U	23 U
n-Nitrosodi-n-propylamine			24 UJ	24 U	22 U	23 U	23 U
n-Nitrosodiphenylamine			24 UJ	24 U	22 U	23 U	23 U
Pentachlorophenol		1200	**1.8 J**	4.7 UJ	4.3 UJ	4.5 UJ	4.5 UJ
Phenol		120	24 UJ	24 U	22 U	23 U	23 U

Table 1
Existing Surface Sediment Analytical Results

		Sample ID	**CR01SD**	**WR03SD**	**WR04SD**	**WR06SD**	**WR07SD**
		Sample Date	**8/28/2007**	**8/28/2007**	**8/28/2007**	**8/29/2007**	**8/29/2007**
		Depth	**0 - 10 cm**	**0 - 10 cm**	**0 - 10 cm**	**0 - 10 cm**	**0 - 10 cm**
		Matrix	**SED**	**SED**	**SED**	**SED**	**SED**
		X	**7,661,613**	**7,657,679**	**7,658,489**	**7,661,917**	**7,660,556**
		Y	**628,978**	**630,128**	**629,227**	**626,284**	**625,318**
		River	**Clackamas**	**Willamette**	**Willamette**	**Willamette**	**Willamette**
		River Mile	**0.2**	**24.1**	**24.4**	**25.2**	**25.4**
	SEF Screening Level	**Washington Sediment Cleanup Objective**					
Polycyclic Aromatic Hydrocarbons (µg/kg)							
2-Methylnaphthalene	470		2.4 U	2.4 U	2.2 U	2.3 U	2.3 U
Acenaphthene	1100		**2.6 J**	2.4 UJ	2.2 UJ	2.3 UJ	**0.92 J**
Acenaphthylene	470		2.4 U	2.4 U	2.2 U	2.3 U	2.3 U
Anthracene	1200		**2.3 J**	2.4 UJ	2.2 UJ	2.3 UJ	2.3 UJ
Benzo(a)anthracene	4300		**13 J**	2.4 UJ	2.2 UJ	**4.4 J**	**3.1 J**
Benzo(a)pyrene	3300		**19 J**	2.4 UJ	2.2 UJ	2.3 UJ	2.2 UJ
Benzo(b)fluoranthene			**19 J**	2.4 UJ	2.2 UJ	**7.4 J**	**5.2 J**
Benzo(g,h,i)perylene	4000		2.4 U	2.4 U	2.2 U	**7.3**	**2.7**
Benzo(k)fluoranthene			**17 J**	2.4 UJ	2.2 UJ	**5.8 J**	**5.5 J**
Carbazole		900	**2.6 J**	24 U	22 U	23 U	23 U
Chrysene	5900		**14 J**	2.4 UJ	2.2 UJ	**6.7 J**	**4.2 J**
Dibenzo(a,h)anthracene	800		**4.2 J**	2.4 UJ	2.1 UJ	2.3 UJ	2.3 UJ
Dibenzofuran	400	200	2.4 UJ	2.4 UJ	2.2 UJ	2.3 UJ	2.3 UJ
Fluoranthene	11000		**21 J**	2.4 UJ	2.2 UJ	**16 J**	2.3 UJ
Fluorene	1000		2.4 UJ	2.4 UJ	2.2 UJ	2.3 UJ	2.3 UJ
Indeno(1,2,3-c,d)pyrene	4100		**11 J**	2.4 UJ	2.2 UJ	**9 J**	2.3 UJ
Naphthalene	500		2.4 UJ	2.4 UJ	2.2 UJ	2.3 UJ	2.3 UJ
Phenanthrene	6100		**2.4 J**	2.4 U	2.2 U	2.3 U	2.3 U
Pyrene	8800		**17 J**	2.4 UJ	2.2 UJ	**18 J**	**6.7 J**
Total Benzofluoranthenes (U = 1/2)	600		**36 J**	2.4 UJ	2.2 UJ	**13.2 J**	**10.7 J**
Total PAH (U = 0)		17000	**143 J**	2.4 UJ	2.2 UJ	**74.6 J**	**28.3 J**
Pesticides (µg/kg)							
2,4'-DDD (o,p'-DDD)			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
2,4'-DDE (o,p'-DDE)			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
2,4'-DDT (o,p'-DDT)			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
4,4'-DDD (p,p'-DDD)			0.92 UJ	0.93 UJ	0.86 UJ	0.9 UJ	0.9 UJ
4,4'-DDE (p,p'-DDE)			0.92 UJ	0.93 UJ	0.86 UJ	0.9 UJ	0.9 UJ
4,4'-DDT (p,p'-DDT)			0.92 UJ	0.93 UJ	0.86 UJ	0.9 UJ	0.9 UJ
Aldrin			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
Chlordane, alpha- (Chlordane, cis-)			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
Chlordane, beta- (Chlordane, trans-)			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
Dieldrin		4.9	0.92 UJ	0.93 UJ	0.86 UJ	0.9 UJ	0.9 UJ
Endosulfan sulfate			0.92 UJ	0.93 UJ	0.86 UJ	0.9 UJ	0.9 UJ
Endosulfan, alpha- (I)			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
Endosulfan, beta (II)			0.92 UJ	0.93 UJ	0.86 UJ	0.9 UJ	0.9 UJ
Endrin			0.92 UJ	0.93 UJ	0.86 UJ	0.9 UJ	0.9 UJ
Endrin aldehyde			0.92 UJ	0.93 UJ	0.86 UJ	0.9 UJ	0.9 UJ
Endrin ketone		8.5	0.92 UJ	0.93 UJ	0.86 UJ	0.9 UJ	0.9 UJ
Heptachlor			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
Heptachlor epoxide			**-- R**	**-- R**	**-- R**	**-- R**	**-- R**
BHC, alpha			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
BHC, beta		7.2	0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
BHC, delta			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
BHC, gamma (Lindane)			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
Methoxychlor			4.7 UJ	4.8 UJ	4.4 UJ	4.6 UJ	4.6 UJ
Mirex			**-- R**	**-- R**	**-- R**	**-- R**	**-- R**
Nonachlor, cis-			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
Nonachlor, trans-			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
Oxychlordane			0.47 UJ	0.48 UJ	0.44 UJ	0.46 UJ	0.46 UJ
Toxaphene			47 UJ	48 UJ	44 UJ	46 UJ	46 UJ
Dioxin Furans (ng/kg)							
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)			0.22 U	0.22 U	0.2 U	0.22 U	0.22 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin			1.14 U	1.18 U	1.05 U	1.04 U	1.17 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin			1.19 U	1.24 U	1.1 U	1.23 U	1.23 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin			1.05 U	1.08 U	0.96 U	1.08 U	1.08 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin			1.14 U	1.18 U	1.05 U	1.17 U	1.17 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin			**5.24**	**9.49**	**4.75**	**3.61**	**6.54**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin			**39.3**	**69.1**	**37.4**	**28**	**51.1**
2,3,7,8-Tetrachlorodibenzofuran			0.22 U	0.22 U	**0.69**	0.22 U	**0.27**
1,2,3,7,8-Pentachlorodibenzofuran			1.01 U	1.05 U	0.93 U	1.17 U	1.04 U
2,3,4,7,8-Pentachlorodibenzofuran			1.01 U	1.05 U	**1.83**	1.04 U	1.04 U
1,2,3,4,7,8-Hexachlorodibenzofuran			1.1 U	1.14 U	**16.2**	1.13 U	1.14 U
1,2,3,6,7,8-Hexachlorodibenzofuran			1.01 U	1.05 U	**2.62**	1.94 U	1.04 U
1,2,3,7,8,9-Hexachlorodibenzofuran			1.01 U	1.05 U	0.93 U	1.04 U	1.04 U
2,3,4,6,7,8-Hexachlorodibenzofuran			1.06 U	1.1 U	**1.41**	1.09 U	1.1 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran			**1.01 J**	2.18 U	**16.6**	1.04 U	1.48 U
1,2,3,4,7,8,9-Heptachlorodibenzofuran			1.01 U	1.05 U	**11.1**	1.04 U	1.04 U
1,2,3,4,6,7,8,9-Octachlorodibenzofuran			2.18 U	**5.74**	**55.8**	2.25 U	**3.07**
Dioxin/Furan TEQ (2005 Mammal) (U = 0)			**0.07 J**	**0.12**	**2.99**	**0.04**	**0.11**

Table 1
Existing Surface Sediment Analytical Results

		Sample ID	CR01SD	WR03SD	WR04SD	WR06SD	WR07SD
		Sample Date	8/28/2007	8/28/2007	8/28/2007	8/29/2007	8/29/2007
		Depth	0 - 10 cm	0 - 10 cm	0 - 10 cm	0 - 10 cm	0 - 10 cm
		Matrix	SED	SED	SED	SED	SED
		X	7,661,613	7,657,679	7,658,489	7,661,917	7,660,556
		Y	628,978	630,128	629,227	626,284	625,318
		River	Clackamas	Willamette	Willamette	Willamette	Willamette
		River Mile	0.2	24.1	24.4	25.2	25.4
	SEF Screening Level	Washington Sediment Cleanup Objective					
PCB Aroclors (µg/kg)							
Aroclor 1016			9.2 U	9.3 U	8.6 U	9 U	9 U
Aroclor 1221			9.2 U	9.3 U	8.6 U	9 U	9 U
Aroclor 1232			9.2 U	9.3 U	8.6 U	9 U	9 U
Aroclor 1242			9.2 U	9.3 U	8.6 U	9 U	9 U
Aroclor 1248			9.2 U	9.3 U	8.6 U	9 U	9 U
Aroclor 1254			9.2 U	9.3 U	8.6 U	9 U	9 U
Aroclor 1260			9.2 U	9.3 U	8.6 U	9 U	9 U
Aroclor 1262			9.2 U	9.3 U	8.6 U	9 U	9 U
Aroclor 1268			9.2 U	9.3 U	8.6 U	9 U	9 U
Total PCB Aroclors (U = 0)	60	110	9.2 U	9.3 U	8.6 U	9 U	9 U

Notes:
Bold = Detected result
Detected concentration is greater than SEF screening level (No Exceedances)
[1] Willamette River "upriver" surface sediment background values range from 2.2 to 5.7 ng/kg based on upper prediction limits (LWG 2011)
J = Estimated value
U = Compound analyzed, but not detected above detection limit
UJ = Compound analyzed, but not detected above estimated detection limit
R = Rejected

µg = microgram
cm = centimeter
mg = millligram
ng = nanogram
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated diphenyl
pct = percent
SED = sediment
SEF = Sediment Evaluation Framework
TEQ = toxic equivalency

Table 2
Conceptual Site Model for Dahl Beach Park Restoration

POTENTIAL SEDIMENT RELEASE FROM SHORELINE REGRADING AND ANTHROPOGENIC MATERIAL REMOVAL (if applicable)

Media of Concern (where chemicals of concern may be present)	**Release[1] Mechanism** (process that liberates or reveals chemicals of concern from media)	**Secondary Media** (other media impacted)	**Primary Pathway** (route from media to receptor)		**Potential Receptors**					
					Benthic Inverts	Fish	ESA Species	Critical Habitat	Birds/Mammals	Humans
SEDIMENT →	**Resuspension**[2] (during restoration or anthropogenic material removal) →	Water column →	Direct Contact →		[A]	[A]	[A]	[A]		
	Generated Residuals[3] (redeposited from sloughing, dislodging, slope failure, or resettling during dredging or disposal) →	Settled sediment →	Direct Contact →		Not Applicable					
			Dietary →	Tertiary Media, Tissue →	Not Applicable					
	Undisturbed Residuals[4] (as uncovered during dredging- measured as the new surface material) →	Newly exposed sediment surface →	Direct Contact →		Not Applicable					
			Dietary →	Tertiary Media, Tissue →	Not Applicable					

Receptor Pathway Abbreviations: **C** = Pathway complete; **P** = Potentially complete pathway;
I = Incomplete or insignificant pathway; NA = not applicable (e.g., NSM is bedrock or concrete)

[1] Release: the process by which the operations result in the transfer of contaminants from sediment pore water and sediment particles into the water column or air (i.e., repartitioning). Contaminants in near-surface sediments (e.g., transport from redeposited sediment or residuals) may be released into the water column by densification, diffusion, and bioturbation (Bridges et. al., 2008).

[2] Resuspension: The process by which attended operations dislodge bedded sediment particles and disperse them into the water column. Resuspension rates range from <0.1% to over 5% (Bridges et. al., 2008).

[3] Redeposition: The process by which suspended particles resettle on the surface of the sediment after disturbance. Redeposition can occur in the near field (the plume area dominated by rapid settling velocities, changes in sediment total suspended concentration, and load with distance from the dredging operation) or the far field (the area where the total load in the plume is slowly varying and where advection, diffusion and settling are of the same order of magnitude).

[4] Residuals: Contaminated sediment found at the post-dredging surface of sediment profile, either within or adjacent to the dredging footprint (Bridges et. al., 2008). Examples include contaminated surface sediments uncovered by dredging, but not fully removed (e.g., newly exposed surface) or contaminated sediment dislodged from nearby slopes during dredging or slope failures. Although in-water disposal does not create undisturbed residuals, resuspended sediment particles settling at a site become part of the generated dredging residuals.

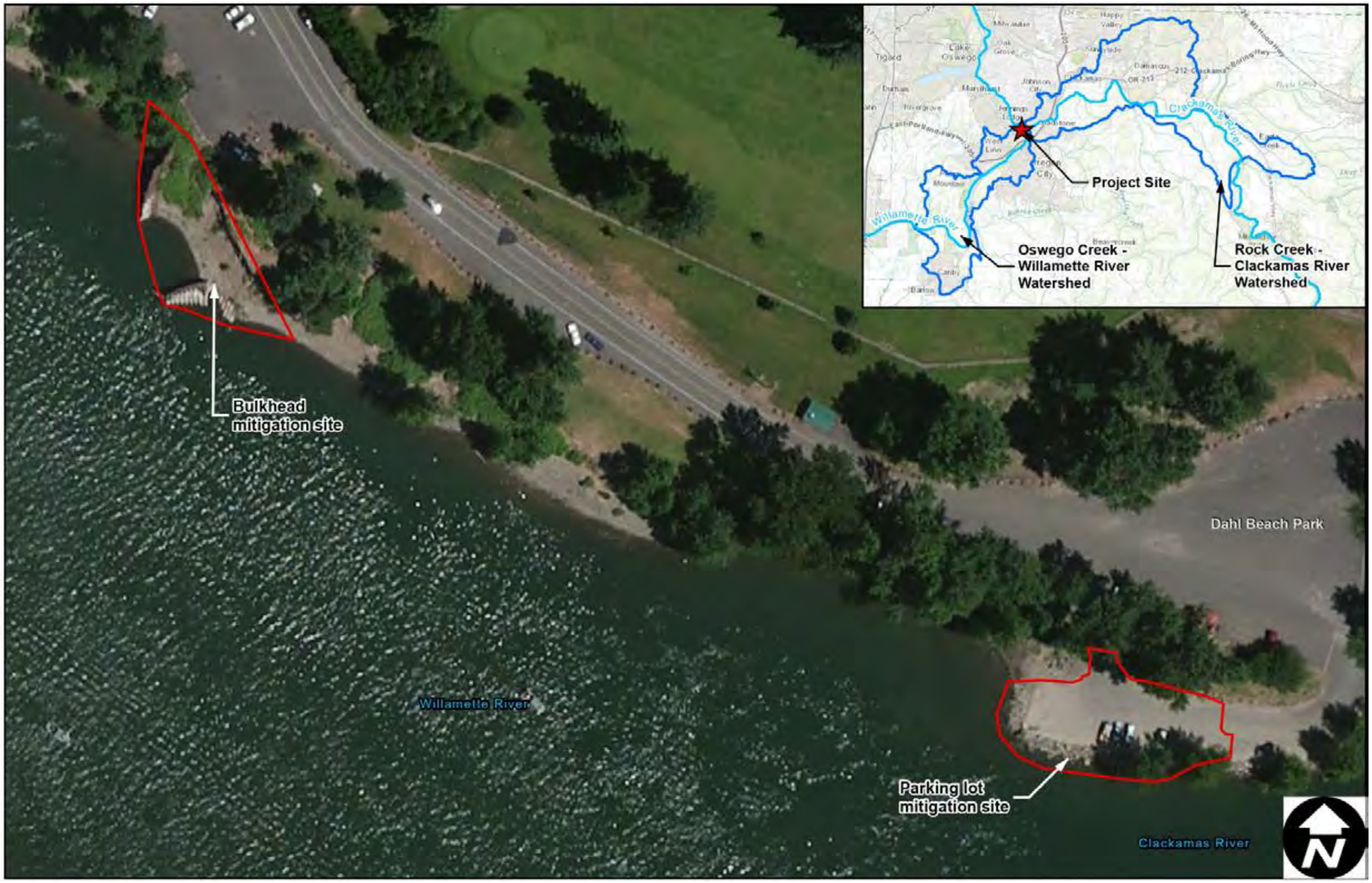
SEDIMENT RELEASE FROM OTHER TYPES OF DISPOSAL (not considered in the SEF) **[B] Not Applicable**

	Disposal Method	**Disposal Location**	**Transport Processes** (Examples)
SEDIMENT →	Upland Disposal →	Upland Confined Aquatic Disposal (CDF)	The following upland processes are outside of the purview of SEF review: 1. Leaching 2. Surface runoff 3. Volatilization 4. Bioaccumulation Additional information on the evaluation of these disposal options can be found the following manuals: 1. Corps. 2003. Upland Testing Manual, ERD/EL TR-03-1. 2. EPA. 1998. Guidance for In Situ Subaqueous Capping of Contaminated Sediment, EPA 905-B96-004.
	Nearshore Disposal →	Nearshore CDF	
	Subaqueous Capping →	Engineered Cap	

[A] – Possible effects from increased turbidity only. There is no reason to believe contaminants are present (i.e., "very low" ranking proposed).

[B] – All native soil and sediment will be left onsite. Only rock, structural debris, and non-native ballast material will be removed and repurposed.

FIGURES



Source: Cascade Environmental Group (8/25/2015)

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ANCHOR QEA

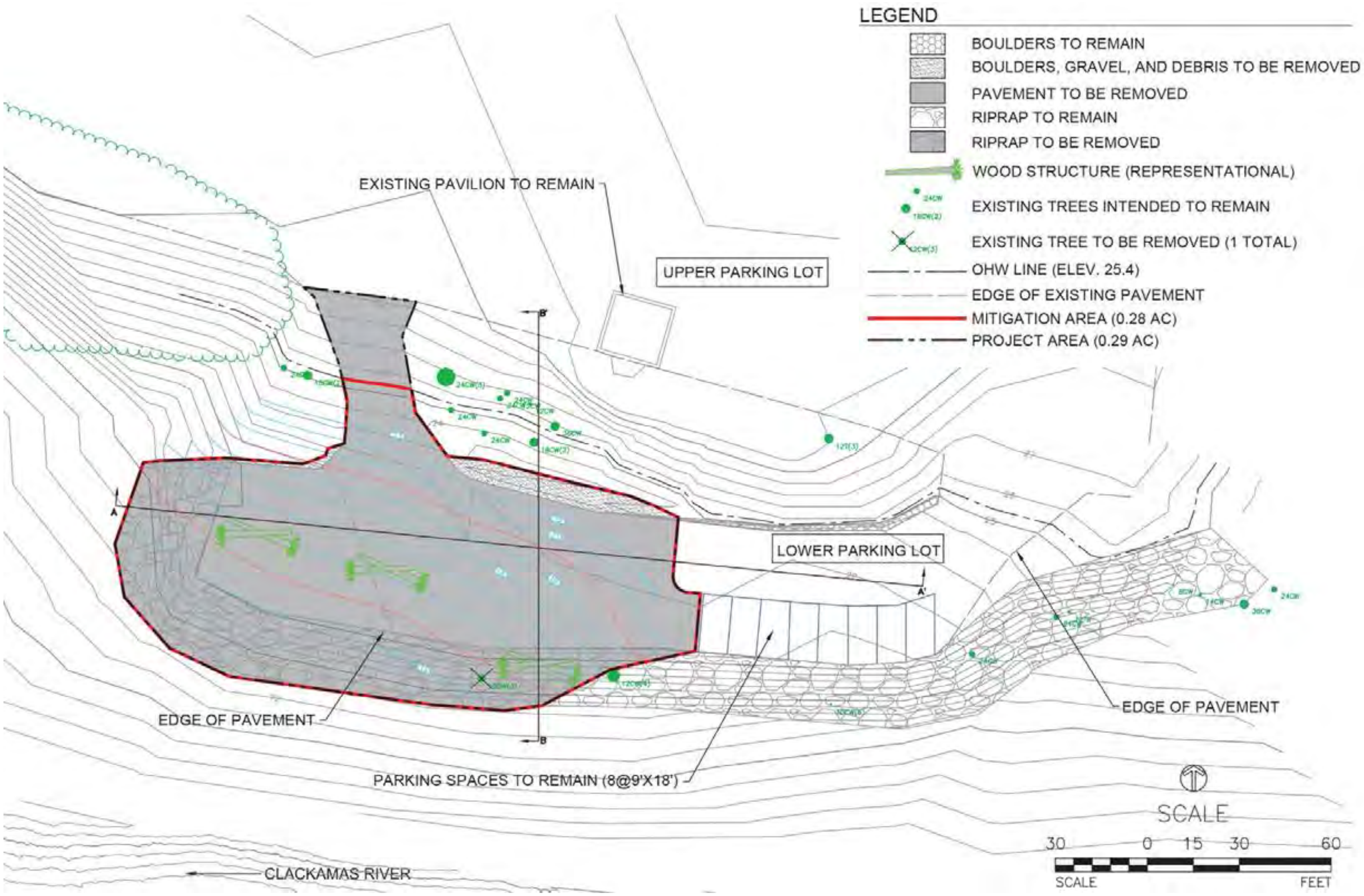
Figure 1
Site Map
Dahl Beach Mitigation Site Level 1 Sediment Evaluation
Port of Portland Terminal 4 Mitigation Project

Looking downriver below parking area showing typical gravel, cobble, and riprap beach.

Looking downriver along failed sheet pile bulkhead showing typical gravel and cobble beach in foreground and background.

ANCHOR QEA

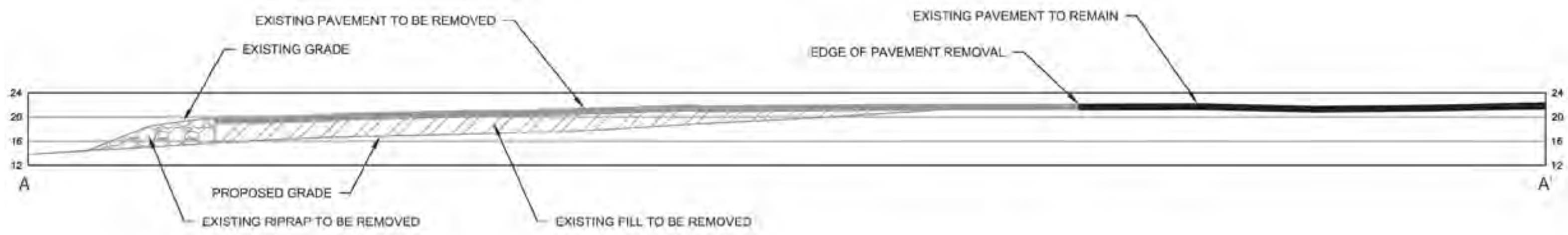
Figure 2
Representative Photographs of Site Sediment Characteristics
Dahl Beach Mitigation Site Level 1 Sediment Evaluation
Port of Portland Terminal 4 Mitigation Project



Source: Cascade Environmental Group (8/2015)

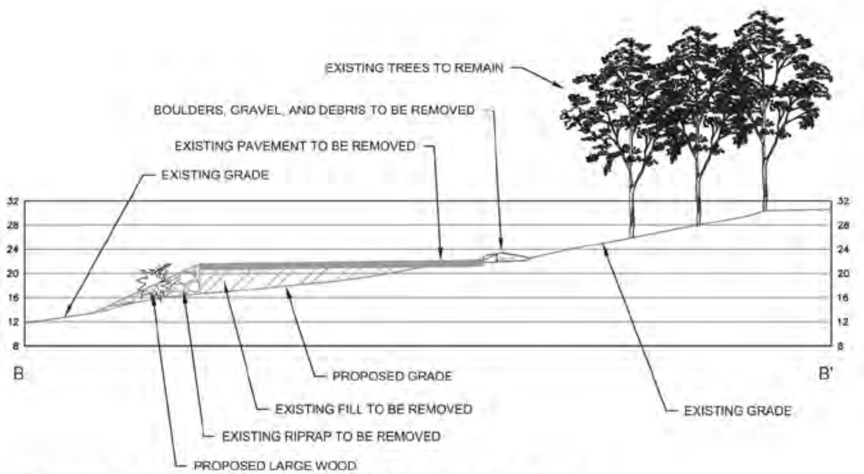
ANCHOR QEA

Figure 3
Lower Parking Lot Area Project Design Concept
Dahl Beach Mitigation Site Level 1 Sediment Evaluation
Port of Portland Terminal 4 Mitigation Project



SECTION A-A' THROUGH RESTORATION AREA

SCALE: VERT. 1"=20' HORIZ. 1"=20'



SECTION B-B' THROUGH RESTORATION AREA

SCALE: VERT. 1"=20' HORIZ. 1"=20'

Source: Cascade Environmental Group (8/2015)

ANCHOR QEA

Figure 4
Lower Parking Lot Area Project Design Cross Sections
Dahl Beach Mitigation Site Level 1 Sediment Evaluation
Port of Portland Terminal 4 Mitigation Project

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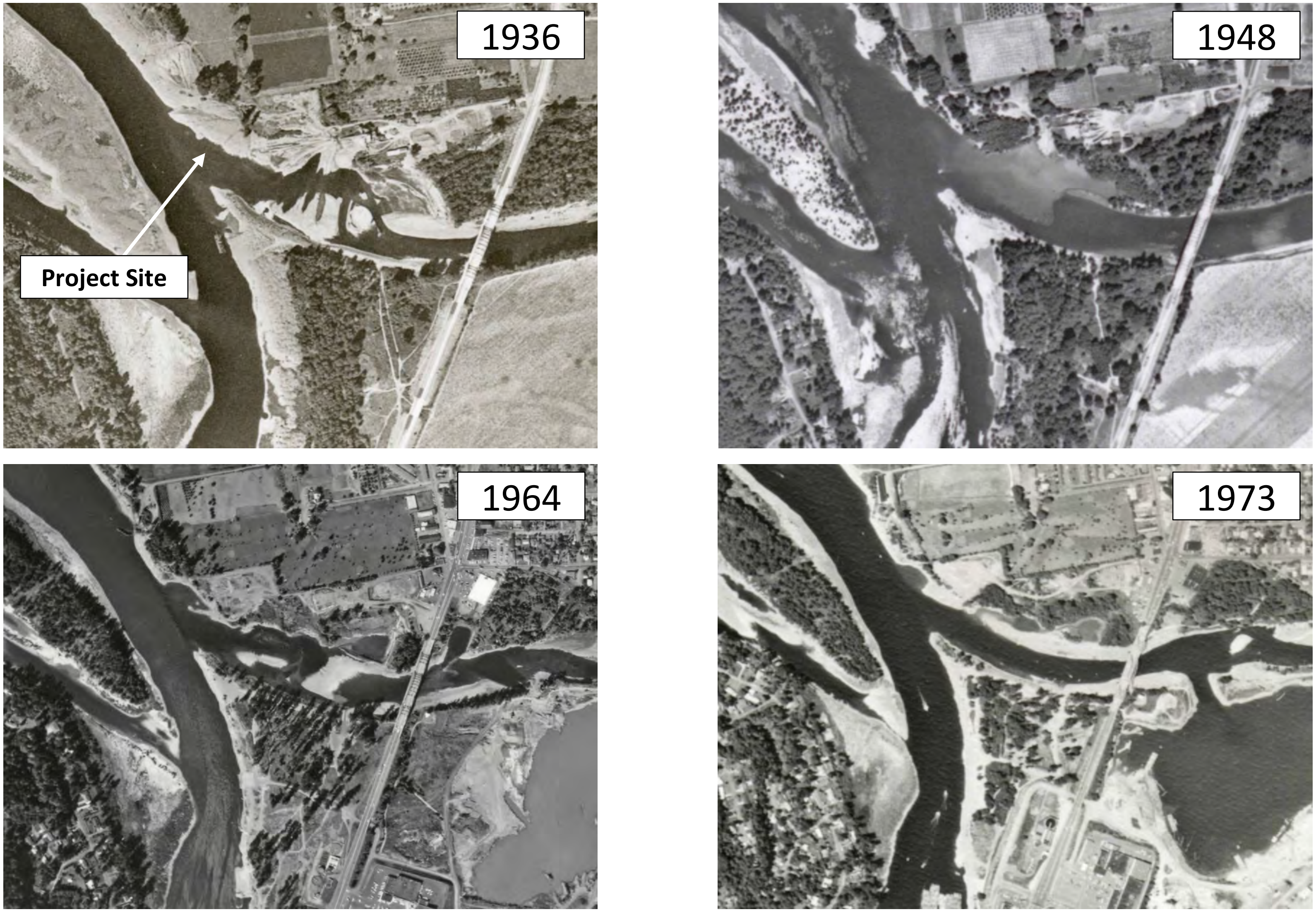
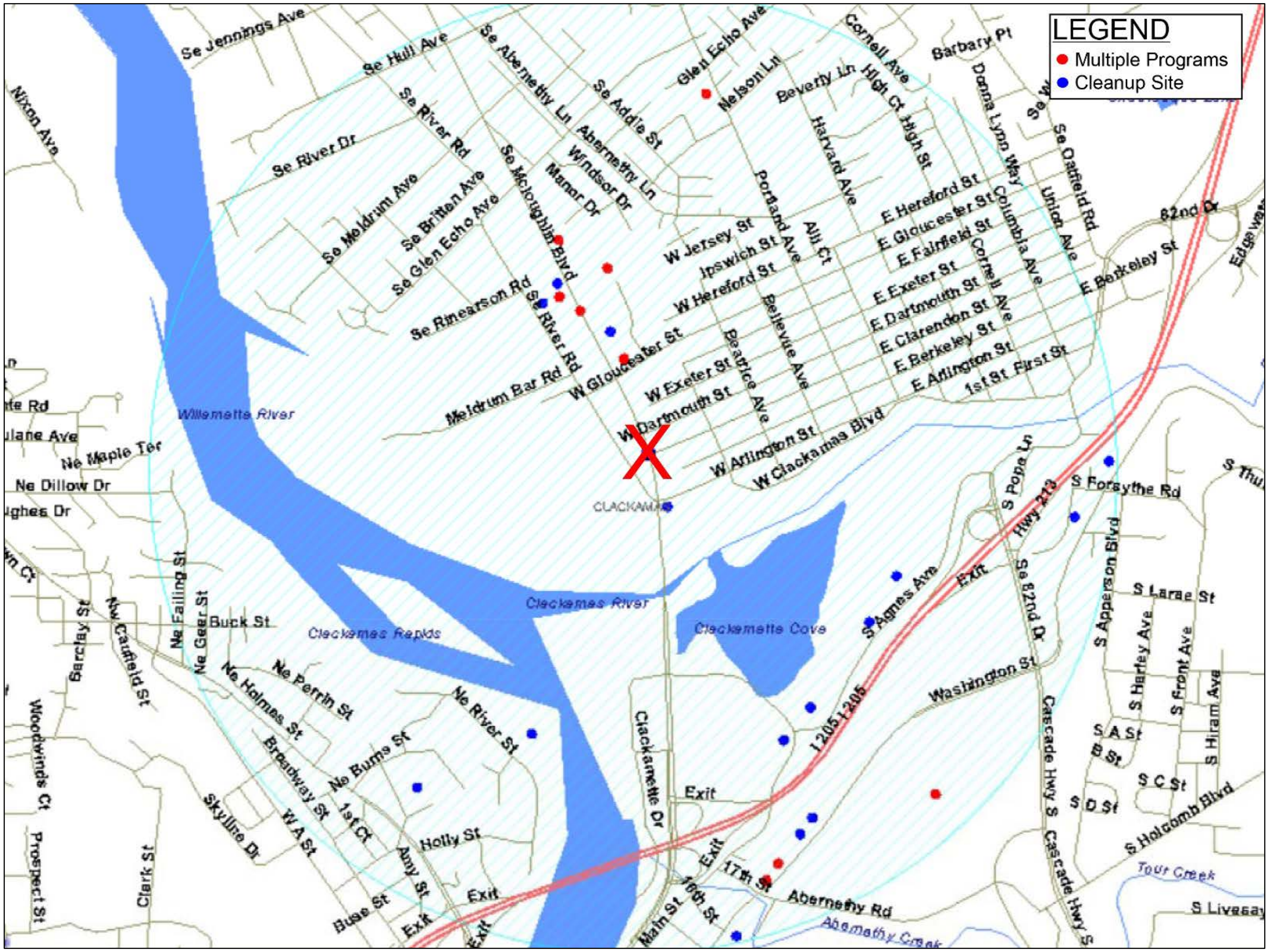


ANCHOR QEA

Figure 5
Representative Historical Photos
Dahl Beach Mitigation Site Level 1 Sediment Evaluation
Port of Portland Terminal 4 Mitigation Project

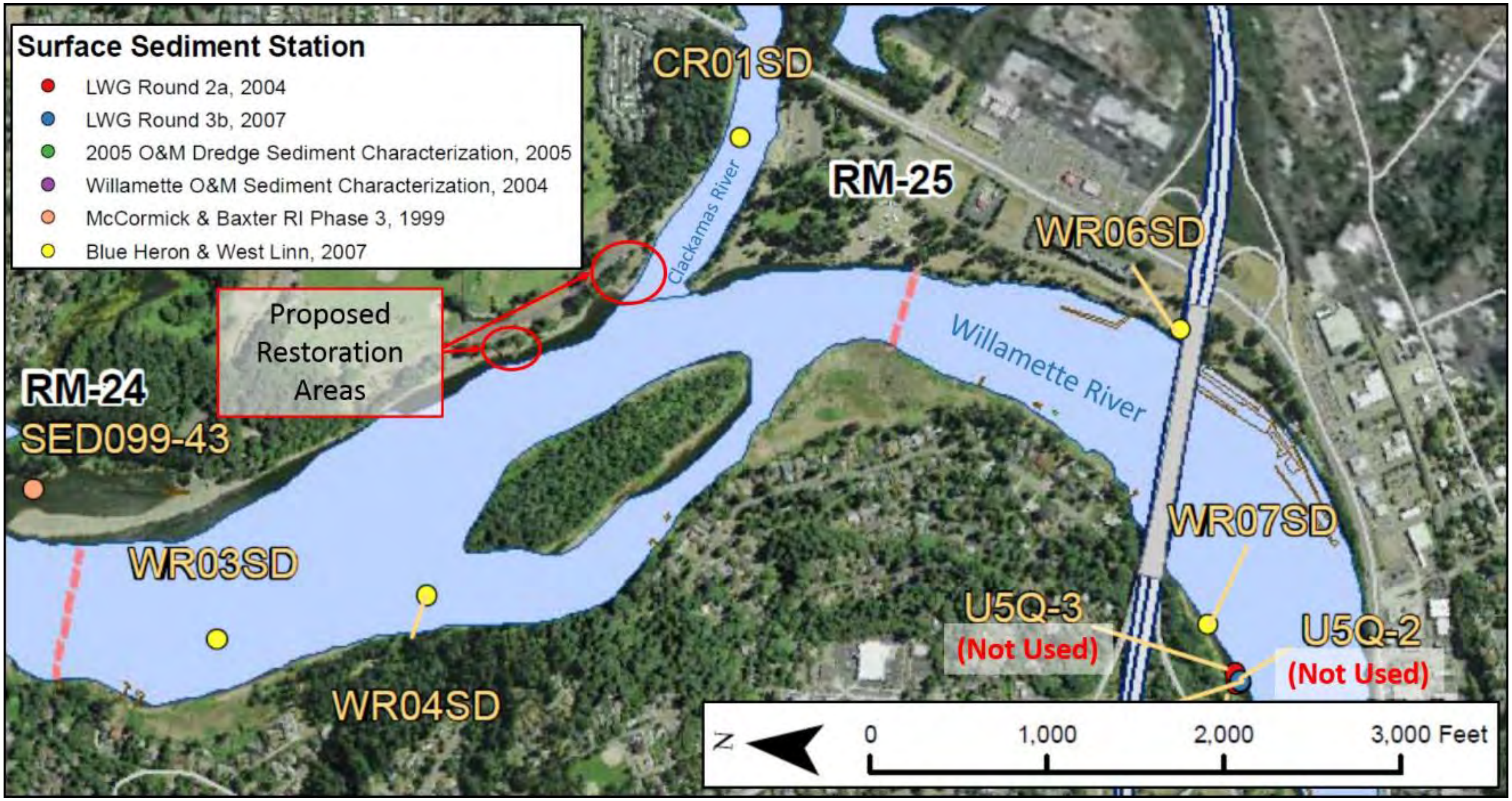


ANCHOR QEA

Figure 6
State Environmental Site Cleanup Inventory (ESCI) Database Search Results
Dahl Beach Mitigation Site Level 1 Sediment Evaluation
Port of Portland Terminal 4 Mitigation Project

ANCHOR QEA

Figure 7
State Water Quality Source Information System (WQSIS) Database Search Results
Dahl Beach Mitigation Site Level 1 Sediment Evaluation
Port of Portland Terminal 4 Mitigation Project



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ANCHOR QEA

Figure 8
Existing Surface Sediment Sampling Locations
Dahl Beach Mitigation Site Level 1 Sediment Evaluation
Port of Portland Terminal 4 Mitigation Project

APPENDIX D
REFERENCE SITE MEMORANDUM

Date: October 14, 2015

To: Kelly Madalinski, Port of Portland

From: Cascade Environmental Group, LLC

Re: Dahl Beach Reference Sites

This memo presents four sites selected to serve as restoration design reference for the Dahl Beach Mitigation Project. Sites were selected based on their proximal location to the Mitigation Project site and shared hydrogeomorphic and topographical characteristics. Slope, elevation, substrate type, and vegetation community were assessed at each site; the information was used to inform planting plan species selection and installation elevations on the Project site, as well as weed management planning. Reference site vegetation communities vary in composition and elevation ranges, but several trends were observed and contributed to the development of planting recommendations for the Project site. The observations and related recommendations are presented at the end of this memo. The reference sites are described in detail in the next section, including photographs, and summarized in a table following the descriptions. The location of the reference sites relative to the Project site is depicted in the attached map.

Reference Site Descriptions

1. Maddax Woods – Burnside Park

The Maddax Woods – Burnside Park reference site is located along the Willamette River, on the opposite bank and just downstream of the Mitigation Project. The site is owned and managed by the City of West Linn as a public park. It is characterized by a moderately-to-steeply sloped (10-30%) sand-cobble beach grading to a short vertical bank and a forested river terrace bordered by a steep upland escarpment. Vegetation occurring on the beach (below 14 ft. NAVD88) is very sparse and dominated by weedy, herbaceous species such as prostrate knotweed (*Polygonum aviculare*), tansy ragwort (*Senecio jacobea*), and bird's foot trefoil (*Lotus corniculatus*). Vegetation occurring on the terrace (above 14 ft. NAVD88) consists of black cottonwood (*Populus balsamifera*) forest with emerging Oregon ash (*Fraxinus latifolia*) and an understory dominated by non-native species including Himalayan blackberry (*Rubus armeniacus*), English ivy (*Hedera helix*), wild Clematis (*Clematis vitalba*), and reed canarygrass (*Phalaris arundinacea*); redosier dogwood (*Cornus sericea*) occurs occasionally. Above the floodplain elevation (48 ft. NAVD88), vegetation consists of Douglas fir (*Pseudotsuga menziesii*)/bigleaf maple (*Acer macrophyllum*) forest with an understory dominated by snowberry (*Symphoricarpos albus*) and English ivy.

Photo 1. Maddax Woods–Burnside Park: looking upstream

Photo 2. Maddax Woods–Burnside Park: looking downstream

2. Lonesome Bottom

This reference site consists of accreted land on an inside bend of the Willamette River, just upstream of the Mitigation Project; ownership is unknown. It features a gently-to-moderately sloped (5-15%) sand-gravel-cobble beach grading to a broad, flat terrace. Vegetation consists of three distinct communities forming bands stratified by elevation. The lowest elevations (10-11 ft. NAVD88) are colonized by Indian hemp (*Apocynum cannabinum*) along with prostrate knotweed and bird's foot trefoil. At elevations of 11-15 ft. NAVD88, a sandbar willow (*Salix fluviatilis*) dominated community occurs and includes pennyroyal (*Mentha pelugium*), St. John's wort (*Hypericum perforatum*), smartweed (*Persicaria* spp.) and beggars tick (*Bidens cernua*). Above 15 ft. NAVD88, young black cottonwood and Oregon ash have established along with St. John's wort.

Photo 3. Lonesome Bottom: looking downstream

Photo 4. Lonesome Bottom: looking upstream

3. **Goat Island**
Goat Island is a large, undeveloped, low-lying island located in the Willamette River, directly across from the Mitigation Project; it is owned and managed by the Oregon Department of State Lands as a public park. The site consists of a gently-to-moderately sloped cobble-gravel beach (5-20%) grading to a level forested floodplain. Similar to Lonesome Bottom, Goat Island features vegetation communities that are distinctly stratified by elevation. At 10-11 ft. NAVD88, the community is composed of Indian hemp along with *Aster* spp., prostrate knotweed, smartweed, and bird's foot trefoil along with sandbar willow shoots. The sandbar willow community colonizes the elevations between 11-14 ft. NAVD88 and includes an understory of beggar's tick, St. John's wort, tansy ragwort, common plantain (*Plantago lanceolata*), and common evening-primrose (*Oenothera biennis*). Above 14 ft. NAVD88, black cottonwood/Oregon ash forest occurs and includes an understory of Himalayan blackberry, English ivy, and, occasionally, redosier dogwood and Pacific ninebark (*Physocarpus capitata*). Scotch broom (*Cytisus scoparius*) also occurs within this elevation range. At elevations above 30 ft. NAVD88, small groves of bigleaf maple are found along with some snowberry.

Photo 5. Goat Island: looking downstream

Photo 6. Goat Island: looking upstream

4. **Meldrum Bar Park Beach**
This site consists of a stretch of beach upstream of the Mitigation Project in the adjacent Meldrum Bar Park, owned and managed by the City of Gladstone. It is characterized by a moderately to very steeply sloped (15-50%) cobble-gravel beach grading to a high vertical bank and broad river terrace; a distinctive scour line is present at around 13.5 ft. NAVD88. Above the scour line, the beach is sparsely vegetated by weedy species to 20 ft. NAVD88 including Scotch broom (occurring around the 20 ft. mark), prostrate knotweed, evening primrose, and mullein (*Verbascum thapsus*). Above 20 ft. NAVD88, black cottonwood/bigleaf maple forest is present which features occasional Oregon ash, Oregon oak (*Quercus garryana*), and honey locust (*Gleditsia triacanthos*) trees and a non-native dominated understory of Himalayan blackberry, English ivy and false brome (*Brachypodium sylvaticum*); redosier dogwood and hazelnut (*Corylus cornuta*) also occur occasionally.

Photo 7. Meldrum Bar Park Beach: looking upstream

Photo 8. Meldrum Bar Park Beach: looking downstream

Reference Site Summary Table

Reference Site	ACM Slope Range (%)	Vegetation Community	Elevation Range (ft. NAVD88)
Maddax Woods - Burnside Park	10-30	weedy forbs	<14
		Black cottonwood- Oregon ash/Himalayan blackberry/English ivy	14-48
		Doug fir-bigleaf maple	>48
Lonesome Bottom	5-15	Indian hemp-weedy forbs	10-11
		Sandbar willow/ smartweed	11-15
		Black cottonwood- Oregon ash/St John's wort	15-25
Goat Island	5-20	Indian hemp-weedy forbs	10-11
		Sandbar willow/weedy forbs	11-15
		Black cottonwood- Oregon ash/Himalayan blackberry/English ivy	15-30
		Bigleaf maple/ snowberry	>30
Meldrum Bar Park Beach	15-50	Scotch broom-weedy forbs	14-20
		Black cottonwood/ bigleaf maple-Himalayan blackberry-English ivy	>20

Key Observations and Applicability to Dahl Beach Mitigation Project Plant Selection

1. **Observation**: Black cottonwood is the dominant tree species in forested areas on the reference sites, extending from near the scour line to the upper limits of riparian areas. Black cottonwood is known as an aggressive colonizer and will likely spread readily once established.

   Recommendation: Plant black cottonwood at the Project site in elevation ranges where there are no existing dominant tree species and allow to spread to other elevations; allow additional native species to establish in other elevation ranges to promote site diversity long term.
2. **Observation:** Vegetation establishment on the reference sites appears to be related to a combination of beach slope and assumed exposure to higher flow velocities: sites with flatter slopes featured intact sandbar willow communities and vegetation present at lower elevations than sites with steeper slopes.

   Recommendation: The Bulkhead Removal Area appears too steep to support favorable conditions for sandbar willow based on the proposed finished gradient and the absence of sandbar willow at the Meldrum Bar Park Reference site (adjacent to the Bulkhead Removal Area). Install sandbar willow only at Parking Lot Area where proposed finished gradients are more gradual and employ adaptive management to inform maintenance of plantings.
3. **Observation:** Himalayan blackberry, English ivy, wild Clematis, and Scotch broom are prevalent on all reference sites and will likely present ongoing management challenges. Non-persistent ruderal forbs are also widespread in areas subject to regular scour.

   Recommendation: Develop specific strategies for control of Himalayan blackberry and English Ivy; control of non-persistent ruderal forbs, however, will provide little benefit.

Date: 10/16/2015

Scale: 1 inch = 500 feet

Data Source: ESRI, 2015; Metro, 2012.

Reference Site Locations

CASCADE ENVIRONMENTAL GROUP

0 500 1,000 Feet

Dahl Beach Park Mitgation Site

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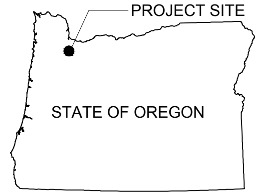
APPENDIX E
30% DESIGN PLANS

DAHL BEACH MITIGATION PROJECT

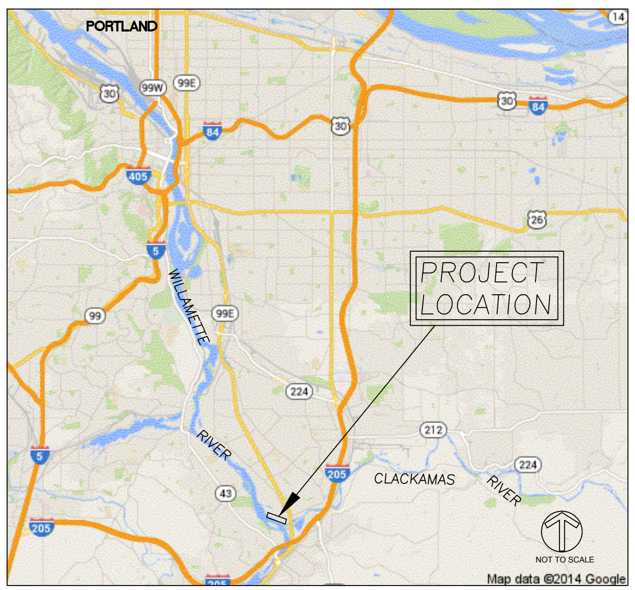
CITY OF GLADSTONE, OREGON

30% DESIGN DRAWINGS

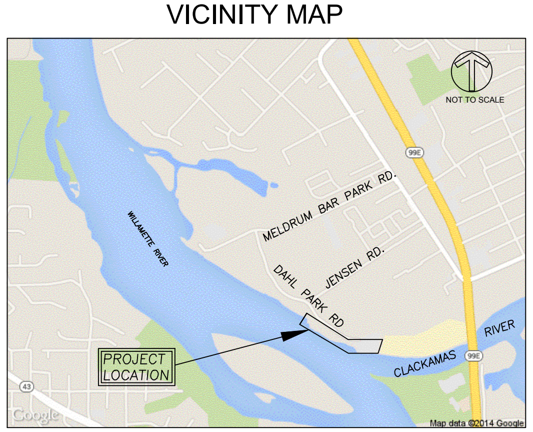
FEBRUARY 2016



LOCATION MAP



VICINITY MAP



SITE MAP

PROJECT LOCATION:

DAHL BEACH MITIGATION PROJECT IS LOCATED IN MELDRUM BAR PARK AND DAHL BEACH PARK, ON DAHL PARK ROAD, IN CLACKAMAS COUNTY, OREGON. LATITUDE = 45.374027°, LONGITUDE = -122.609661°

PROJECT DESCRIPTION:

THIS PROJECT IS INTENDED TO CREATE AND IMPROVE FISH AND WILDLIFE HABITAT. IT INVOLVES TWO CONSTRUCTION AREAS, ONE AT WHICH A SHEETPILE BULKHEAD STRUCTURE WILL BE REMOVED AND THE SURROUNDING SLOPE REGRADED, AND ONE AT WHICH PART OF A PARKING LOT WILL BE REMOVED AND THE SURROUNDING SLOPE REGRADED. WOOD STRUCTURES WILL BE PLACED AT THE PARKING LOT PARTIAL REMOVAL AREA, REVEGETATION WITH NATIVE SPECIES WILL OCCUR AT BOTH AREAS, AND STORMWATER TREATMENT WILL BE CONSTRUCTED ALONG THE EXISTING PARKING LOTS THAT DRAIN INTO BOTH AREAS.

SHEET INDEX

PROJECT TEAM

LANDOWNER
CITY OF GLADSTONE
CONTACT: JIM WHYNOT
525 PORTLAND AVE.
GLADSTONE, OR 97027
PH: 503-656-7957

PROJECT PROPONENT
PORT OF PORTLAND
CONTACT: KELLY MADALINSKI
7200 NE AIRPORT WAY
PORTLAND, OR 97208
PH: 503-415-6000

ENVIRONMENTAL CONSULTANT / CIVIL ENGINEER
CASCADE ENVIRONMENTAL GROUP
CONTACT: BRENT HADDAWAY
222 NW DAVIS ST., SUITE 317
PORTLAND, OR 97209
PH: 503-894-8585

SURVEYOR (SITE)
WATERWAYS CONSULTING, INC.
CONTACT: JOHN DVORSKY
1020 SW TAYLOR, SUITE 380
PORTLAND, OR 97205
PH: 503-227-5979

SURVEYOR (BATHYMETRY)
HYDRO SOLMAR
6635 N. BALTIMORE ST., SUITE 241
PORTLAND, OR 97203
PH: 206-200-7941

GEOTECHNICAL ENGINEER
HARTCROWSER
CONTACT: JIM ALDERS
300 W. 15TH STREET, SUITE 302
VANCOUVER, WA 98660
PH: 206-826-4476

PRELIMINARY: NOT FOR CONSTRUCTION

REVISIONS

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DAHL BEACH MITIGATION PROJECT
30% DESIGN DRAWINGS

COVER

February 2016

DRAWN BY: AMM
DESIGNED BY: RPL
CHECKED BY: BH

SHEET NUMBER
G1 OF 11

PROJECT NO.
00089

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

GENERAL NOTES

1. THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITIES OR STRUCTURES SHOWN ON THESE PLANS WAS OBTAINED BY A SEARCH OF AVAILABLE RECORDS AND MAY BE AN INCOMPLETE REPRESENTATION. THE CONTRACTOR SHALL PROTECT ALL UTILITIES WHETHER OR NOT THEY ARE SHOWN ON THESE PLANS. THE CONTRACTOR ASSUMES ALL LIABILITY AND RESPONSIBILITY FOR ALL EXISTING UTILITIES.
2. THE CONTRACTOR AGREES TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR THE JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS; AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY, AND HOLD THE OWNER AND THE OWNER'S REPRESENTATIVE HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPT FOR LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF THE OWNER OR THE OWNER'S REPRESENTATIVE.
3. THE CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS, DIMENSIONS, AND QUANTITIES AND SHALL REPORT ALL DISCREPANCIES TO THE OWNER'S REPRESENTATIVE PRIOR TO THE COMMENCEMENT OF WORK.
4. CONTRACTORS COMPLETING ANY PORTION OF THIS WORK ARE RESPONSIBLE FOR MEETING ALL PERMIT CONDITIONS, INCLUDING BUT NOT LIMITED TO THOSE FOUND IN LOCAL, STATE, AND FEDERAL PERMITS.
5. CONTRACTOR TO SUBMIT TRAFFIC CONTROL PLAN TO THE CITY AND ENGINEER FOR APPROVAL A MINIMUM OF 4 WEEKS BEFORE COMMENCING WORK.
6. CONTRACTOR IS RESPONSIBLE FOR COORDINATING AND SEQUENCING ALL ASPECTS OF THE WORK.
7. PROTECT EXISTING FEATURES AND INFRASTRUCTURE EXCEPT AS NOTED ON PLANS.
8. EXISTING CONTOURS SHOWN ON PLANS COMBINE LIDAR AND SURVEY DATA; FIELD VERIFY.
9. CONTOUR INTERVAL IS ONE FOOT. ELEVATIONS AND DISTANCES ARE SHOWN IN DECIMAL FEET.

GRADING NOTES:

1. EXISTING AND PROPOSED CONTOURS ARE SHOWN AT 1' INTERVALS.
2. PLACE AND COMPACT FILL ACCORDING TO RECOMMENDATIONS FOUND IN GEOTECH REPORT.
3. AVOID EXISTING TREES TO THE EXTENT POSSIBLE DURING GRADING ACTIVITIES, EXCEPT AS NOTED ON PLANS. MINOR ADJUSTMENTS TO GRADING PLAN MAY BE NECESSARY.
4. IN THE BULKHEAD AREA, TILL 3" OF COMPOST INTO TOP 6" OF SOIL FOR ALL EARTHWORK AREAS ABOVE EL. 18, AS SHOWN ON PLANS, DURING FINISH GRADING. AFTER FINISH GRADING IS COMPLETE, PLACE 3" OF COMPOST ON TOP OF FINISH GRADE THROUGHOUT BULKHEAD EARTHWORK AREAS ABOVE OHW (EL. 25.4), AS SHOWN ON PLANS. HYDROSEED AREAS WHERE COMPOST IS PLACED ABOVE OHW (EL. 25.4). SEE SPECIFICATIONS.

DEMOLITION NOTES:

1. BLACKBERRIES. EXISTING BLACKBERRY PLANTS WILL BE REMOVED THROUGH A COMBINATION OF GRUBBING AND EXCAVATION. REGROWTH WILL BE TREATED BY CUTTING BACK CANES AND SPOT TREATING THE CUT STUMPS WITH HERBICIDE. HERBICIDE WILL BE APPLIED WITHIN 20 MINUTES OF CUTTING TO ENSURE EFFECTIVENESS. SEE HERBICIDE NOTE BELOW.
2. INVASIVE NON-NATIVE VEGETATION. ALL OTHER INVASIVE NON-NATIVE VEGETATION WILL BE REMOVED IN ACCORDANCE WITH STATE AND LOCAL GUIDELINES AND ACCEPTED BEST PRACTICES FOR INVASIVE SPECIES REMOVAL.
3. HERBICIDE. ANY HERBICIDE USE MUST STRICTLY ADHERE AT ALL TIMES TO THE HERBICIDE USE REQUIREMENTS IN THE SLOPES V PROGRAMMATIC PERMIT.
4. TREES AND DOWNED WOOD. ALL EXISTING TREES AND DOWNED WOOD SHALL REMAIN IN PLACE UNLESS REQUIRED TO BE REMOVED WITH GRADING OR OTHERWISE NOTED ON PLANS. EXISTING DOWNED AND CUT WOOD LYING IN THE BULKHEAD PARKING LOT SHALL BE REMOVED AND DISPOSED OF BY THE CONTRACTOR.

LOCATES (48 HOURS NOTICE REQUIRED PRIOR TO EXCAVATION)

NOTICE TO EXCAVATORS:

ATTENTION: OREGON LAW REQUIRES YOU TO FOLLOW RULES ADOPTED BY THE OREGON UTILITY NOTIFICATION CENTER. THOSE RULES ARE SET FORTH IN OAR 952-001-0010 THROUGH OAR 952-001-0090. YOU MAY OBTAIN COPIES OF THE RULES BY CALLING THE CENTER. (NOTE: THE TELEPHONE NUMBER FOR THE OREGON UTILITY NOTIFICATION CENTER IS 503-232-1987).

POTENTIAL UNDERGROUND FACILITY OWNERS

Dig Safely.

Call the Oregon One-Call Center

DIAL 811 or 1-800-332-2344

NORTHWEST NATURAL GAS LINE

NOTIFY NORTHWEST NATURAL BEFORE ANY GRADING OR DIGGING ACTIVITIES OCCUR WITHIN 10 FEET OF THE NORTHWEST NATURAL GAS LINE. A NORTHWEST NATURAL REPRESENTATIVE MUST BE ON SITE TO OBSERVE ANY GRADING OR DIGGING THAT OCCURS WITHIN THE EASEMENT.

PRELIMINARY: NOT FOR CONSTRUCTION

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS

0 1"

REVISIONS

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www.cascadeenv.com

DAHL BEACH MITIGATION PROJECT
30% DESIGN DRAWINGS

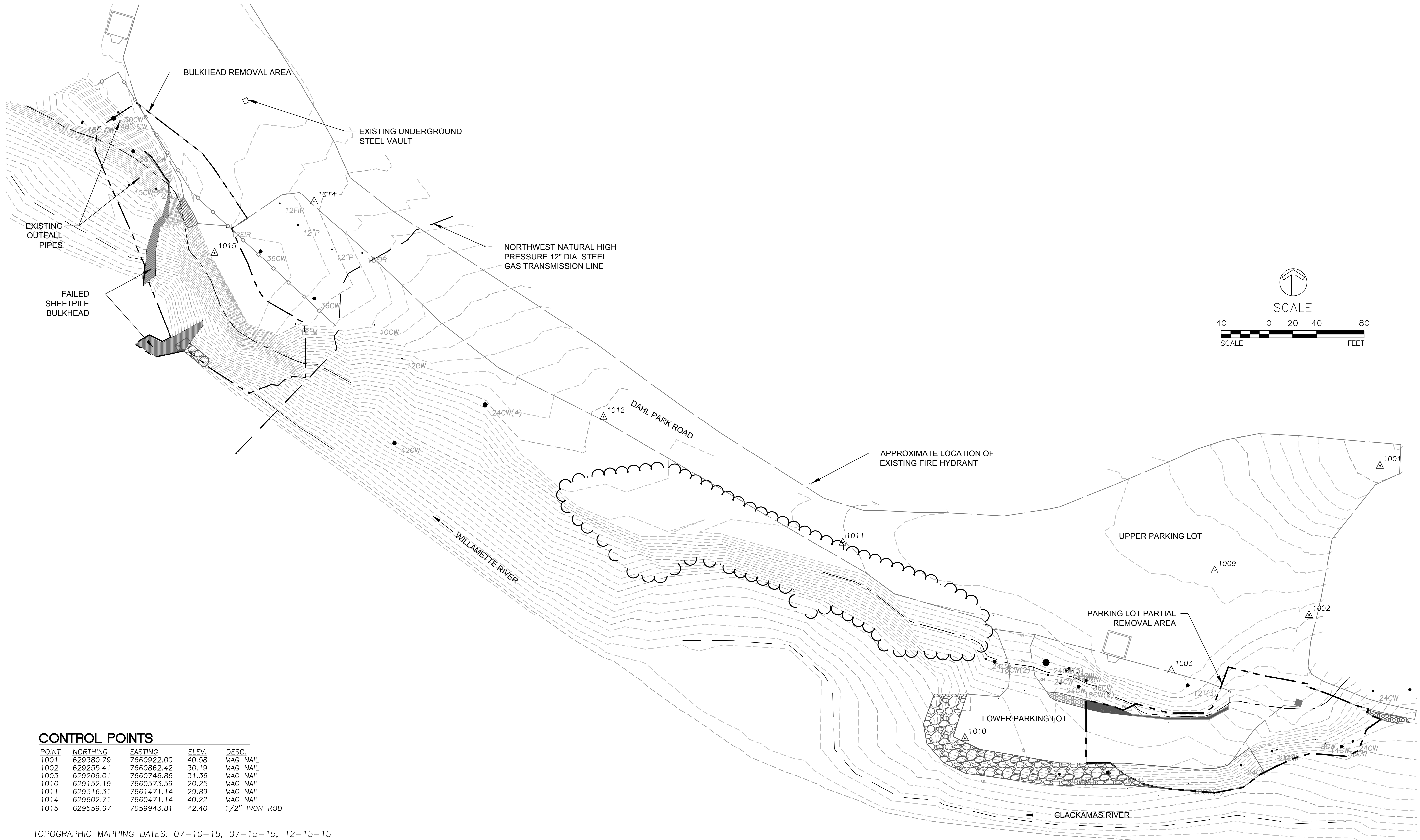
GENERAL NOTES AND INFORMATION

February 2016

DRAWN BY: AMM
DESIGNED BY: RPL
CHECKED BY: BH

SHEET NUMBER
G2 OF 11

PROJECT NO.
00089



CONTROL POINTS

POINT	NORTHING	EASTING	ELEV.	DESC.
1001	629380.79	7660922.00	40.58	MAG NAIL
1002	629255.41	7660862.42	30.19	MAG NAIL
1003	629209.01	7660746.86	31.36	MAG NAIL
1010	629152.19	7660573.59	20.25	MAG NAIL
1011	629316.31	7661471.14	29.89	MAG NAIL
1014	629602.71	7660471.14	40.22	MAG NAIL
1015	629559.67	7659943.81	42.40	1/2" IRON ROD

TOPOGRAPHIC MAPPING DATES: 07-10-15, 07-15-15, 12-15-15
TOPOGRAPHIC MAPPING COMPLETED BY: WATERWAYS CONSULTING, INC.
BATHYMETRIC DATA COLLECTED BY SOLMAR HYDRO
CONTROL SET WITH LEICA VIVA RTK USING OREGON REAL TIME GNSS NETWORK (ORGN)
NAD83, OREGON STATE PLANE, NORTH ZONE, INT'L FEET
VERTICAL DATUM: NAVD88

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DAHL BEACH MITIGATION PROJECT
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EXISTING CONDITIONS

February 2016
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G3 OF 11
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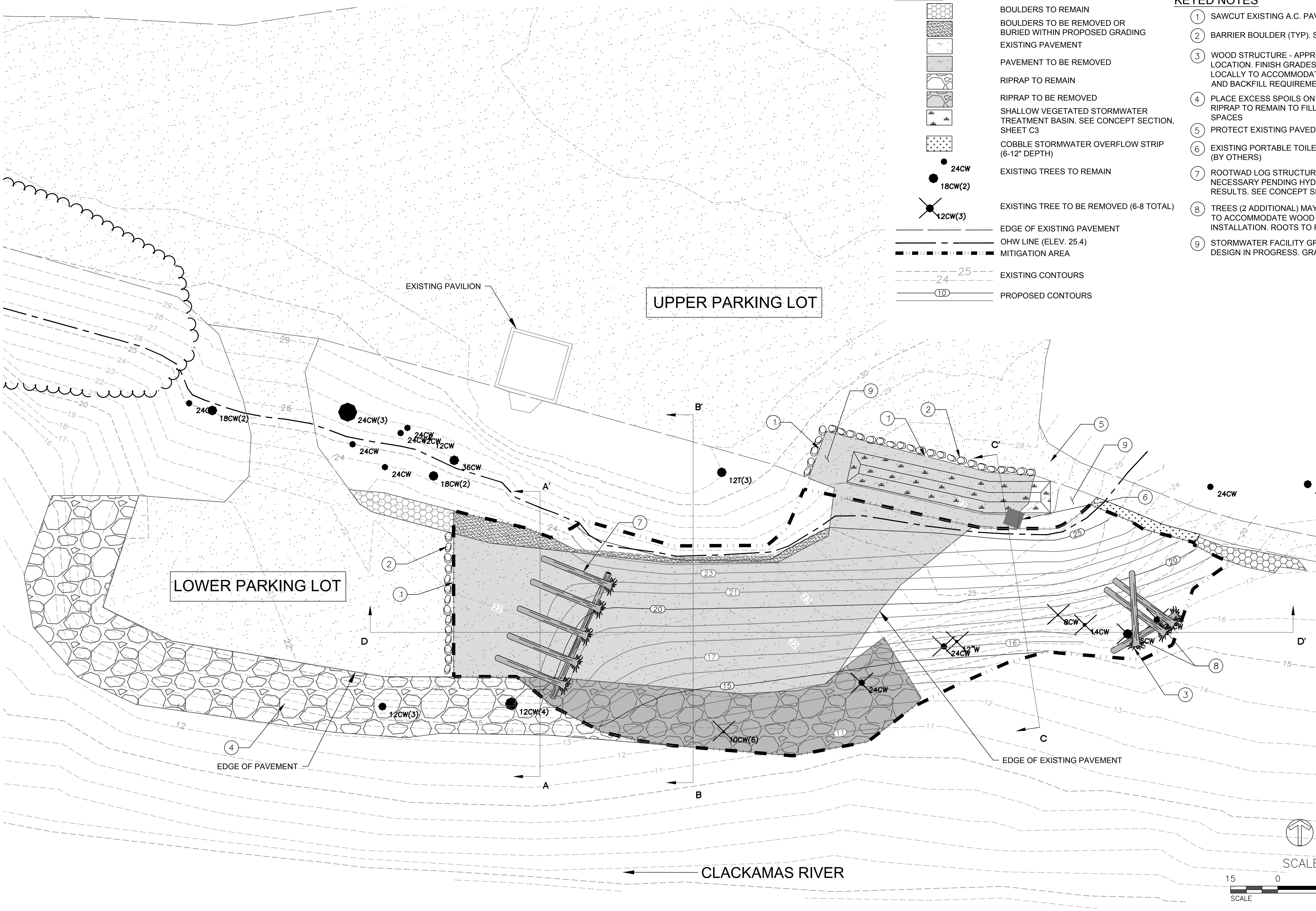
00089



LEGEND

- BOULDERS TO REMAIN
- BOULDERS TO BE REMOVED OR BURIED WITHIN PROPOSED GRADING
- EXISTING PAVEMENT
- PAVEMENT TO BE REMOVED
- RIPRAP TO REMAIN
- RIPRAP TO BE REMOVED
- SHALLOW VEGETATED STORMWATER TREATMENT BASIN. SEE CONCEPT SECTION, SHEET C3
- COBBLE STORMWATER OVERFLOW STRIP (6-12" DEPTH)
- 24CW / 18CW(2) — EXISTING TREES TO REMAIN
- 12CW(3) — EXISTING TREE TO BE REMOVED (6-8 TOTAL)
- EDGE OF EXISTING PAVEMENT
- OHW LINE (ELEV. 25.4)
- MITIGATION AREA
- 24 / 25 — EXISTING CONTOURS
- 10 — PROPOSED CONTOURS

KEYED NOTES

1. SAWCUT EXISTING A.C. PAVEMENT
2. BARRIER BOULDER (TYP). SEE NOTES SHEET P1
3. WOOD STRUCTURE - APPROX. SCALE AND LOCATION. FINISH GRADES WILL BE ADJUSTED LOCALLY TO ACCOMMODATE MINIMUM BALLAST AND BACKFILL REQUIREMENTS
4. PLACE EXCESS SPOILS ON FACE OF EXISTING RIPRAP TO REMAIN TO FILL INTERSTITIAL SPACES
5. PROTECT EXISTING PAVED PATH
6. EXISTING PORTABLE TOILET TO BE RELOCATED (BY OTHERS)
7. ROOTWAD LOG STRUCTURE ASSUMED NECESSARY PENDING HYDRAULIC MODELING RESULTS. SEE CONCEPT SECTION, SHEET C4
8. TREES (2 ADDITIONAL) MAY NEED TO BE FELLED TO ACCOMMODATE WOOD STRUCTURE INSTALLATION. ROOTS TO REMAIN INTACT
9. STORMWATER FACILITY GRADING AND OVERFLOW DESIGN IN PROGRESS. GRADE TO DRAIN.

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DAHL BEACH MITIGATION PROJECT
30% DESIGN DRAWINGS
DEMO AND GRADING PLAN
PARKING LOT PARTIAL REMOVAL

February 2016

DRAWN BY:	AMM
DESIGNED BY:	RPL
CHECKED BY:	BH

SHEET NUMBER
C1 OF 11
PROJECT NO.
00089

PLOT DATE: 2/23/2016 Z:\Jobfiles\089 – Dahl Beach Shallow Water Mitigation\Design\CAD\Sheet Sets\Dahl Beach design.dwg

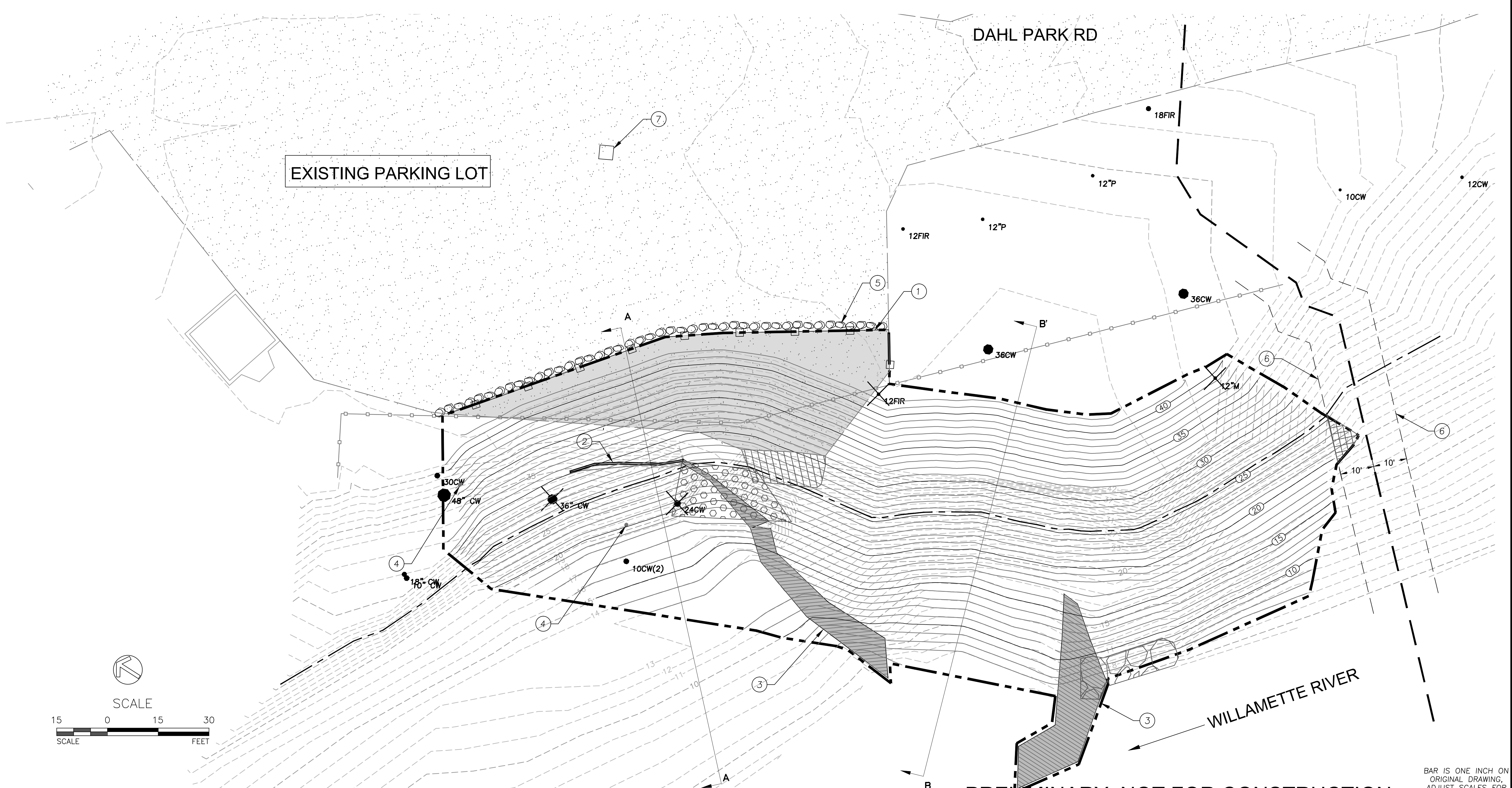
LEGEND

- EXISTING RIPRAP AND CONCRETE DEBRIS TO BE REMOVED
- REMOVE EXISTING PIECES OF BROKEN AC PAVEMENT WHERE ENCOUNTERED
- EXISTING PAVEMENT
- PAVEMENT TO BE REMOVED. REMOVE BUILDING FOUNDATIONS, CONCRETE, AND RELATED MATERIALS WHERE ENCOUNTERED
- NW NATURAL GRADING MONITORING ZONE
- AREA OF STRUCTURAL FILL. STRUCTURAL FILL TO BE COMPOSED OF NATIVE MATERIAL OBTAINED FROM SITE GRADING

- LIMIT OF WORK
- EDGE OF EXISTING PAVEMENT
- NW NATURAL 12" DIA. STEEL HIGH PRESSURE GAS TRANSMISSION LINE
- EXISTING CONTOURS (25)
- PROPOSED CONTOURS (10)
- OHW LINE (ELEV. 25.4)
- EXISTING FENCE
- NEW FENCE
- EXISTING TREES INTENDED TO REMAIN (24CW, 18CW(2))
- EXISTING TREE TO BE REMOVED (3 TOTAL) (12CW(3))

KEYED NOTES

1. SAWCUT EXISTING A.C. PAVEMENT
2. SHEET PILE SEGMENT INSTALLED PARALLEL TO BANK SHALL BE CUT OFF BELOW FINISH GRADE AND BURIED WITH NATIVE MATERIAL. SEE SECTION A-A'
3. REMOVE EXISTING SHEET PILE BULKHEAD AND RELATED CABLE, HARDWARE, AND APPURTENANCES WHERE ENCOUNTERED. SHEETPILE SEGMENTS THAT ARE UNABLE TO BE REMOVED WITHOUT EXTRAORDINARY EFFORT WILL BE CUT 2-3 FEET BELOW GRADE AND BURIED WITH NATIVE MATERIAL
4. PROTECT EXISTING PIPE TO REMAIN
5. BOULDER BARRIER; SEE NOTES SHEET P1
6. CONTRACTOR TO FLAG 10' CLEAR ZONE ON EITHER SIDE OF NW NATURAL GAS LINE
7. EXISTING UNDERGROUND STEEL VAULT



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DAHL BEACH MITIGATION PROJECT
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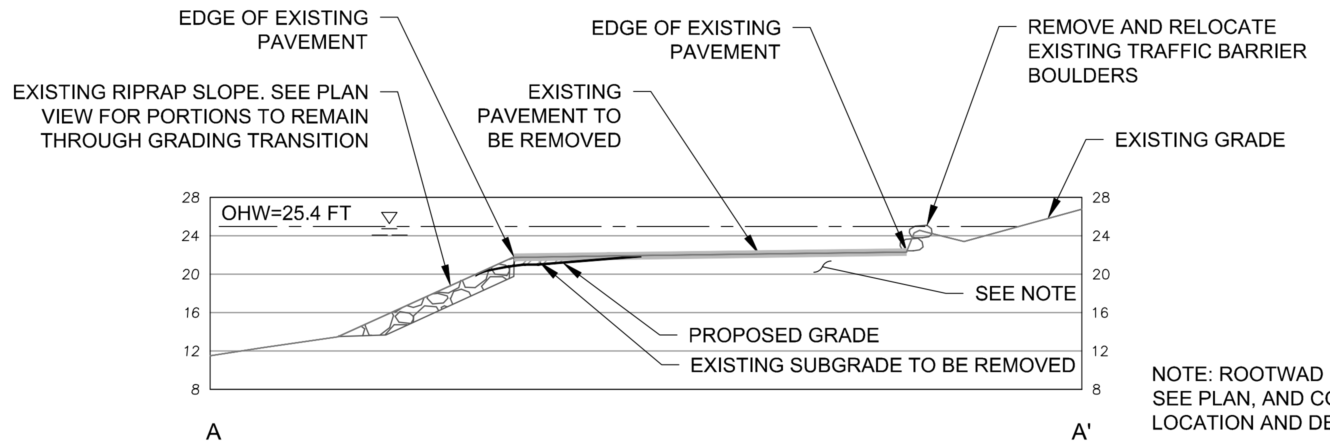
DEMO AND GRADING PLAN
BULKHEAD REMOVAL AREA

February 2016
DRAWN BY: AMM
DESIGNED BY: RPL/AMM
CHECKED BY: BH
SHEET NUMBER
C2 OF 11
PROJECT NO.
00089

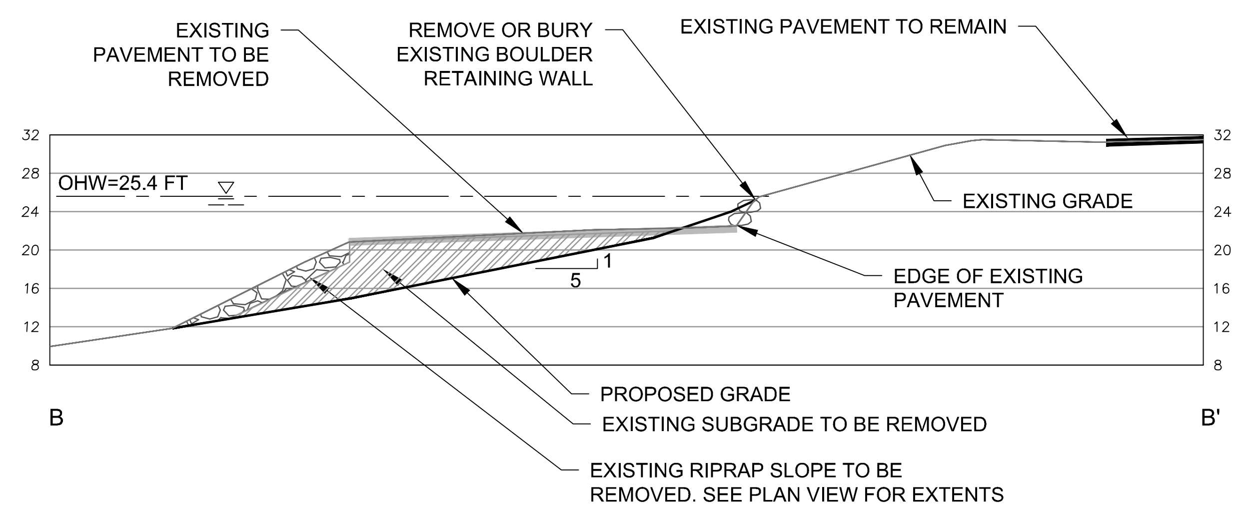
PLOT DATE: 2/23/2016 Z:\Jobfiles\089 – Dahl Beach Shallow Water Mitigation\Design\CAD\Sheet Sets\Dahl Beach design.dwg



NOTE: ROOTWAD STRUCTURE NOT SHOWN FOR CLARITY. SEE PLAN, AND CONCEPT SECTION SHEET C4, FOR LOCATION AND DETAIL

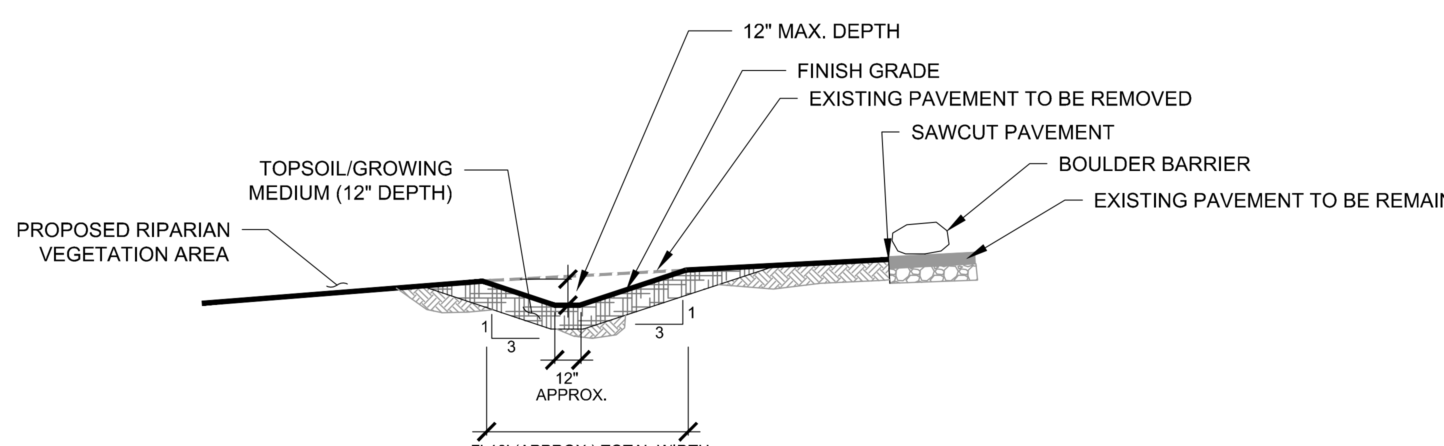
SECTION A-A'

SCALE: VERT. 1"=20' HORIZ. 1"=20'



SECTION B-B'

SCALE: VERT. 1"=20' HORIZ. 1"=20'



VEGETATED STORMWATER TREATMENT BASIN

N.T.S.

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DAHL BEACH MITIGATION PROJECT
30% DESIGN DRAWINGS

SECTIONS
PARKING LOT PARTIAL REMOVAL

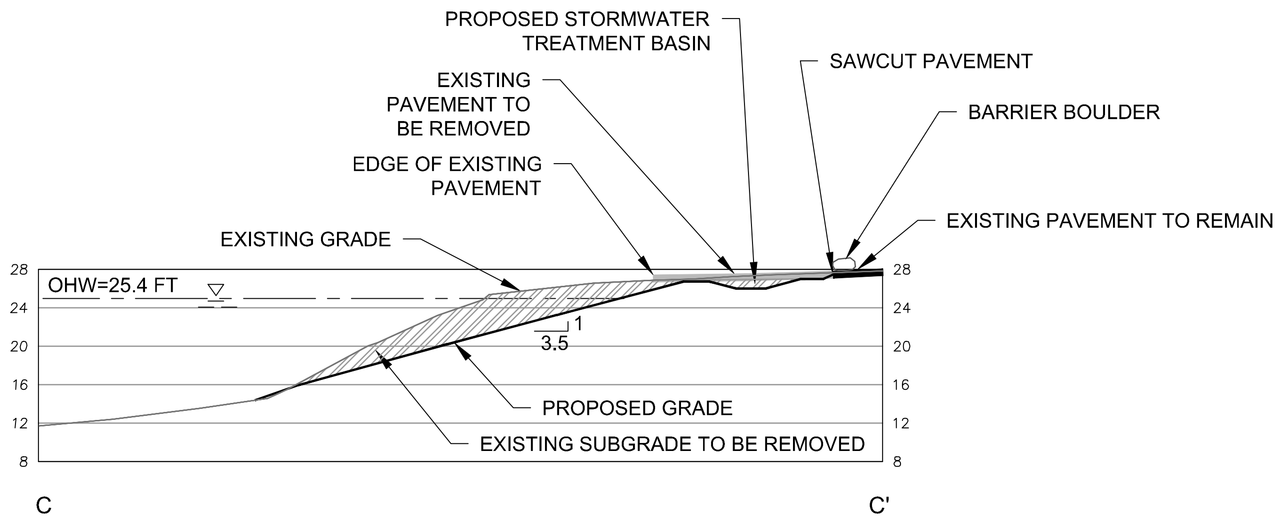
February 2016

DRAWN BY: AMM
DESIGNED BY: RPL
CHECKED BY: BH

SHEET NUMBER
C3 OF 11

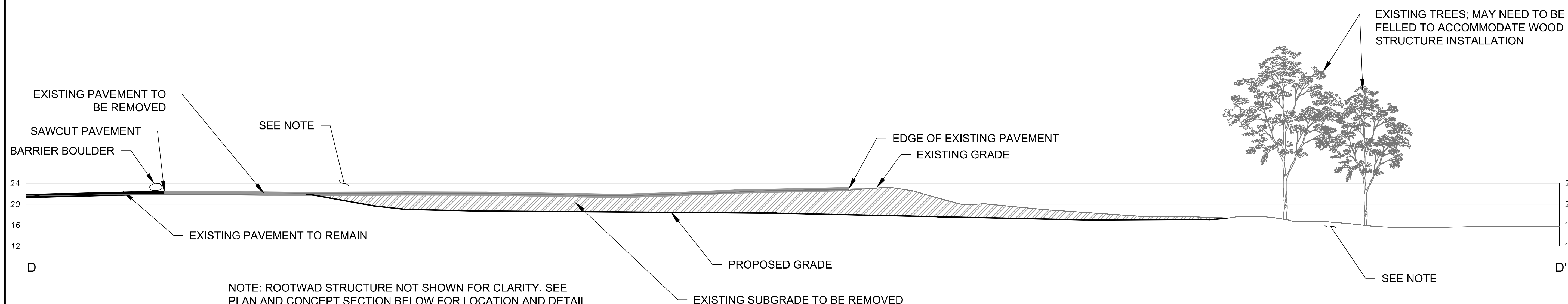
PROJECT NO.
00089

PLOT DATE: 2/23/2016 Z:\Jobfiles\089 - Dahl Beach Shallow Water Mitigation\Design\CAD\Sheet Sets\Dahl Beach design.dwg



SECTION C-C'

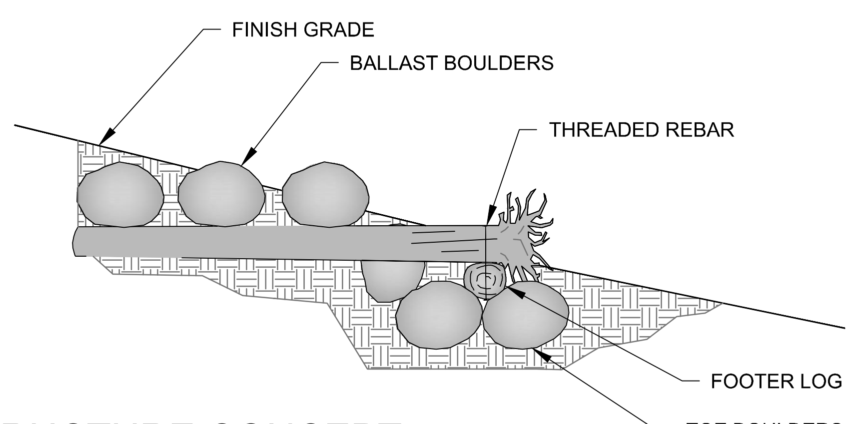
SCALE: VERT. 1"=20' HORIZ. 1"=20'



NOTE: ROOTWAD STRUCTURE NOT SHOWN FOR CLARITY. SEE PLAN AND CONCEPT SECTION BELOW FOR LOCATION AND DETAIL

SECTION D-D'

SCALE: VERT. 1"=20' HORIZ. 1"=20'



ROOTWAD LOG STRUCTURE CONCEPT

NOT TO SCALE

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DAHL BEACH MITIGATION PROJECT
30% DESIGN DRAWINGS

SECTIONS
PARKING LOT PARTIAL REMOVAL

February 2016
DRAWN BY: AMM
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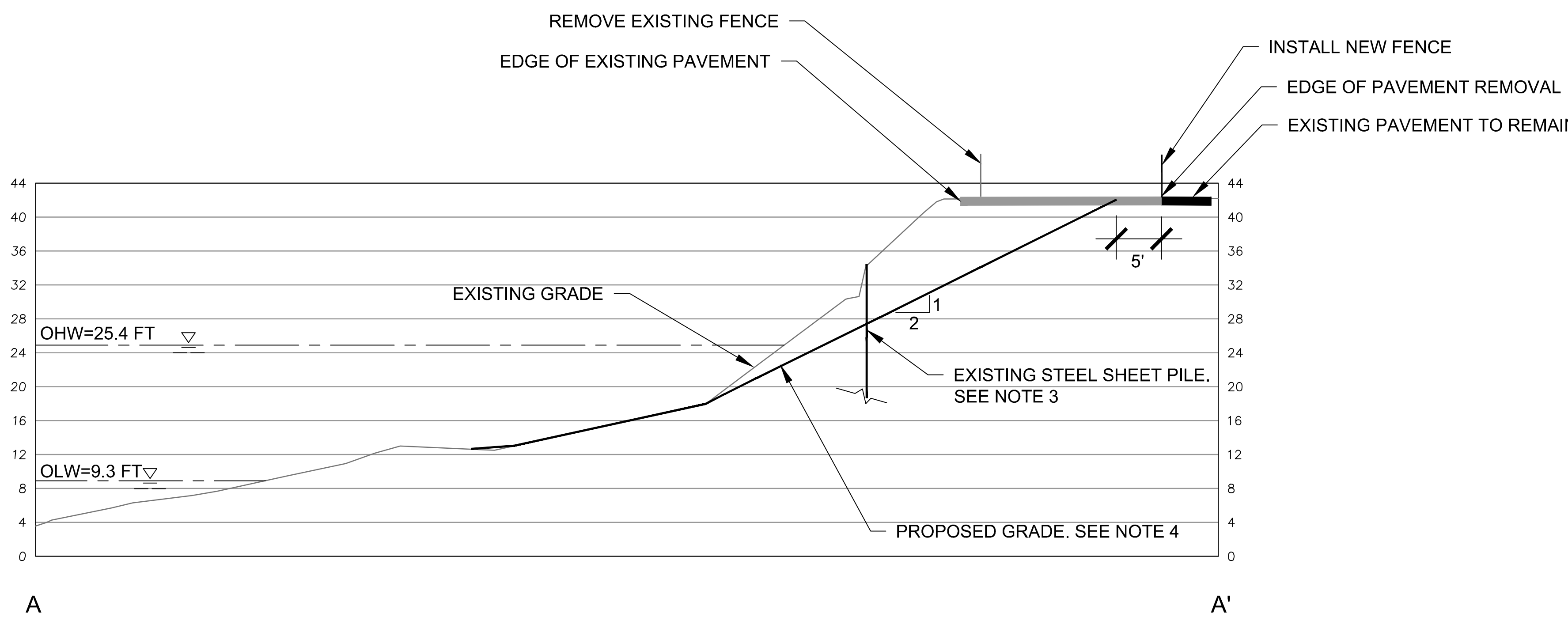
SHEET NUMBER
C4 OF 11

PROJECT NO.
00089

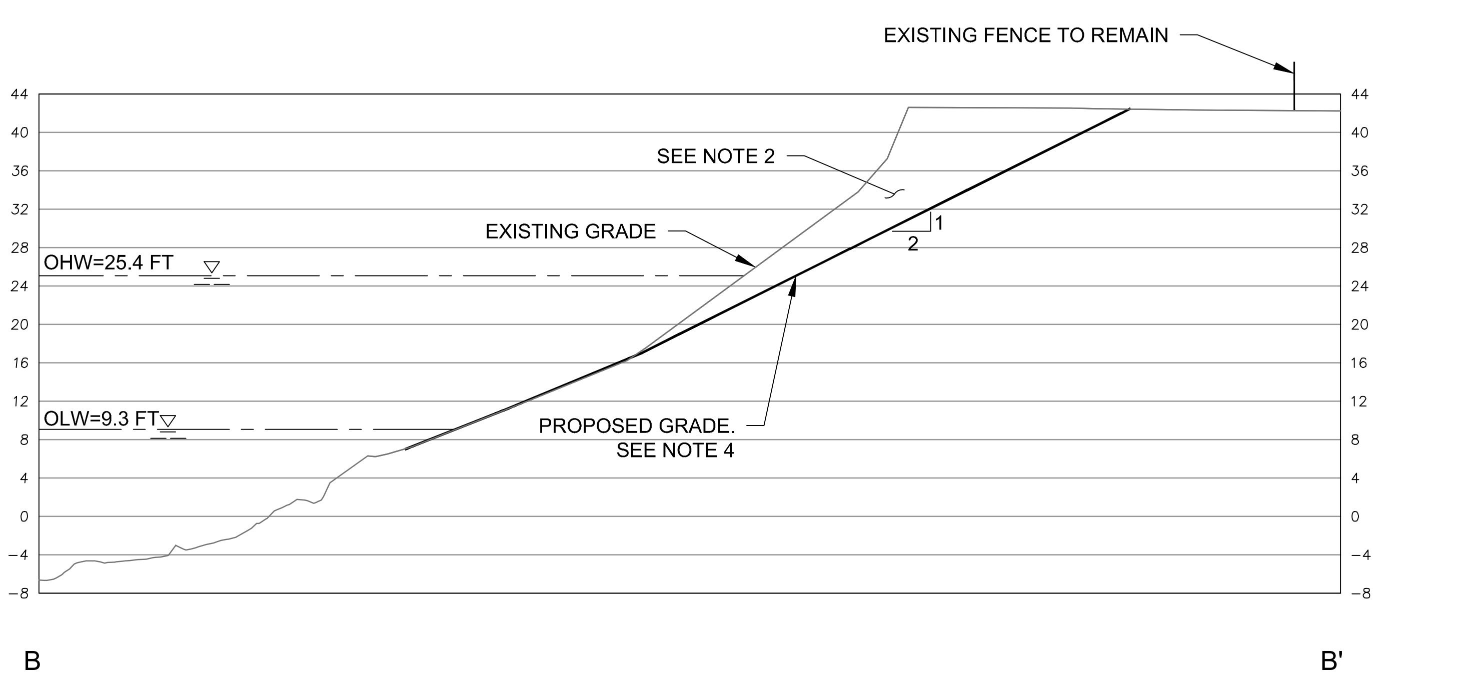


SECTION A-A'

SCALE: VERT. 1"=10' HORIZ. 1"=10'

NOTES

1. REMOVE EXISTING CABLES, HARDWARE, AND OTHER APPURTENANCES WHERE ENCOUNTERED. IF FEATURE EXTENDS BELOW FINISH GRADE, CUT OFF 2 FT BELOW FINISH GRADE.
2. MASS EXCAVATION MATERIAL EXPECTED TO BE SPREAD ON DOWNSTREAM BEACH AND WASHED OF FINES OR REPURPOSED AS FINISH GRADE SURFACING MATERIAL.
3. CUT EXISTING STEEL SHEET PILE 2 FEET BELOW FINISH GRADE AND BACKFILL WITH NATIVE GRANULAR FILL.
4. CONTRACTOR TO SALVAGE EXISTING CLEAN NATIVE COBBLE MATERIAL FROM PROPOSED GRADED SURFACES. COVER REGRADED SURFACES BELOW ELEV. 18 FT. WITH SALVAGED COBBLES. WASH ANY FINES INTO SUBGRADE.



SECTION B-B'

SCALE: VERT. 1"=10' HORIZ. 1"=10'

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DAHL BEACH MITIGATION PROJECT
30% DESIGN DRAWINGS
SECTIONS
BULKHEAD REMOVAL AREA

February 2016
DRAWN BY: AMM
DESIGNED BY: RPL/AMM
CHECKED BY: BH
SHEET NUMBER
C5 OF 11
PROJECT NO.
00089

NOTES

1. PLANTING AREAS WILL BE STAKED IN THE FIELD BY A QUALIFIED WETLAND SPECIALIST PRIOR TO COMMENCEMENT OF PLANTING OPERATIONS
2. PLANT ALL TREES AT 10' O.C. AND ALL SHRUBS AT 3' O.C.
3. HYDROSEED ALL AREAS OF EARTHWORK OR DISTURBANCE WITH APPROPRIATE SEED MIX; SEE SPECIFICATIONS
4. A NW NATURAL REPRESENTATIVE MUST BE ON SITE DURING ANY DIGGING OR PLANTING ACTIVITY WITHIN 10 FEET OF THE GAS TRANSMISSION LINE (NEAR THE BULKHEAD REMOVAL AREA). CONTACT NW NATURAL 48 HOURS PRIOR TO WORK IN THIS AREA
5. AFTER GRADING IS COMPLETE, ANY RESIDUAL INVASIVE PLANT SPECIES WILL BE IDENTIFIED BY A QUALIFIED WETLAND SPECIALIST AND WILL BE REMOVED
6. BOULDER PLACEMENT: PLACE BOULDERS ALONG EDGES OF PARKING LOT WHERE SHOWN. BOULDERS TO BE THOSE CURRENTLY IN LOWER PARKING LOT AREA (PARKING LOT EDGING AND RIPRAP) THAT WILL BE REMOVED DURING CONSTRUCTION. PLACE BOULDERS FLAT ON GROUND SURFACE, 6" APART, SO THAT THEY MAKE SOLID CONTACT WITH THE GROUND SURFACE AND DO NOT TIP OR MOVE. BOULDERS TO BE APPROXIMATELY 18-24" L X 15-20" W X 15-20" H.
7. WATER PLANTS AFTER INSTALLATION, AS NEEDED, AND PROVIDE ONGOING IRRIGATION AS NEEDED, USING A FIRE HOSE OR WATERING TRUCK. SEE SHEET G3 FOR LOCATION OF EXISTING FIRE HYDRANT (WATER SOURCE)
8. SEE SPECIFICATIONS FOR ADDITIONAL INFORMATION

PLANTING LEGEND

COBBLE STORMWATER OVERFLOW STRIP; SEE GRADING PLANS

BOULDERS TO REMAIN

PAVEMENT TO REMAIN

RIPRAP TO REMAIN

18CW(2) EXISTING TREES TO REMAIN

18CW(2) EXISTING TREE TO BE REMOVED (6-8 TOTAL)

MITIGATION AREA

EDGE OF EXISTING PAVEMENT

25 EXISTING CONTOURS

10 PROPOSED CONTOURS

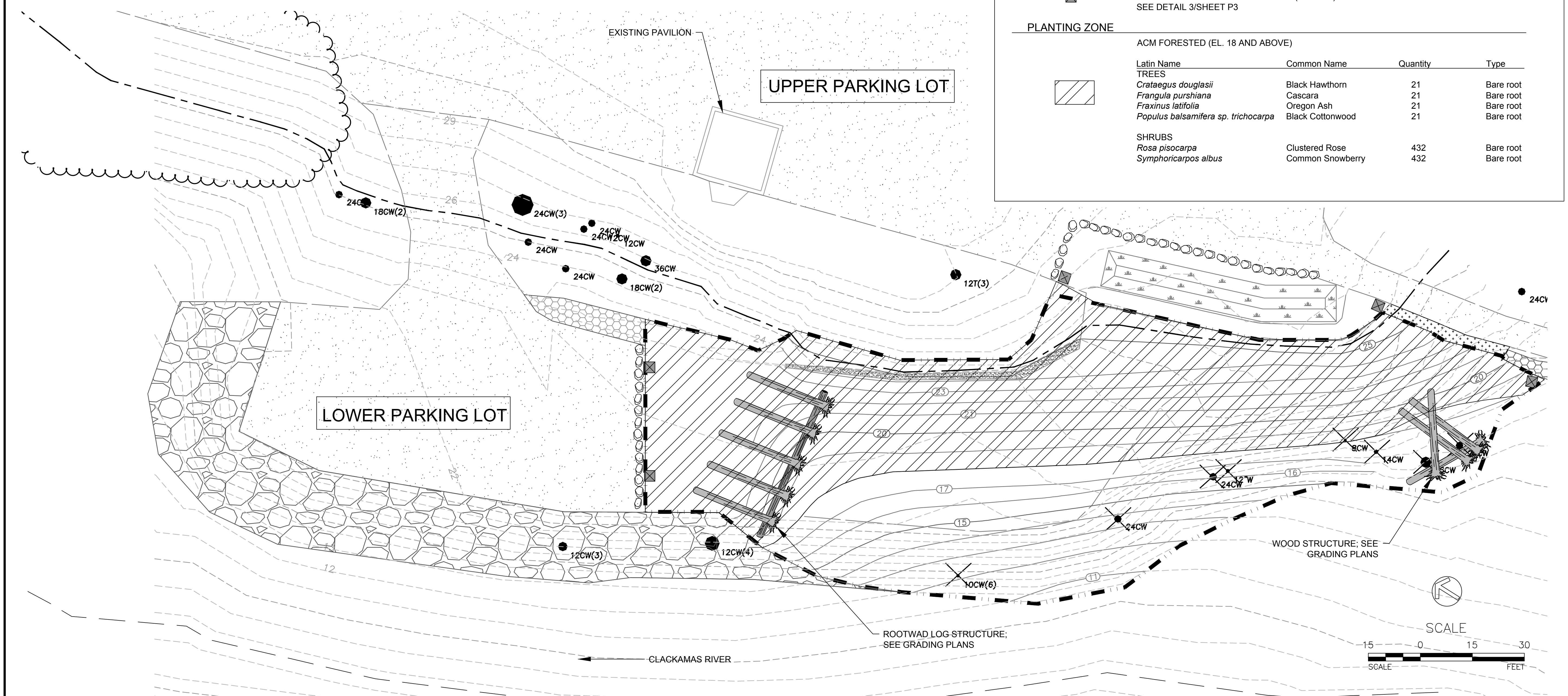
BOULDER BARRIER; SEE NOTES, THIS SHEET

PROPOSED HABITAT AREA SIGNAGE (5 TOTAL). SEE DETAIL 3/SHEET P3

PLANTING ZONE

ACM FORESTED (EL. 18 AND ABOVE)

Latin Name	Common Name	Quantity	Type
TREES			
Crataegus douglasii	Black Hawthorn	21	Bare root
Frangula purshiana	Cascara	21	Bare root
Fraxinus latifolia	Oregon Ash	21	Bare root
Populus balsamifera sp. trichocarpa	Black Cottonwood	21	Bare root
SHRUBS			
Rosa pisocarpa	Clustered Rose	432	Bare root
Symphoricarpos albus	Common Snowberry	432	Bare root



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DAHL BEACH MITIGATION PROJECT
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PLANTING PLAN
PARKING LOT PARTIAL REMOVAL

February 2016

DRAWN BY: AMM
DESIGNED BY: AMM/TS
CHECKED BY: BH

SHEET NUMBER
P1 OF 11

PROJECT NO.
00089

PLANTING LEGEND

- EXISTING PAVEMENT TO REMAIN
- NW NATURAL HIGH PRESSURE GAS TRANSMISSION LINE
- 24CW / 18CW(2) — EXISTING TREES TO REMAIN
- 12CW(3) — EXISTING TREE TO BE REMOVED (4 TOTAL)
- LIMIT OF WORK
- 25 — EXISTING CONTOURS
- 10 — PROPOSED CONTOURS
- EDGE OF EXISTING PAVEMENT
- EXISTING FENCE
- NEW FENCE
- PROPOSED HABITAT AREA SIGNAGE (2 TOTAL). SEE DETAIL 3/SHEET P3
- PROPOSED BOULDER BARRIER. SEE NOTES SHEET P1

SEE NOTES, SHEET P1

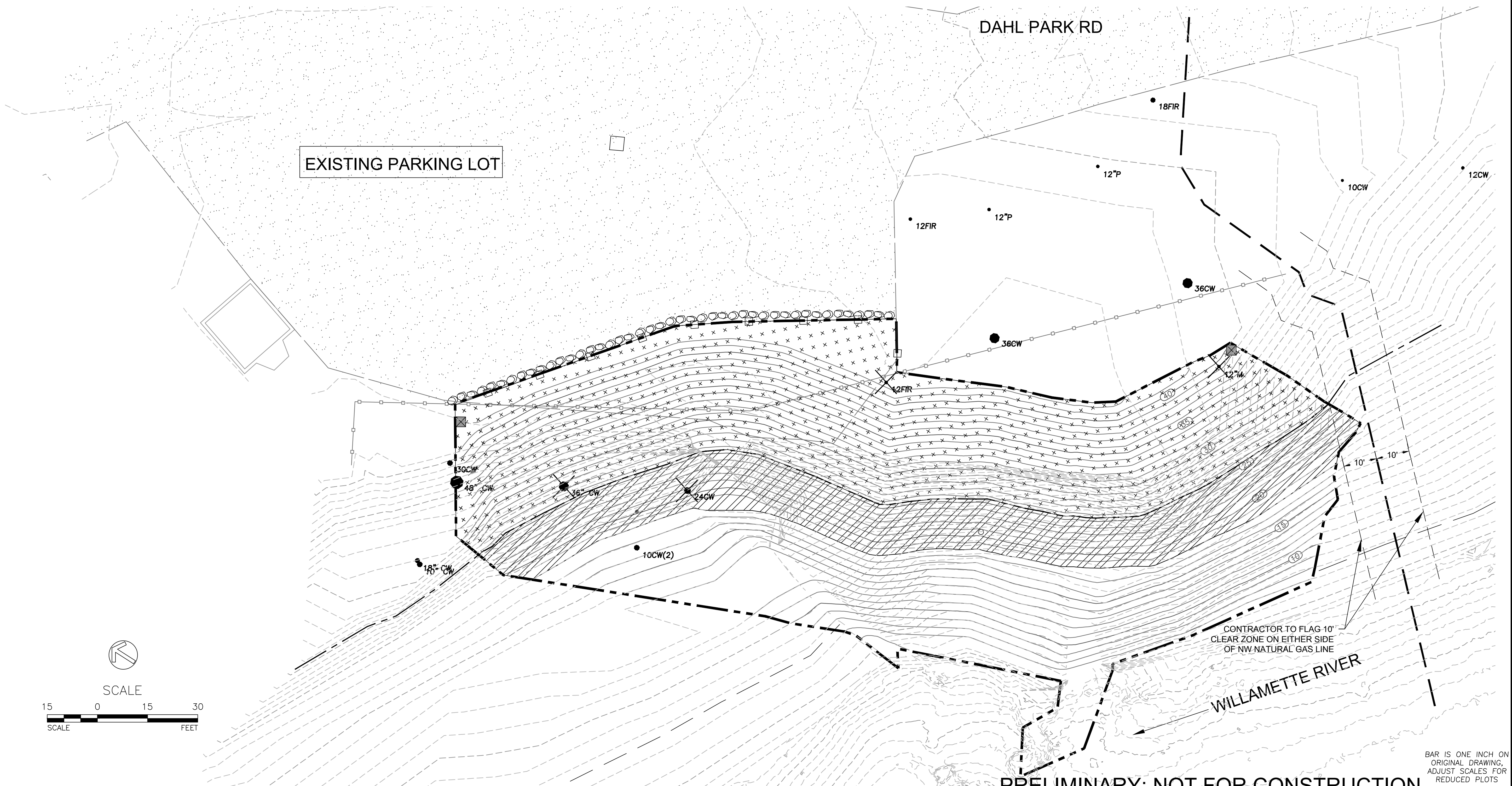
PLANTING ZONES

RIPARIAN (EL. 25.4 AND ABOVE)

Latin Name	Common Name	Quantity	Type
TREES			
Acer marcophyllum	Big-leaf Maple	50	Bare root
Pseudotsuga menziesii	Douglas Fir	50	Bare root
SHRUBS			
Berberis aquifolium	Tall Oregon Grape	500	Bare root
Symphoricarpos albus	Common Snowberry	500	Bare root

ACM FORESTED (EL. 18-25.4)

Latin Name	Common Name	Quantity	Type
TREES			
Crataegus douglasii	Black Hawthorn	15	Bare root
Frangula purshiana	Cascara	15	Bare root
Fraxinus latifolia	Oregon Ash	15	Bare root
Populus balsamifera sp. trichocarpa	Black Cottonwood	15	Bare root
SHRUBS			
Rosa pisocarpa	Clustered Rose	215	Bare root
Symphoricarpos albus	Common Snowberry	215	Bare root



PRELIMINARY: NOT FOR CONSTRUCTION

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS 0 1"

REVISIONS

CASCADE ENVIRONMENTAL GROUP
222 NW Davis St. Suite 317
Portland, Oregon 97209
503.894.8585
www.cascadeenv.com

DAHL BEACH MITIGATION PROJECT
30% DESIGN DRAWINGS

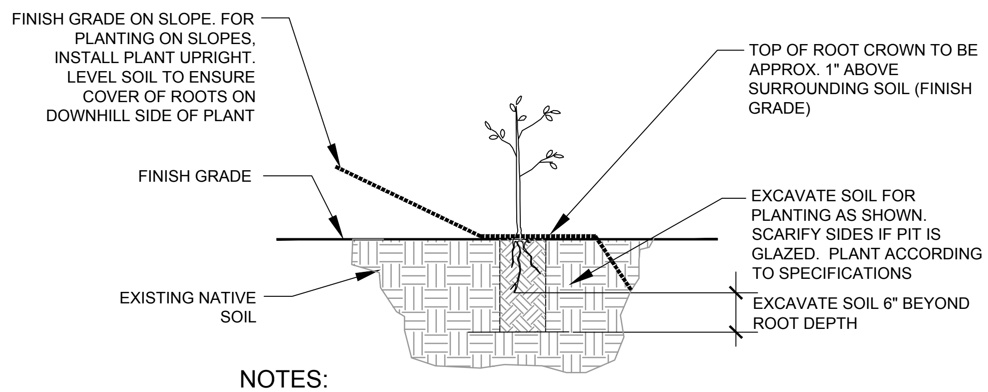
PLANTING PLAN BULKHEAD REMOVAL AREA

February 2016

DRAWN BY: AMM
DESIGNED BY: AMM/TS
CHECKED BY: BH

SHEET NUMBER P2 OF 11

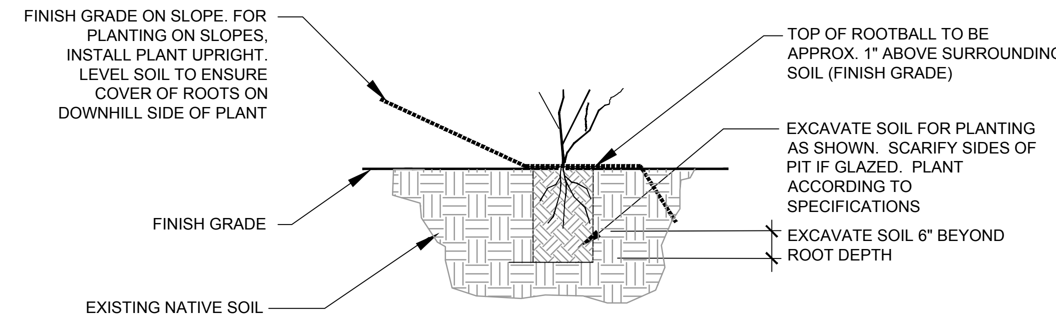
PROJECT NO. 00089



NOTES:

1. MAKE PLANTING HOLE LARGE ENOUGH TO ONLY ACCOMMODATE DIVISION AND ROOTS
2. ENSURE PLANTING HOLE IS DEEP ENOUGH TO AVOID CRIMPING OF ROOTS
3. DO NOT OVER-EXCAVATE FOR PLANTING
4. TAMP SOIL AROUND AND OVER ROOTS WITHOUT CRUSHING OR DAMAGING PLANT OR ROOTS
5. SEE SPECIFICATIONS FOR ADDITIONAL INFORMATION

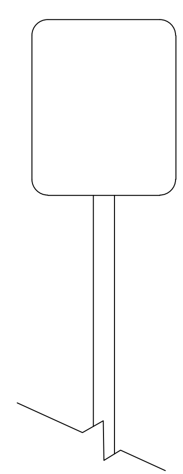
1 BARE ROOT TREE PLANTING
\- NOT TO SCALE



NOTES:

1. MAKE PLANTING HOLE LARGE ENOUGH TO ONLY ACCOMMODATE DIVISION AND ROOTS
2. ENSURE PLANTING HOLE IS DEEP ENOUGH TO AVOID CRIMPING OF ROOTS
3. DO NOT OVER-EXCAVATE FOR PLANTING
4. TAMP SOIL AROUND AND OVER ROOTS WITHOUT CRUSHING OR DAMAGING PLANT OR ROOTS
5. SEE SPECIFICATIONS FOR ADDITIONAL INFORMATION

2 BARE ROOT SHRUB PLANTING
\- NOT TO SCALE



SIGNAGE NOTES:
1. COORDINATE PRODUCTION AND INSTALLATION OF SIGNS WITH THE CITY OF GLADSTONE

3 HABITAT AREA SIGN
\- NOT TO SCALE

PRELIMINARY: NOT FOR CONSTRUCTION

BAR IS ONE INCH ON ORIGINAL DRAWING, ADJUST SCALES FOR REDUCED PLOTS
0 1"

REVISIONS

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DAHL BEACH MITIGATION PROJECT
30% DESIGN DRAWINGS

PLANTING AND SIGNAGE DETAILS

February 2016
DRAWN BY: AMM
DESIGNED BY: AMM/TS
CHECKED BY: BH
SHEET NUMBER
P3 OF 11
PROJECT NO.
00089

APPENDIX F
GEOMORPHOLOGY REPORT

GEOMORPHIC EVALUATION - DRAFT MEMORANDUM

To: Rod Lundberg, Cascade Environmental Group

From: John Dvorsky, Waterways Consulting, Inc.

Date: November 6, 2015

Re: Dahl Beach Mitigation Project

Introduction/Project Objectives

Cascade Environmental Group (CEG) is leading the planning, engineering, and permitting effort to restore two areas of hardened stream bank along the Clackamas and Willamette Rivers to a more natural bank profile. Both restoration areas are on City property, which consists of the Parking Lot Area located within Dahl Beach Park and the Bulkhead Removal Area located in Meldrum Bar Park (Figure 1). The effort is being funded by the Port of Portland (Port) to mitigate for bank hardening conducted by the Port on the Willamette River within Port property. To support the design effort, CEG has asked Waterways Consulting, Inc. (Waterways) to evaluate geomorphic conditions within and around the vicinity of the proposed projects. The primary objective of the geomorphic evaluation is to identify historic geomorphic and sediment transport processes, geomorphic dynamics of the modern river, and expected future trends after restoration construction.

The project areas are located adjacent to the confluence of the Clackamas and Willamette Rivers, and extend from the north bank of the Clackamas River, downstream and along the east bank of the Willamette River (Figure 2). The Parking Lot Area is located along the north bank of the lower Clackamas River and the proposed restoration actions focus on removing a portion of the lower parking lot and restoring a more natural beach profile. The Bulkhead Removal Area is located downstream on the Willamette River and the proposed restoration actions focus on removing a failed bulkhead consisting of reinforced sheet pile. This report summarizes the outcome of the geomorphic evaluation and includes a discussion of how geomorphic conditions and trends should be considered during the engineering design phase.

Project Location

Meldrum Bar and Dahl Beach Park (Park) are owned and managed by the City of Gladstone and encompasses riverside property on the north side of the confluence of the Clackamas and Willamette Rivers. The Park includes several parking areas, sandy beaches, trails, golf course and a Natural Area. The Park is heavily used for fishing, due to its location at the confluence of the Clackamas and Willamette Rivers. Several publicly accessible, developed boat access ramps occur nearby including the Clackamette Park Boat Ramp to the south, and the Meldrum Bar Boat Ramp to the north. Highway 99E Bridge crosses the Clackamas River just to the east of the project area and the Highway 205 Bridge crosses the Willamette River to the south of the project area. The project areas occur in a dynamic river environment that has experienced significant changes in the past century.

Geomorphic History

Historically, the confluence of the Clackamas and Willamette Rivers was a dynamic environment largely controlled by the sediment transport regime of the Clackamas River. Cobble, gravel, and sand delivery from the Clackamas River created a large depositional feature and braided channel morphology where the higher gradient Clackamas River transitioned to the lower gradient and tidally influenced Willamette River (Photo 1). The disparities in the gradients of these two large river systems resulted in formation of a tributary alluvial fan at the mouth of the Clackamas River as coarse bed material emanating from the higher energy Clackamas River deposited in the lower energy confluence environment. Coarse bed load deposition at the mouth had a significant influence on the bed elevations and morphology of the Willamette River for thousands of feet upstream and downstream of the confluence. Goat Island is a remnant of this feature and in fact many maps still refer to this portion of the Willamette River as the Clackamas Rapids. The bed of the Willamette River, adjacent to the Clackamas River, was on the order of 10 -20 feet higher in elevation than the present day bed elevation. The reach at that time was most likely not influenced by tidal process and prior to the 1930's, navigation past this portion of the Willamette River would have been difficult.

Photo 1: The photo on the left shows the Clackamas and Willamette confluence in the 1920's and pre-dates significant mining activity at the mouth (photo on the right). Mining activity limited the influence of the Clackamas River on the overall Willamette-Clackamas confluence by inhibiting bed load transport (photo on the right is from 1938).

Over the past century, changes to both the Clackamas and Willamette River watersheds (i.e. – dam construction, modified hydrology, levee construction and bank revetments) along with local impacts associated with gravel mining and dredging of the Willamette to improve navigation, has resulted in major changes at the confluence. Regional-scale changes to the form and function of the Willamette, Clackamas, and even Columbia Rivers has reduced channel complexity and narrowed and deepened the river along these mainstem river systems, often driven by the desire to improve navigation, provide flood control, and encourage development of floodplain and terrace areas.

Dam construction in the Clackamas River watershed has severely reduced the sediment supply to the lower river. Much of the remaining sediment currently delivered to the lower river is supplied from tributaries downstream of the large dams and bank erosion along the mainstem. These factors have contributed to significant changes in the project area whereby the lower portion of the Clackamas River, from the confluence with the Willamette River to the Highway 99E Bridge over the Clackamas, functions more as a backwater of the Willamette River during most flow conditions.

Within the restoration area reaches, deepening of the Willamette River channel to improve navigation, and reductions in bed load supply from the Clackamas River has resulted in channel degradation that has simplified the geometry of the Willamette River. Historically, the Willamette River was much shallower and wider with extensive gravel bars along the margin of the low flow channel that were scoured annually and free of vegetation. Mid-channel bars, that were historically unvegetated because they were frequently in contact with scouring flow events, converted to vegetated islands with higher resistance to flow, causing further incision of the channel. Beginning around 1970, managed flows on the Columbia River led to lower overall water surfaces on the Willamette River. The overall results of these management activities has been a deeper thalweg, wider low flow channel, steeper banks, and less cross-sectional complexity.

To visualize the changes that have occurred over the past 80+ years at the confluence of the Clackamas and Willamette Rivers, aerial photos dating back to the 1930's were acquired and georeferenced. The results, shown in Figures 3 and 4, show a clear reduction in the form and function of the river and stabilization of sand and gravel depositional features through establishment of riparian vegetation. As reference, the locations of the two project areas are overlain on the series of aerial photos along with approximate location of the bank line from the 2012 condition. The bank line was determined to be the edge of vegetation.

Existing Conditions

An evaluation of existing geomorphic conditions within and adjacent to the project area was conducted. The approach included a field-based reconnaissance-level assessment followed by a focused evaluation using topographic data and hydraulic modeling outputs to understand and interpret geomorphic observations. The more detailed evaluation focused primarily on understanding geomorphic conditions that directly relate to the elements of the engineering design for the two restoration areas. The primary concerns that arose during discussions with stakeholders during the early stages of the project included the following:

- How would the proposed plan to remove a portion of the parking lot along the lower Clackamas affect the overall trend of erosion that has been observed over the past several decades?
- It appears that gravel bars are beginning to form on the lower Clackamas downstream of the Highway 99E Bridge. If that trend continues how will the project be affected?
- Will the proposed parking lot and bulkhead removals affect the presence of and access to sandy beaches that occur along the northern shoreline of the Clackamas and eastern shoreline of the Willamette?
- Where is the inclusion of log structures appropriate as habitat elements?

These concerns and questions were addressed through the following evaluations:

- Reconnaissance-level geomorphic evaluation of the project area to understand sediment dynamics, existing and future erosion risks, and substrate conditions,
- An evaluation of hydraulic conditions from upstream of the 99E Bridge to the confluence with the Willamette using a 1-dimensional hydraulic model developed by WEST Consultants, and

- An evaluation of existing bank angles on the Willamette River upstream and downstream of the bulkhead project site as reference conditions for regrading of the bank at the bulkhead.

Reconnaissance Assessment

The reconnaissance-level geomorphic assessment consisted of field-based observations of site conditions extending from the inlet of Clackamette Cove at the upstream end to approximately 500 feet downstream of the bulkhead project site. A graphic summary of the findings of the assessment are presented in Figure 5. Segments of the riverbed dominated by scour or deposition are noted along with bank segments that are either erosion-dominated, armored with coarse bed substrate, or experience slack water conditions during high flow events. Figure 6 presents a series of photos taken of the project area, the locations of which are noted on Figure 5.

The following key observations were made during the assessment:

- Much of the coarse bed load being delivered to the lower Clackamas River is being deposited upstream of the Highway 99E Bridge at the mouth of Clackamette Cove. There appears to be several reasons for this: the constricting effect of the Bridge which causes a slight backwater upstream; and expansion of the flow at the entrance to Clackamette Cove which reduces shear and encourages deposition of bed load. There is a potential that the material deposited in this reach will eventually mobilize downstream as the bed aggrades and the profile steepens.
- Efforts to protect the 99E Bridge abutments from scour through placement of riprap has encouraged bed scour through the Bridge. There is currently a deep hole under the Bridge that may require future maintenance.
- Bar formation downstream of the Bridge in the vicinity of the Clackamette Boat Ramp appears to be material scoured from the streambed under the 99E Bridge rather than material delivered from upstream. Because this deposition is favored on the inner bend on the Gladstone side of the Clackamas, higher velocities and erosive forces are likely to be directed at the boat ramp on the Oregon City side.
- The sandy beach erosion on the Gladstone side of the Clackamas River appears to be associated with wave action from boats.
- Slackwater effects on the Gladstone side of the Clackamas and downstream of the bulkhead on the Willamette River have created sandy beaches.
- Coarsening of the bank material along the Willamette River due to erosive forces during high flow events have led to a cobble-dominated armored bank condition.

Hydraulic Modeling Results

A 1-dimensional hydraulic model of the lower Clackamas River from Clackamette Cove to approximately 400 feet from the confluence with the Willamette River was provided for our use by WEST Consultants[1]. The model was set up to generate hydraulic output for the 10-year, 50-year, 100-year and 500-year

[1] Additional modeling may eventually be available for the portion of the Willamette River within the project area but it was not available at the time this report was prepared.

events under both a free flowing (normal depth boundary condition) and backwater condition from the Willamette. To evaluate the accuracy of observations made during the reconnaissance-level assessment, the model was run for both the free-flowing and backwatered condition at the 10-year event. The locations of the modeled cross-sections and modeling results for key hydraulic variables are presented in Figure 7. Key hydraulic variables that are presented include velocity and shear stress. Velocity represents the rate of flow of the water at the modeled discharge and shear stress represents a measure of work being conducted on the bed of the channel. Because this is a 1-dimensional model the numbers presented represent averages along the cross-section.

The results largely confirm the findings of the reconnaissance-level assessment. From upstream to downstream there is a dip in shear stress at the entrance to Clackamette Cove (Station 2050), followed by an increase just downstream as water flows over the steepened riffle created by bedload deposition at the Cove. At the Bridge (Station 1391) the shear stress spikes and then declines in the downstream direction as the cross-section widens out and velocities decline within the backwater of the Willamette River.

Reference Bank Angles

In general, bank slopes along the Willamette River, within and adjacent to the project area, are relatively steep with surface conditions dominated by coarse material, such as cobble. As discussed above, this condition is due to the historic lowering of the bed of the Willamette River to enhance navigation and the successive encroachment of land use into the floodplain and terraces areas. Although the prevailing bank conditions are steep and localized erosion does occur, in general, the banks have eroded to a stable angle that represents an equilibrium condition.

To understand what bank angles occur within this reach of the Willamette River we utilized LiDAR-generated topography and in-channel bathymetric surveys compiled from a variety of sources to measure bank angles. The analysis consisted of equally spaced cross-section along approximately 2,000 feet of the Willamette River extending from the mouth of the Clackamas and downstream along the east bank. At each cross-section bank angles were measured from the toe of the slope to the top of bank upstream, downstream, and within the project area. A total of seven locations were assessed with the following results:

- Average bank angle: 2.5:1 or 39% slope
- Maximum bank angle: 1.4:1 or 69% slope
- Minimum bank angle: 4:1 or 25% slope
- Standard deviation: 15% slope; 1.8:1 to 4.1:1

Design Implications

An engineering design that focuses on conversion of an armored, modified bank to a more natural bank condition needs to consider a variety of factors in the design approach including the presence of existing infrastructure, geotechnical stability recommendations, the desire to integrate habitat elements, and the overall geomorphic context and expected future trends. Furthermore, the design needs to consider societal interests and the desire to maintain existing landscape features, where feasible. Achieving a finalized design approach is often based on the need to balance these sometimes disparate interests within the context of limiting risks of failure.

From a purely geomorphic perspective there is always the understanding that rivers, especially at confluences of major systems such as the Clackamas and Willamette, are dynamic by nature with processes that are the result of the integration of processes occurring at the reach and watershed scale. We can predict trends based on past and current trends but there will always be unknowns that can change the overall dynamics. For example, a decision could be made in the future to deepen the Willamette River channel for navigation which could ultimately affect bank stability through the reach.

With that said, we have the following comments on the 30% engineering design with the goal of addressing the questions laid out in the Existing Conditions discussion:

- ***Erosion Trends:*** The proposed modifications to the Parking Lot and Bulkhead areas are not expected to increase the potential for erosion at the project areas. Currently, the presence of the bulkhead and associated sheet pile structure likely exacerbates erosion in the vicinity because of the turbulence created by the structure at high flows. Removal of the bulkhead and contouring of the site to match upstream and downstream conditions will reduce the risk of catastrophic bank failure at and adjacent to the bulkhead. Long-term, following removal of the bulkhead, we would expect the bank condition at the bulkhead site to look very similar to conditions immediately upstream and downstream, which are characterized by a relatively steep, armored slope consisting of cobble and gravel. Removing the bulkhead will result in removal of an unnatural discontinuity.
- ***Bar Development along the Lower Clackamas:*** The noted bar development appears to be the result of bed scour at the 99E Bridge. In this case it is difficult to assess what the future trend might be given the unknowns associated with any necessary maintenance activities at the Bridge and any dredging of the channel proposed at the mouth of Clackamette Cove. If no maintenance is conducted it is likely that the gravel bars will grow slowly but the impact is likely to be additional bank erosion along the Oregon City side of the River.
- ***Presence of Sandy Beaches:*** The proposed partial parking lot removal is not expected to impact the hydraulic dynamics at the sandy beach located just downstream of the Parking Lot Area. That feature was present even before the parking lot was constructed and the alcove and beach would be expected to persist into the future. That feature is a result of an eddy current that develops where flow from the Clackamas River interacts with flow from the Willamette River. Conversely, we do expect that the sandy beach downstream of the bulkhead will not persist once the bulkhead is removed and the bank is recontoured. Sand only accumulates in that location because it is in the "shadow" of the sheet pile structure. It will likely require a 5-year event or greater to mobilize the sand and expose the underlying cobble.
- ***Log Structures:*** It is our recommendation that log structures only be integrated into the parking lot removal portion of the project. The flow dynamics and importance of the confluence area as fish habitat drives this recommendation. It is an area where there would likely be some natural recruitment of large wood. That is not the case for the bulkhead site where flow vectors are parallel in the downstream direction and natural recruitment would be highly unlikely do the lack of a natural eddy.

DAHL BEACH MITIGATION BANK

GEOMORPHIC EVALUATION

FIGURES

Regional Location Map showing Project Area

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FIGURE
1

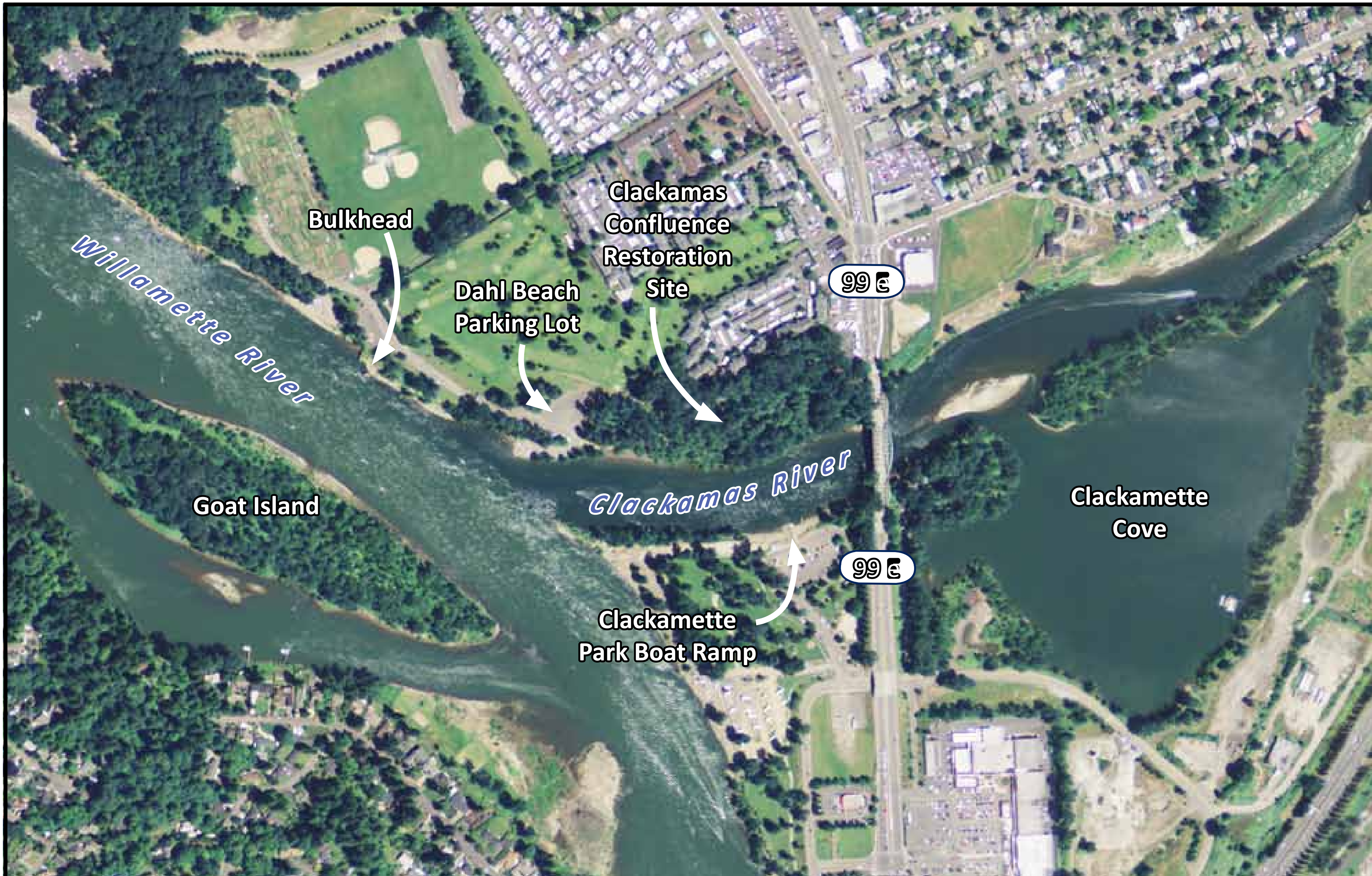

FIGURE 2

Project area and points of interest

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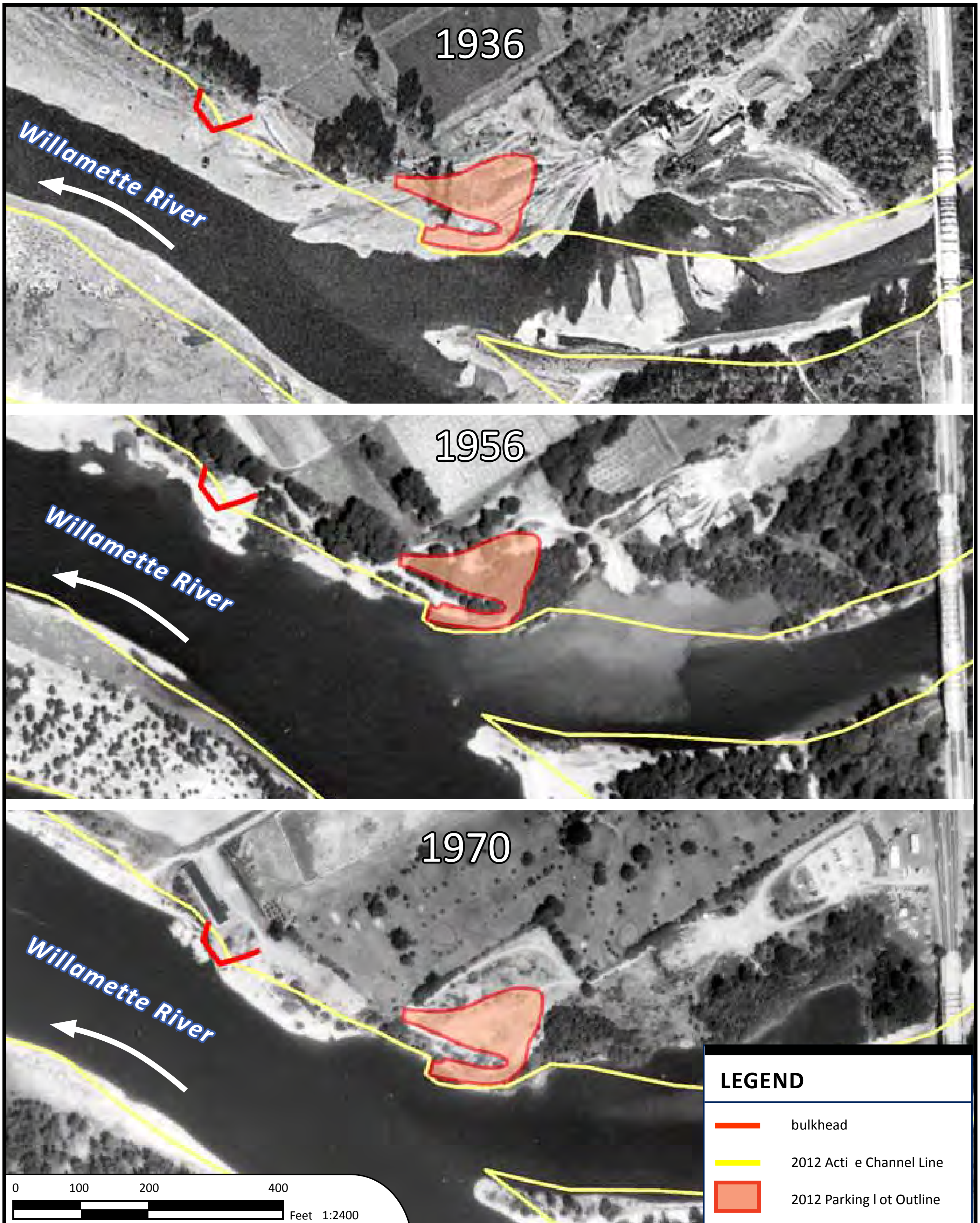

historic Photos with
2012 Parking lot, bulkhead,
and Channel bank line

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FIGURE
3

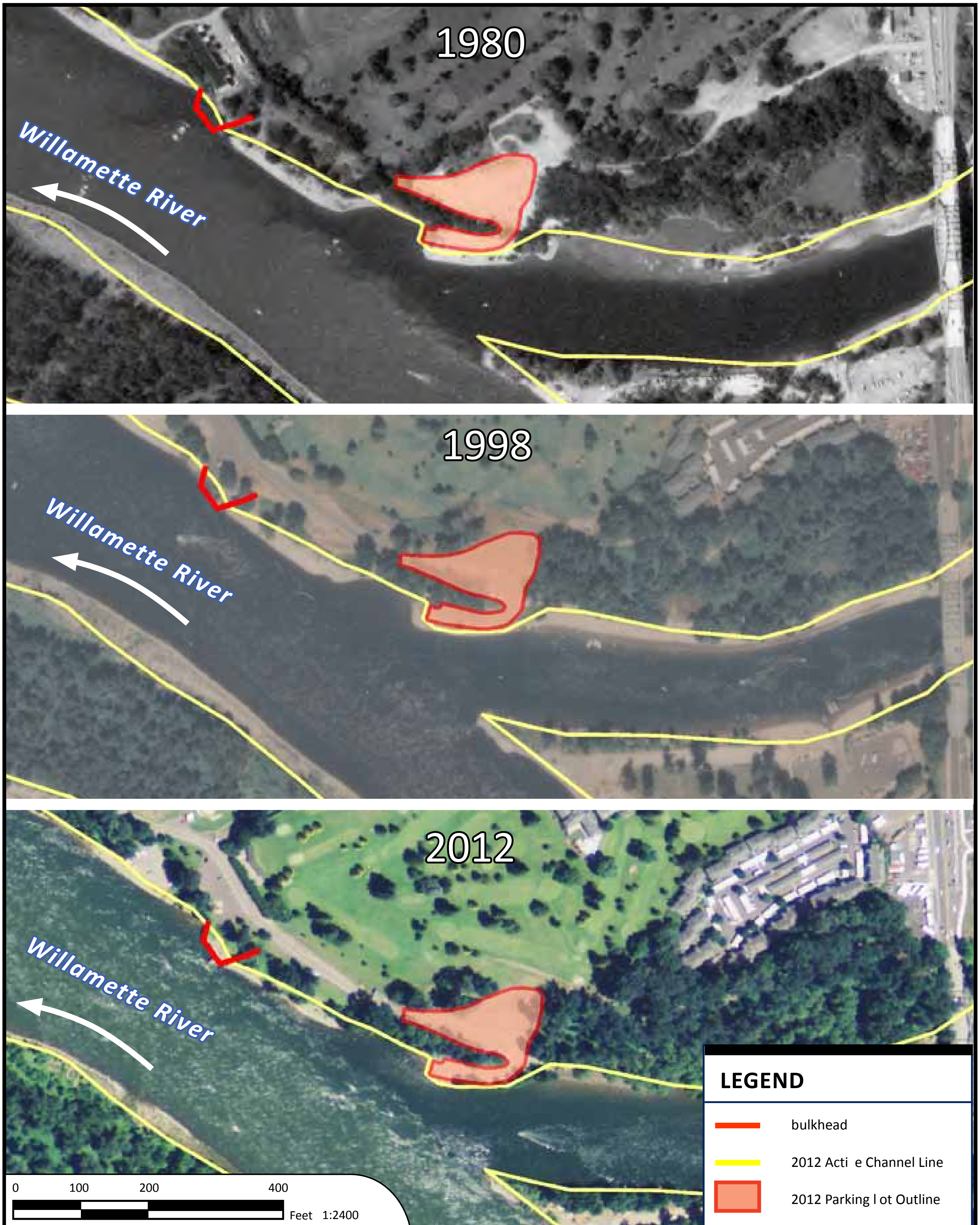

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FIGURE
4

FIGURE 5

Results of reconnaissance-level geomorphic assessment showing locations of erosion, scour, and areas that experience slackwater conditions during high flow events. Numbers correspond with photos shown in Figure 6. D = Depositional reach; S = Scour/Erosional reach; Polygons represent slackwater areas.

DAHL BEACH BANK MITIGATION

GEOMORPHIC MEMO
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Site 2: Bar at Clackamette Cove; Site 3: Inundated parking lot during 2-year event; Site 4: Alcove/Beach downstream of parking lot; Site 5: Armored bank upstream of bulkhead; Site 6: Slackwater/beach at bulkhead; Site 7: Beach erosion from boat wake; Site 8: Scour pool under 99E Bridge; Site 9: Bar formation near Boat Ramp.

DAHL BEACH BANK MITIGATION

GEOMORPHIC MEMO
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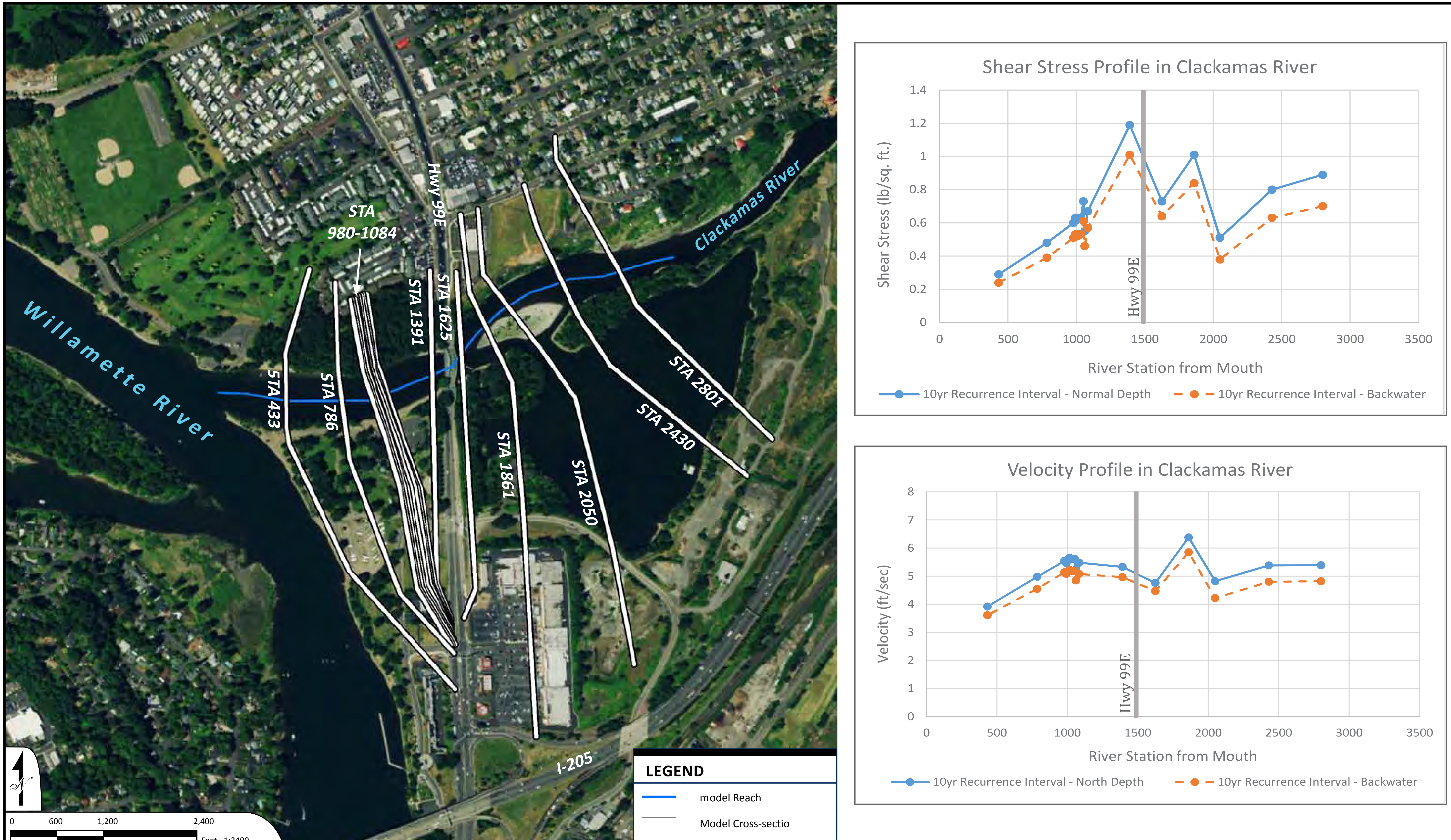
FIGURE
6



Locations of heC-RAS model cross-sections and hydraulic output for the lower Clackamas River. The model was provided by WeST Consultants.

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FIGURE 7