Integrated Feasibility Study &

Draft Environmental Assessment

Section 204 Studies: Beneficial Use of Dredged Material for Ecosystem Restoration

Woodland Islands, Lower Columbia River Estuary

February 2018 **DRAFT**

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Woodland Islands,

Lower Columbia River Estuary

Section 204 Studies:

Beneficial Use of Dredged Material for Ecosystem Restoration

Feasibility Study and Draft Environmental Assessment

Prepared by

U.S. Army Corps of Engineers

Portland District

Lower Columbia River Beneficial Use of Dredged Material for Ecosystem Restoration Project Delivery Team

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Executive Summary

This integrated Feasibility Study and draft Environmental Assessment (FS/EA) has been prepared by the U.S. Army Corps of Engineers, Portland District (Corps) to develop and evaluate the feasibility of alternatives for the strategic placement of dredged material to restore and expand shallow water and scrub-shrub wetland habitat for fish and wildlife species in the Lower Columbia River estuary. This evaluation resulted in the recommendation of a Tentatively Selected Plan (TSP), also referred to as the "Proposed Action" for purposes of the National Environmental Policy Act of 1969 (NEPA). In accordance with regulations implementing NEPA, this FS/EA compares the environmental consequences of the alternatives, including the Proposed Action, and identifies a preferred alternative (the TSP/Proposed Action).

This project is authorized under the Continuing Authorities Program (CAP) pursuant to Section 204 of the Water Resources Development Act (WRDA) of 1992, as amended by Section 2037 of WRDA 2007, which provides the U.S. Army Corps of Engineers with the authority to restore, protect, and create aquatic and wetland habitats in connection with construction, operation, or maintenance dredging of an authorized navigation project.

Over the last 150 years the natural landscape of the estuarine Lower Columbia River has been transformed by human activities through diking, dredging and river training works. In addition the hydrologic and geomorphic processes that sustained the river ecosystem have been altered by dam operation, upriver diversions, and channel deepening. Conversion of wetlands and floodplains to agriculture and development and changes in river stages has resulted in the loss of 77% of these habitats (Fresh et al., 2005).

The Columbia River, the estuary, and the Pacific Ocean immediately offshore provide habitat for a variety of anadromous and resident fish species. Anadromous fish are present in the river almost year-round, either as adults migrating upstream to spawn or as juveniles migrating downstream to the ocean. Recent research has documented the importance of the remaining intertidal wetlands and floodplains along the Lower River in supporting juvenile wild salmon (Bottom et al., 2011) and the paucity of these habitats along the river corridor is now identified as a major limiting factor in salmon population recovery (NOAA 2011).

USACE has authority to utilize dredged material for "beneficial use," meaning providing an ecologic or societal benefit. There have been a number of instances where dredged material has been placed in large river systems over the past 50 years, including the Columbia River. In many cases, wetlands have formed as a result of the combined effect of dredged material placement and pile dikes (Borde et al., 2011), which help stabilize the dredged material and thereby provide adequate time for habitat to form. The fundamental concept is that dredged material must be placed such that semi-stable landforms remain in place long enough for plant communities to establish and intertidal habitats to form. In sum, beneficial use of dredged material provides opportunities to create or enhance habitat with similar morphology to fully functioning wetlands and floodplains, and to place material in a way that optimizes self-sustaining natural processes (ESA PWA, Ltd. and PC Trask. 2011).

Beginning in 2015, the Corps identified multiple potential habitat restoration sites from River Mile (RM) 20 to 105 on the Columbia River that could support a CAP Section 204, “Beneficial Uses of Dredged Material” project. Following an initial screening, ten sites were evaluated and ranked based on a number of factors, and the highest-ranking site, Woodland Islands, was chosen for this feasibility analysis.

The Woodland Islands site consists of several small islands and sheltered side channel area lying between the Columbia River Federal Navigation Channel (FNC) and the Washington side of the Columbia River shore from RM 86 to 84.5 near St. Helens, Oregon. The island is based around a major longitudinal pile dike constructed in 1885 and are themselves remnants of previous dredged material placement from FNC maintenance dredging of the St. Helens Bar. The site is ideal for the strategic placement of dredged material for ecosystem restoration due to the relatively large area suitable for placement, the proximity to a reliable material source, and the need for habitat restoration in this reach of the river. The island complex currently has a variety of habitat types including some low velocity, shallow water habitat in sheltered embayments located on the back side of the islands within the side channel area, but the extent and complexity of the habitat within the greater side channel area is limited.

The TSP/Proposed Action includes placing dredged material on the back side of the middle Woodland Island to create low velocity shallow water and riparian shrub habitat. The created habitat adds to the existing habitat diversity, and is compatible with the existing and created shallow water and wetland habitats on the back side of the island. The project includes a measure to support vegetation establishment through plantings, which also helps prevent invasive species from establishing. It also includes a measure to add topographic complexity by doing additional grading that will shape the placed dredged material. A monitoring plan is included in the project as a part of the adaptive management strategy.

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List of Acronyms

AAHU	Average Annual Habitat Units
ACHP	Advisory Council on Historic Preservation
AdH	Adaptive Hydraulics
AEP	Annual Exceedence Probability
ARPA	Archaeological Resources Protection Act
ATV	All-Terrain Vehicle
BiOp	Biological Opinion
BPA	Bonneville Power Administration
CAA	Clean Air Act
CAP	Continuing Authorities Program
CE-ICA	Cost Effectiveness, Incremental Cost Analysis
CFS	Cubic Feet per Second
CIA	Cumulative Impacts Analysis
CREST	Columbia River Estuary Study Taskforce
CWA	Clean Water Act
CY	Cubic Yard
CZMA	Coastal Zone Management Act
DAHP	Department of Archeology and Historic Preservation
DEQ	Department of Environmental Quality
DI	Design and Implementation
DOE	Department of Ecology
EA	Environmental Assessment
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
ER	Engineering Regulation
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FNC	Federal Navigation Channel
FONSI	Finding of No Significant Impact
FWCA	Fish and Wildlife Coordination Act
FWOP	Future Without Plan
FS	Feasibility Study
HEP	Habitat Evaluation Procedure
HSI	Habitat Suitability Index
IWR	Institute of Water Resources
LCRE	Lower Columbia River Estuary
MBTA	Migratory Bird Treaty Act
MHHW	Mean Higher High Water
MHW	Mean High Water
MLW	Mean Low Water
MLLW	Mean Lower Low Water
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MTL	Mean Tide Level
NAAQS	National Ambient Air Quality Standards
NAVD	North American Vertical Datum (1988)
NER	National Ecosystem Restoration
NFS	Non-Federal Sponsor
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service (NOAA Fisheries)
NOAA	National Oceanic & Atmospheric Administration
NRHP	National Register of Historic Places
NRCS	Natural Resources Conservation Service
ODFW	Oregon Department of Fish and Wildlife
OHW	Ordinary High Water
O&M	Operations & Maintenance
OR	Oregon
PDT	Project Delivery Team
RM	River Mile of Corps Columbia River navigation channel
ROE	Right of Entry
RPA	Reasonable and Prudent Alternative
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TSP	Tentatively Selected Plan
TWAE	Temporary Work Area Easement
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish & Wildlife Service
WA	Washington
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WRDA	Water Resources Development Act
WSE	Water Surface Elevation

1 Introduction

1.1 Study Purpose and Scope

This Section 204 Beneficial Use of Dredged Material Woodland Islands study is being undertaken by the U.S. Army Corps of Engineers (USACE), Portland District (Corps) and the Columbia River Estuary Study Taskforce (CREST) to develop and evaluate the feasibility of alternatives for the strategic placement of dredged material to restore and expand shallow water and scrub-shrub wetland habitat for fish and wildlife species in the Lower Columbia River estuary (LCRE).

Beginning in 2015, the Corps identified multiple potential habitat restoration sites from River Mile (RM) 20 to 105 that were then screened to ten sites based on proximity to shoals dredged by a pipeline dredge, area available for potential habitat restoration, and hydraulic complexity. Following the initial screening, the ten sites were evaluated in greater detail and ranked, and the highest-ranking site was chosen for this feasibility analysis.

The Woodland Islands site consists of several small islands and sheltered side channel area lying between the Columbia River Federal Navigation Channel (FNC) and the Washington side of the Columbia River shore from RM 86 to 84.5 near St. Helens, Oregon. The island is based around a major longitudinal pile dike constructed in 1885. The islands are remnants of previous dredged material placement from FNC maintenance dredging of the St. Helens Bar.

The site is ideal for the strategic placement of dredged material as a beneficial use for ecosystem restoration due to the relatively large area suitable for placement, the proximity to a reliable material source, and the need for habitat restoration in this reach of the river.

The island complex currently has a variety of habitat types including some low velocity, shallow water habitat in sheltered embayments located on the back side of the islands within the side channel area, but the extent and complexity of the habitat within the greater side channel area is limited.

Pipeline dredging at the St. Helens Bar produces 300,000 cubic yards (CY) of dredged material every two to three years on average, and neighboring reaches require annual dredging of over 100,000 CY. Regular disposal of dredged material from St Helens Bar is at the nearby upland site, Austin Point, and along the shoreline of Sand Island are available. The Woodland Islands site is in close proximity to the major St Helens shoal, close enough that material could be supplied directly from the Dredge OREGON via pipeline.

The scope of this study is to evaluate the feasibility of placing dredged material at the Woodland Islands site to increase the quantity of beneficial shallow water and wetland habitat zones, increase topographic diversity that will result in increased habitat diversity, and increase the overall habitat quality in this section of the river.

1.2 Study Authority

This project is authorized under the Continuing Authorities Program (CAP) Section 204 of the Water Resources Development Act (WRDA) of 1992, as amended by Section 2037 of WRDA 2007 and provides the Corps the authority to restore, protect, and create aquatic and wetland habitats associated with construction or maintenance dredging of an authorized project.

1.3 Lead Federal Agency and Non-Federal Sponsor

The Corps is the lead federal agency for compliance with the National Environmental Policy Act of 1969 (NEPA) and other applicable laws. CREST is the non-federal sponsor. See Appendix A of this report for the non-federal sponsor's Letter of Intent. The design and implementation cost of the proposed project would be cost-shared at a ratio of 65% federal and 35% non-federal. The responsibilities of the non-federal sponsor (NFS) for this project are to: (1) provide all necessary real estate interests (such as a temporary construction easement); (2) provide any cash contribution during construction as needed so that total contribution of the non-federal sponsor, including the value of real estate interests, would be 35% of the cost of the project; (3) pay 100% of the operation, maintenance, and rehabilitation costs of the project; and, (4) hold and save the United States free from damages due to construction, operation, and maintenance of the project, except for damages due to the fault of the United States or its contractors. The non-federal share of the cost of the project applies to the incremental cost above the cost of the base plan for maintaining the navigation channel, and the sponsor would receive credit for the value of any in-kind contributions, against the requirements for additional cash to meet the 35% cost share.

1.4 Location of the Study Area

The Columbia River originates in British Columbia, Canada, and travels a distance of 1,243 miles through Washington and Oregon to the Pacific Ocean, draining an area of 259,000 square miles. The river is regulated by a series of dams. Tidal influence on the Columbia River extends from the mouth of the Columbia River up to Bonneville Dam at RM 146.

The Woodland Islands site is located in the Columbia River near St Helens, Oregon, halfway between Vancouver and Longview, Washington. Extending from approximately RM 86 to 84.5, the site is roughly one mile downstream of major Columbia River confluences with the Lewis River and Multnomah Channel (see Figure 1.)

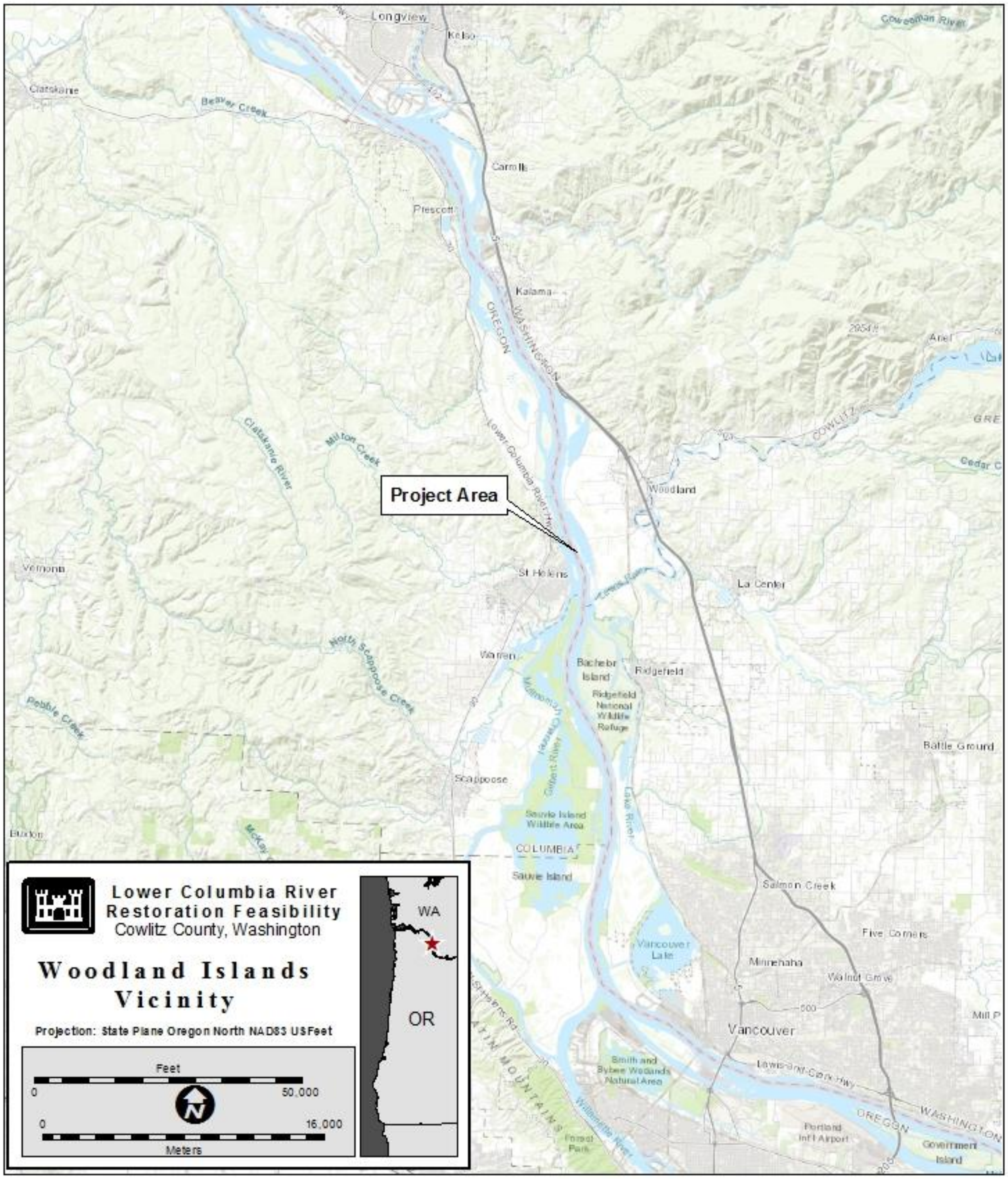

Figure 1. Study area vicinity map.

The site is within the St Helens reach and is immediately adjacent to the St. Helens bar. The St. Helens Bar was the location of the first improvements in the lower river, which included the construction of timber pile dike structures to straighten the alignment of the navigation channel within the river cross section, and to narrow the cross section of the river and direct flow toward the navigation channel to increase flow velocity in the center of the channel. The Woodland

Islands were created in the lee of the pile dikes through placement of several million cubic yards of dredged material during the 1920s to the late 1970s to further stabilize and deepen the navigation channel. At its largest size, the island complex was built into a contiguous peninsula extending from the Washington shore to the end of the pile dikes.

Since dredged material placement and maintenance ceased in the 1970s, riverine forces have morphed the placed material into a string of small islands. The relatively protected side channel behind the islands is a nearly 300-acre, slack-water embayment that is slowly aggrading with sand eroded from the islands and fine material from the river. Water depth varies greatly based on location but the average depth below the mean higher high water (MHHW) is roughly 8 feet with typical bed elevations from -2 to 6 feet NAVD. The side channel is low energy due to the protective islands and pile dike network separating it from the main channel. The major pile dike network is still largely in-tact and functional.

In 2010 the Lower Columbia River Estuary Partnership (LCREP) mapped the land covers by vegetation type on the lower Columbia River ecosystem, including the Woodland Islands project area. According to the assessment, the vast majority of the project area is mapped as open waters. The most commonly mapped land cover is classified as “sand” along the edges of the islands, shoal areas, and bare shores (see Figure 2). On the island, riverine and successional processes have created a mosaic of sand flats, marshes, willow thickets, and cottonwood forests. The Columbia River shoreline along the side channel is a mosaic of open space and residential lots.

1.5 Proposal for Federal Action

This report analyzes the feasibility of measures to improve the aquatic and associated nearshore terrestrial environments at the Woodland Islands site. The Tentatively Selected Plan (TSP), also referred to as the “Proposed Action” for NEPA purposes, includes placing dredged material on the back side of the middle Woodland Island to create low velocity shallow water and riparian shrub habitat. The created habitat adds to the existing habitat diversity, and is compatible with the existing and created shallow water and wetland habitats on the back side of the island. The project includes a measure to support vegetation establishment through plantings, which also helps prevent invasive species from establishing. The TSP/Proposed Action also includes a measure to add topographic complexity by doing additional grading that will shape the placed dredged material. A monitoring plan is included in the project as a part of the adaptive management strategy.

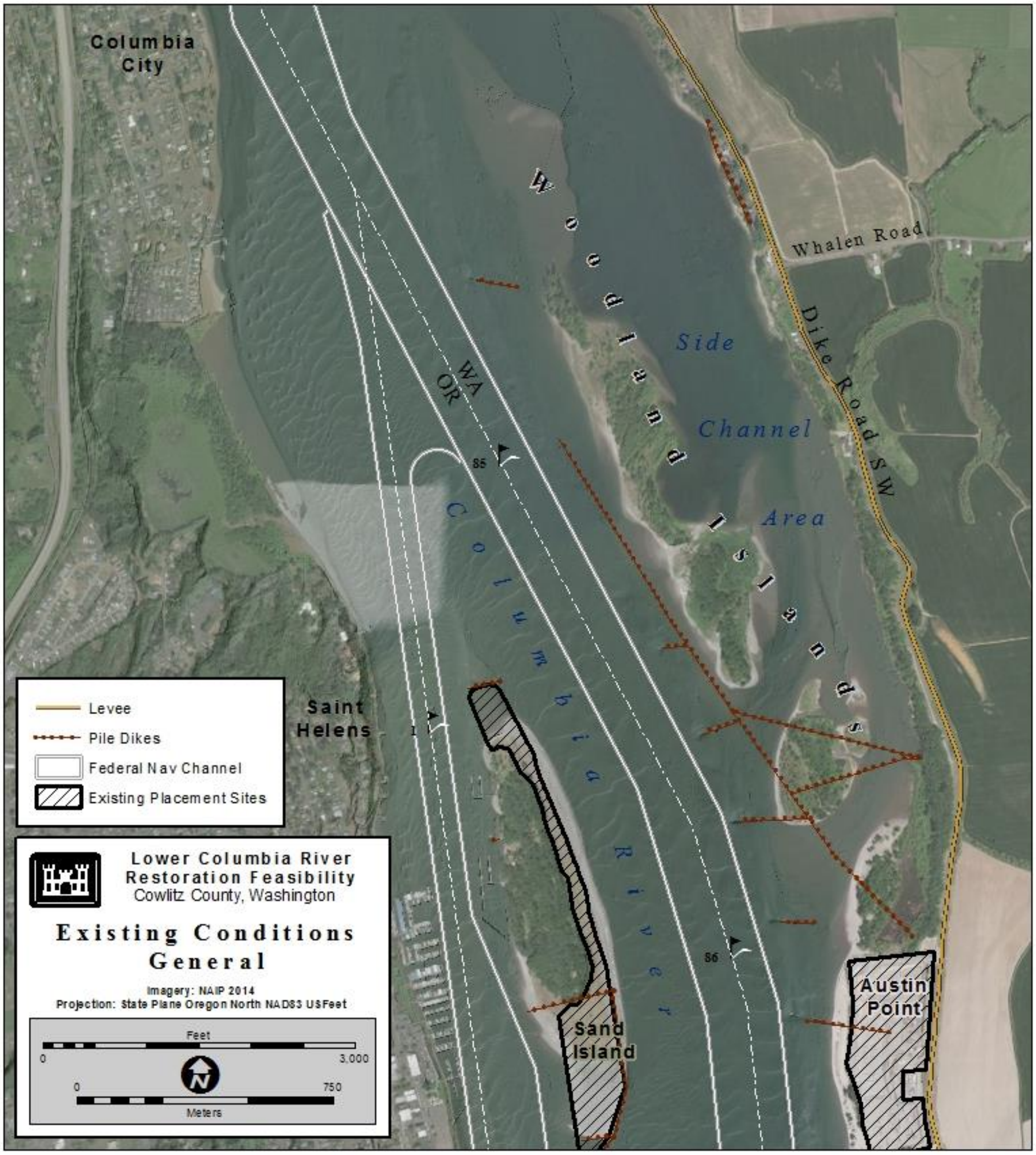

Figure 2. Woodland Island study area.

The project is expected to reach the Design Implementation (DI) Phase in 2018 and construction would occur as early as September 2018. This project would be implemented using routine operations and maintenance (O&M) dredged material placed by the pipeline Dredge OREGON using an existing contract for maintenance of the Columbia River FNC.

1.6 Integrated Document Layout

This document is an integrated Feasibility Study and Environmental Assessment (FS/EA). The purpose of the FS is to identify a plan that reasonably maximizes ecosystem restoration benefits and is technically feasible. Regulations implementing NEPA require federal agencies to "provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact" (FONSI) on actions authorized, funded, or carried out by the Federal government. 40 C.F.R. § 1508.9(a)(1). The EA sections in this FS/EA compare the environmental consequences of the alternatives, including the TSP/Proposed Action, and identify a preferred alternative. In this instance, the Corps' Preferred Alternative is the TSP/Proposed Action. The integrated document will be made available for a 30-day public comment period, after which, assuming the Preferred Alternative is selected, a FONSI would be signed.

The six steps of the Corps' planning process each align with a NEPA requirement. NEPA-specific sections of the document are noted in the table of contents and in the body of the document with an asterisk after the applicable headings. The planning steps are listed below with the NEPA element to which they relate and the document chapter:

Table 1. Six steps of the Corps' planning process.

Planning Step	Analogous NEPA Requirement	Document Chapter
Step One – Specify Problems and Opportunities	Specification of purpose and need for action	Chapter 2
Step Two – Inventory and Forecast Conditions	Description of affected environment and discussion of environmental consequences of the No Action Alternative	Chapter 4
Step Three – Formulate Alternative Plans	Development of alternatives including the Proposed Action	Chapter 3
Step Four – Evaluate Effects of Alternative Plans	Discussion of environmental consequences of the alternatives including the Proposed Action	Chapter 4
Step Five – Compare Alternative Plans	Comparison of the environmental consequences of the alternatives including the Proposed Action	Chapters 3 and 4
Step Six – Select Recommended Plan	Identification of the Preferred Alternative	Chapter 5

2 Need for and Objectives of Action

2.1 Problems and Opportunities

The Columbia River has been affected and shaped over time by a variety of natural forces, including volcanic activity, floods, and climate changes. These forces had and continue to have a significant influence on the environment of the Columbia River. In addition to natural processes, human activities over the past century also have had an effect on the Columbia River environment. Major changes included changes to flow regulation, isolation of the floodplain by development, and the dredging of navigation channels. The hydropower system has reduced the peak seasonal discharges and changed the velocity and timing of flows in the river. The Columbia River estuary historically received annual spring freshet flows that were 75 to 100% higher on average than present-day freshet flows. Historical winter flows (from October through March) also were approximately 35-50% lower than current flows. The greater historical peak discharge and variable flows encouraged greater sediment transport and more flooding of wetlands, contributing to a more complex ecosystem than occurs today (ISAB 2000).

These variable and regulated river flows affect nearly every aspect of the historical ecosystem, including such diverse components as the following:

- Complexity and extent of tidal marsh vegetation,
- Seasonal patterns of salinity and location of the estuarine turbidity maximum,
- Rates of sand and sediment transport,
- Variations in temperature patterns,
- Complexity and species composition of the food web, and
- Amount and distribution of woody debris,
- Distribution and abundance of salmonid predators.

Historically, flooding occurred frequently and was important to habitat diversity in the river because it provided more flow to side channels and bays and deposited more woody debris into the ecosystem. The channel morphology was less incised; river banks were gently sloping, with riparian and wetland vegetation at the higher elevations of the river floodplain. It is estimated that the historical estuary had 75% more tidal habitats than the present-day estuary because tidal waters could reach floodplain areas that are now diked. Historic flooding increased the habitat available for juvenile salmonids by providing them access to a wide expanse of low-velocity marshland and tidal channel habitats for feeding and resting (Bottom et al. 2005).

The Columbia River drains an area of 259,000 square miles and flows 1,243 miles from its headwaters in the Canadian Rockies of British Columbia, across the State of Washington, and along the border of Washington and Oregon to its mouth on the Pacific Ocean near Astoria, Oregon. Within the United States, there are 11 major dams along the main reach of the river. In addition, there are 162 smaller dams that form reservoirs with capacities greater than 5,000 acre-feet in the Canadian and United States portions of the basin. The Lower Columbia River Basin extends from Bonneville Dam to the mouth of the Columbia River, a distance of 146 miles, and drains an area of about 18,000 square miles, all to the west of the crest of the Cascade Range.

The Columbia River and estuary provide habitat for a variety of anadromous and resident fish species, waterfowl and other bird species, and a wide variety of terrestrial and aquatic wildlife. Anadromous fish are present in the river almost year-round, either as adults migrating upstream to spawn or as juveniles migrating downstream to the ocean. Anadromous species include spring, summer, and fall Chinook salmon *(Oncorhynchus tshawytscha);* coho salmon (*0. kisutch*); sockeye salmon (0. *nerka);* chum salmon *(0. keta);* pink salmon (0. *gorbuscha);* winter/summer run steelhead trout (0. *mykiss);* and sea-run cutthroat trout *(0. clarki clarki).* Other anadromous species include green sturgeon *(Acipenser medirostris),* white sturgeon *(A. transmontanus),* eulachon *(Thaleichthys pacificus),* American shad *(Alosa sapdissima),* river lamprey *(Lampetra ayresi),* and Pacific lamprey *(L. tridentate).*

Upriver migrating adult salmonids are present in the estuary and river throughout the year. The residence time in the estuary is usually short, and they normally do not feed to any extent. However, some may hold in the estuary or lower river for some period of time before entering their spawning streams. Juveniles are present in the lower river in the early spring and summer during their migration to the ocean. Year-old juvenile spring Chinook, coho, and steelhead smolts actively migrating to the ocean are migrating principally at the surface of the deeper water and move through the river and estuary without stopping. Chum and fall Chinook migrate downstream as subyearlings, a life stage preceding the smolt life stage. They migrate downstream at a slower rate and can be present in the lower river and estuary for extended periods of time. Most remain in the estuary throughout the summer, while some may overwinter, rearing in shallow-water areas and bays such as Cathlamet, Youngs, and Grays Bays before becoming smolts and migrating to the ocean. Resident species consist of both cold water and warm water species. Cold water species include rainbow and cutthroat trout and mountain whitefish *(Prosopium williamsoni).* Warm water species include northern pikeminnow *(Ptychocheilus oregonensis),* smallmouth bass *(Micropterus dolomieUl),* largemouth bass *(M. salmoides),* yellow perch *(Perca flavescens),* chubs, and crappies. Resident species remain in the river and estuary year-round during all phases of their life history.

Stream flow along the mainstem of the Lower Columbia River is affected by spring snowmelt, winter rainstorms, and flow regulation by the upriver dams. Outflows from the majority of the major dams located within the Columbia River system are regulated by the Corps to provide flood protection and storage capacity. While winter floods can produce high flows in the Lower Columbia River (e.g. February 1996), annual peak flows typically occur with the spring freshet in April through June. The impact of upriver regulation on the river flows below Bonneville Dam is often a substantially reduced annual peak discharge and decreased frequency of local flooding. Releases from the dams during the summer and fall are conducted to satisfy requirements for fisheries, irrigation, navigation, and pollution abatement (Fuhrer et al. 1996).

Historically, flooding associated with the spring freshet occurred frequently on the Columbia River and was important to maintain habitat diversity in the river because it provided more flow to side channels and bays and deposited more woody debris into the ecosystem. The channel morphology was less incised; river banks were gently sloping, with riparian and wetland vegetation at the higher elevations of the river floodplain. The Corps estimates that, across the lower Columbia River and estuary (i.e., from Bonneville Dam to the mouth), the estuary prior to development (circa 1870) had approximately 75% more tidal marshes than the present-day estuary because tidal waters could flood into floodplain areas that are now diked or filled. Historic flooding increased the habitat available for juvenile salmonids by providing them access to a wide expanse of low-velocity marshland and tidal channel habitats for feeding and resting (Bottom et al. 2001). Historical winter flows (from October through March) also were approximately 35-50% lower than current flows. The greater historical peak discharge and variable flows encouraged greater sediment transport and more flooding of wetlands, contributing to a more complex ecosystem than occurs today (ISAB 2000).

Recent research has documented the importance of the remaining intertidal wetlands and floodplains along the Lower River in supporting juvenile wild salmon (Bottom et al., 2011) and the scarcity of these habitats along the river corridor is now identified as a major limiting factor in salmon population recovery (NOAA 2011). These habitats are also valuable for other native aquatic, avian, and wildlife species (ODFW, 2018).

USACE has authority to utilize dredged material for "beneficial use," meaning providing an ecologic or societal benefit. There have been a number of instances where dredged material has been placed in large river systems over the past 50 years, including the Columbia River. In many cases, wetlands have formed as a result of the combined effect of dredged material placement and pile dikes (Borde et al., 2011), which help stabilize the dredged material and thereby provide adequate time for habitat to form. The fundamental concept is that dredged material must be placed such that semi-stable landforms remain in place long enough for plant communities to establish and intertidal habitats to form. In sum, beneficial use of dredged material provides opportunities to create or enhance habitat with similar morphology to fully functioning wetlands and floodplains, and to place material in a way that optimizes self-sustaining natural processes (ESA PWA, Ltd. and PC Trask. 2011).

The Woodland Islands area is an ideal site for beneficial use. With the exception of a small island core, the island complex was created through the placement of dredged material in conjunction with the historic pile dike network. In the early 1970s, placement of dredged material formed a continuous peninsula connecting to what is now Austin Point, and created a sheltered bay. Material placement at the site ceased in the late 1970s, and after almost 40 years of exposure to regular high water and periodic flood events, the peninsula has eroded into the complex of islands, side channels, and embayments that exists today.

Several factors contribute to the study area's high suitability for the proposed project. First, the evolution of the study area from the 1970s to the present suggests that natural processes can sustain and accentuate the development of desired aquatic and riparian habitat. Second, the current condition of the study area indicates that additional placement of Columbia River sand can expand and restore habitat, and there is an available source of such material on a nearby shoal in the FNC. Third, the character of the side channel is such that material can be placed without adversely impacting existing high quality habitat or river hydraulics. Taken together, these factors illustrate the opportunity to place dredged material to meet ecosystem restoration objectives.

*2.2 Purpose and Need**

The purpose of this project is to beneficially use dredged material from the Columbia River navigation channel operations and maintenance program to restore and expand shallow water habitat for fish and wildlife species in accordance with Section 204 of WRDA 1992, as amended.

The need for the project is to restore shallow water and wetland habitats to help rebuild Columbia River salmon populations listed as threatened or endangered under the Endangered Species Act of 1973 (ESA). Additionally, restoration of these habitats would be expected to support waterfowl, shorebirds, neotropical migratory songbirds, native mammals, reptiles, amphibians, and non-ESA listed aquatic species.

2.3 Resource Significance – Technical, Institutional and Public

The LCRE is both a regional and national resource of significance. The project includes resources of Technical, Institutional, and Public Significance as defined in Engineer Regulation (ER) 1105-2-100.

Technical resource significance means that the resource qualifies as significant based on its "technical" merits as determined through a review of published and non-published literature and other scientific documents. Numerous studies and plans have documented the importance of the lower Columbia River estuary and its natural resources. Thirteen (13) species of salmonids that occur in the basin are listed under the ESA. Each species and population uses the estuary. Recent research illustrates the importance of the estuary for growth and feeding of juvenile fish prior to ocean entry. The lower Columbia River area also provides important migratory and breeding habitat for a variety of shorebirds and neotropical migrant bird species.

Institutional resource significance is based on the recognition of the importance of an environmental resource in laws, regulations, adopted plans, and other policies of agencies, tribes, and private organizations. In 1991, Snake River sockeye salmon was the first Columbia River Basin salmon species listed as endangered under the federal ESA. In 1992, two other salmon species, Snake River spring/summer Chinook and Snake River fall Chinook salmon, were listed as threatened. To date, 13 species of salmonids in the basin have been listed under the ESA. The Columbia River estuary is designated as part of the National Estuary Program, an Environmental Protection Agency (EPA) program to protect and restore the water quality and ecological integrity of estuaries of national significance.

Similarly, neotropical migrant passerine birds are a high priority management bird group and increasing their habitat helps achieve the objectives of the Neotropical Migratory Bird

Conservation Act, and bird conservation objectives carried out in Washington by the Washington Department of Fish and Wildlife (WDFW) and Oregon by the Oregon Department of Fish and Wildlife (ODFW). Yellow warblers are a widely-occurring species within this group that migrate through and nest within the LCR floodplains. Managing yellow warbler habitat to increase the regional population also represents a significant resource.

Public resource significance indicates that segments of the public, either individually or as groups, recognize the importance of an environmental resource, as evidence by people engaged in activities that reflect an interest or concern for the particular resource. The National Audubon Society has designated several Important Bird Areas in the LCRE. CREST and other entities attract funding from local governments, grants, and donations, and also engage volunteers and student groups. WDFW and ODFW are supportive of beneficial use of dredged material to meet ecosystem objectives.

2.4 Planning Objectives

The planning objectives for the Woodland Islands, CAP Section 204 study through the 50-year planning horizon are:

- Increase rearing/foraging habitat for juvenile salmonids at the Woodland Islands site;
- Increase flood refugia for juvenile and adult salmon at the Woodland Islands site;
- Increase floodplain habitat complexity at the Woodland Islands site;
- Increase the extent of quality riparian habitat at the Woodland Islands site; and
- Decrease the amount and extent of non-native vegetation at the Woodland Islands site.

2.5 Planning Constraints

The constraints identified for the Woodland Islands, CAP Section 204 study are:

- Use of dredged material must be compatible with existing routine O&M equipment and operations (e.g., schedule of dredge operations, same dredge equipment, etc.);
- Project will not have an adverse impact on adjacent property owners (e.g., increased flood risk, access, etc.); and,
- Project will be constructed with the intent that it does not contain habitat attractive to colonial piscivorous birds (e.g., cormorants or Caspian terns) that prey on salmonids..

3 Plan Formulation

3.1 Management Measures

At the outset of the planning process for the study, the Corps' Woodland Island Project Delivery Team (PDT) developed a list of management measures to achieve the planning objectives and address the identified ecosystem problems. The team considered an array of possible actions that could benefit the floodplain, riparian and riverine habitat in this area of the lower Columbia

River. A description of each measure and assumptions associated with them used to develop initial cost estimates is provided below. The initial array of measures considered is presented in Table 2 along with the objectives each addresses.

3.1.1 Measures

The base measure is the measure that provides the initial habitat created using dredged material beneficially. This would entail placement of a minimum of 200 kcy (1 kcy equals 1000 CY) up to 500 kcy of dredged material on the backside of the main Woodland Island. The dredged material would be placed in a manner to fully use the available area suitable for placement as well as integrate the placed material with existing habitat and topography while not compromising stability or violating other constraints.

Additional measures that are additive to the base measures were formulated and provide additional habitat benefits.

- Topography Grading
- Vegetation Plantings
- Invasive Plant Species Removal
- Supplemental Fine Material
- Engineered Bank Stabilization

Table 2. Project objectives and measures.

Measure	Objective 1 (rearing/foraging habitat-salmon)	Objective 2 (flood refugia for salmon)	Objective 3 (floodplain habitat)	Objective 4 (riparian habitat)	Objective 5 (remove non-native veg)
Base Measure	X	X	X	X	
Depth Measure 1 (simple grading)	X	X	X	X	
Depth Measure 2 (complex grading)	X	X	X	X	X
Vegetation 1 (natural seed source)	X	X	X	X	X
Vegetation 2 (willow stake plantings)	X	X	X	X	X
Invasive Plant Species Removal				X	X
Supplemental Fine Material			X	X	
Engineered Bank Stabilization		X	X		

3.2 Screening of Measures

Screening is the process of eliminating, based on planning criteria, those measures that will not be carried forward for further consideration. Criteria are derived for the specific planning study, based on the planning objectives, constraints, and the opportunities and problems of the study/project area. The PDT developed criteria to screen the measures before they were combined into alternatives to ensure that each met the study objectives and were feasible within the constraints. Those criteria are listed below and are used to evaluate and screen the initial array of measures (see Table 3):

- Geomorphically stable
- Effectiveness (certainty of success)
- Constructability (equipment limitations, site limitations)
- Disturbance to existing habitat
- Real Estate complexity (defined as requiring acquisition of real estate and/or easements from adjacent private property)

Table 3. Screening criteria and rating of measures.

	Geomorphically Stable (Completeness)	**Effectiveness (certainty of success)**	**Constructability (equipment limitations, site limitations) (Efficiency)**	**Disturbance to Existing Habitat (Acceptability)**	**Real Estate Complexity***	**Screened**
Base Measure	+	+	+	o	+	N
Depth Measure 1 (simple grading)	+	+	+	+	+	N
Depth Measure 2 (complex grading)	+	o	+	+	+	N
Vegetation 1 (natural seed source)	+	+	+	+	+	N
Vegetation 2 (willow stake plantings)	+	+	+	+	+	N
Invasive Plant Species Removal	+	-	o	-	-	Y
Supplemental Fine Material	-	-	-	+	-	Y
Engineered Bank Stabilization	+	-	-	-	-	Y

*Real Estate criteria - Less complex = "+", more complex = "-", no change = "o"

After applying the screening criteria to the measures, three measures were screened and were not carried forward to alternatives development. The PDT screened out the invasive plant species removal measure because it does not meet the effectiveness, disturbance to existing habitat, and real estate complexity criteria. The PDT determined that, based on experience in other locations along the Columbia River, the invasive plant species that are present are very difficult to control or remove, and even if they were initially removed, they tend to readily recolonize because the seed sources are widespread. On the island, the PDT determined the removal of invasive plant species would unnecessarily disturb existing habitats and could not be suppressed without intensive maintenance over the 50-year planning period. The island includes portions that are private property so real estate would need to be acquired to remove the invasive plant species currently existing on the island.

The PDT screened out the supplemental fine material measure because it does not meet the geomorphically stable, effectiveness, constructability, and real estate complexity criteria. Placing supplemental fine material would require additional equipment and has a high likelihood of not staying where placed due to anticipated river and tidal velocities and scour. Further, placing the fines would not likely improve the growth of the native plants. The need for additional equipment and source for fine material would add to real estate complexities by requiring additional borrow sites and easements.

Lastly, the PDT screened out the engineered bank stabilization measure because it does not meet the effectiveness, constructability, disturbance to existing habitat, and real estate complexity criteria. Several different types of bank stabilization materials such as large wood and stone revetment were assessed by the PDT. It was determined that large wood would not stay in place due to velocities. Stone revetment could adversely impact existing habitat, require special equipment, and would increase the complexity of real estate for placement and maintenance because it would require additional easements both temporary and permanent.

3.3 Siting of Measures

One of the primary factors influencing the selection of the Woodland Islands site is the large relatively protected side-channel area. Protection is provided by the extensive pile dike network and the remaining vegetated dredge spoils that separate the side channel from the main channel of the Columbia River. The relatively low energy environment on the side-channel side of the islands is ideal for the placement of sand for beneficial uses. Furthermore, analysis of historic imagery and general fluvial morphological trends support the placement of material into the lee of the larger mounds of sand and in a configuration that allows flow to pass by the features, as opposed to obstructing flow.

Some quality habitat exists in small pockets at the site. The sheltered alcove areas contain shoreline habitat and support submerged aquatic vegetation. Dredged material placement for additional habitat creation should avoid converting these areas to upland, and instead should expand the high quality habitat there by increasing the sheltered effect and expanding the alcove areas.

3.4 Measures Carried Forward for Alternatives Development

Five measures were carried forward for alternatives development: the base measure (scaled by volume), two grading measures, and two vegetation measures. Assumptions and dependencies related to these measures are described below.

3.4.1 Base Measure

The base placement includes all basic construction activities, e.g. mobilization and site preparation, pipeline construction, material placement, pumping and managing dredged material slurry, and basic grading to target max elevation and extents. The final shape is gently sloped mound with target elevations between 10 and 14 feet NAVD with variable width. The side slopes below 10 feet NAVD are assumed to be 10:1 down to existing ground elevation. Some settlement is expected after the first winter.

The construction process is described in detail in Appendix C, Dredging and Construction. The following simplifying assumptions were used to help design and cost the base measures:

- Dredged material (DM) will be placed using the Dredge Oregon via 30-inch pipeline in a parallel configuration;
- The design volume of DM will be available in the dredging year when the project is implemented;
- Pumping rate: 20 kcy/day;
- Assume 15% loss of efficiency to set up sites at Woodland Island (alternate to normal disposal site); this efficiency penalty cost is picked up in the per-volume pricing;
- Grading uses the normal method for beach nourishment, using three dozers, one front loader, and one excavator working the site.
- Operations are 24 hours per day, 5 days per week; no noise restrictions; no lighting restrictions.
- Construction window is commensurate with the O&M dredging in the Lower Columbia River, typical between May and November. It is envisioned that this project will be constructed during periods of low water near the end of the dredging season.

An important aspect of the base measure is that it can be scaled by increasing the volume of placed material to increase the areal extent and habitat benefits of the project. The volume of material to be placed was evaluated using 100 kcy increments, starting from the base at 200 kcy. The maximum volume that can be placed is limited by the volume of material expected to be available. The current estimate for the available volume for the 2018 dredging season at St Helens is 400 kcy, however, the PDT looked at up to 500 kcy as an upper limit. The lower limit is based on minimum volume of material that justifies use of the Dredge Oregon, considering the additional constraints and time required to pump into the Woodland Island side channel.

The scaled increments utilize the same construction and habitat assumptions described in the base measure. Changes to habitat areas (described in following sections) are based on volume-area relationships from various design terrains created for hydraulic modeling.

3.4.2 Depth Measure 1 (Simple Grading)

The depth measure 1 (simple grading) is dependent on the base measure. The assumption is that once dredged material is placed, there is a minimum amount of simple grading that will occur as part of placement of the material in order to meet basic slope and depth requirements for habitat creation.

3.4.3 Depth Measure 2 (Complex Grading)

The “complex grading” measure includes additional construction activities required to re-grade or sculpt placed dredged material to create additional topographic diversity aimed at increasing habitat value and functionality, as well as stability. Dredged material may be excavated and reallocated to increase submerged placement features or it can be pushed up to create topographic diversity in the emergent areas.

Dredged material may be excavated from the initial placement elevation (approximately 14 feet NAVD) down to 6 to 8 feet NAVD (or as low as possible) to create small channels, submerged shelves or inlets. Using a long-reach excavator, excavated material may be cast into the deeper water (where other equipment may not be able to access due to river stage constraints) to create shallow water habitat shelves (elevation 6 to 9 feet NAVD).

Material could also be pushed out beyond the existing shoreline using an excavator/dozer combo to create mini fingers of upland area, converting a straight shoreline to a “wavy” shoreline to increase habitat area and diversity. Material could also be moved around to generally increase topographic diversity, e.g., low ridges with top elevation between 12 and 14 feet NAVD (not to exceed 14 feet).

Construction and cost assumptions related to complex grading are outlined below:

- The amount of material that is expected to be moved is roughly 0.75-1 kcy per acre of base measure placed material. This was estimated with the assumption that 0.5 foot of material per acre is reallocated during complex grading.
- Assume the standard equipment from base construction plus an additional long reach excavator to assist with placing material beyond the shoreline.
- Assumed 20% reduction in shift length (due to the tides and the regular need to operate at daily low water levels)
- Assume grading rate of 900 CY per hour.

3.4.4 Vegetation Measure 1 (Natural Vegetation)

Based on experience at similar placement sites, the constructed base measure is assumed to be fully vegetated via natural seed source within 5 years in the low grade elevations of 10 to 14 feet NAVD. Emergent marsh vegetation may establish between elevations 8.5 and 9.5 feet in sheltered areas. Relying on revegetation from the natural seed sources could result in less consistent establishment of the target species of willows and other hydrophytic shrubs, and more establishment of non-native and invasive species, which could result in not achieving the desired habitat value.

The PDT determined the natural revegetation measure would be dependent on the base measure. The assumption is that once the dredged material is placed, natural seed sources carried by the river or by wind will establish on the newly placed material and vegetation will grow. The types of vegetation that would establish would be a mix of native and non-native species, and would have less optimal habitat benefits; natural vegetation would have a slower rate of establishment and plant maturity for providing shading and cover habitat.

3.4.5 Vegetation Measure 2 (Plantings)

The purpose of this measure is to plant vegetation that would have an even distribution of willow shrubs across the range of elevations (10 to 14 feet) to provide scrub-shrub habitat, to more rapidly establish native plants that will reach maturity sooner, and to stabilize the placed dredged material. Below are the simplified assumptions used to estimate costs and inform the planning-level evaluation:

- Plantings consist of native willow stakes that are 3 feet in length; and,
- Plant spacing is 5 feet on center.

3.5 Evaluation of Alternatives

Alternatives were developed based on the results of the measures screening process and in consideration of planning constraints. Alternatives were formulated by combining the various measures in consideration of any dependencies. The USACE Institute for Water Resources Planning Suite software (IWR Plan) was used to input the measures, their dependences, and create all possible combinations of measures.

Alternatives are compared against the No Action Alternative, which is synonymous with the "Future Without-Project Condition" (FWOP). More information and details on the No Action Alternative are contained in Section 4 of this report, but a brief description of the alternative and the associated FWOP is provided below to provide context for establishing the plan formulation process.

3.5.1 No Action/Future Without-Project Condition

Under the No Action/FWOP alternative, no sediment from St. Helens Bar would be used for beneficial use at the project site. Mature and new growth vegetation bordering the shoreline would continue to be swept downstream as high water events erode the islands, mostly on the main channel side of the island. Sediment in the side channel would likely continue to slowly aggrade but bed elevations would remain too deep to support emergent marsh and shoreline habitat

Hydrology in the project area would not be expected to change. In the absence of additional sand there would be no additional bathymetric/topographic features for water to flow around, over, or through. Current velocities would also remain the same and flow would continue to be dictated by daily and seasonal variations, water operations at Bonneville Dam, and periodic weather events.

Maintenance dredging of the FNC would continue to occur as needed and the material would be placed in other locations. Currently dredged material is typically placed at Austin Point, a nearby upland site, and along the shoreline of Sand Island. No sand would be added to the project site; thus, no additional sediment would be made available in the side channel for the subsequent formation of tidal finger channels, tidally submerged peaks and troughs, and other fluvial variations that could influence the movement of water and sediment throughout the system.

The existing pile dikes are preserving habitat by decreasing velocity and erosion potential in the vicinity of the islands, and help reduce lateral migration away from the FNC. Pile dike maintenance is part of another federally authorized project and, as part of that other project the pile dikes have been prioritized based on their need and function related to the O&M dredging mission. Repairs to the pile dikes in this location are not considered a high priority for reducing dredging needs but will continue to be evaluated. If in the future the pile dikes in this location are found to be in need of repair, compliance with applicable laws and regulations such as NEPA and ESA compliance would be occur at the time the need is identified.

Under the No Action Alternative, the islands would continue to shift and migrate as they have over the last 50 years with erosion typically on the main channel shoreline and deposition on the side channel shoreline. Bed elevations will continued slowly accrete in the side channel as island-overtopping floods mobilize material from upland island areas and then deposit material at lower elevations. In areas of natural accretion, some shrub wetland vegetation could be established.

Under the No Action Alternative, the existing habitat on the project islands would be generally unchanged. However, aquatic and terrestrial fish and wildlife species would continue to be affected by natural forces such as erosion and high flow events; effects would be minimal to existing benthic communities in intertidal and subtidal areas. Fish and wildlife species would continue to use the islands and surrounding waters, but use of the site would not increase and may even decrease as the erosive forces of the river continue to shift, erode, and overtop various portions of the site.

Without placement of dredged material at the project site, the expected benefits to threatened and endangered species would not occur. The existing habitat would not be improved to increase shallow water habitat extent, or quality of suitable rearing habitat for juvenile salmonids traversing through the area. Overwintering salmonids would not be likely to use the side channel as a place of rest as velocities would remain too high for refuge and feeding as they migrate through the estuary. Though no direct adverse impacts to threatened or endangered species are anticipated under the No Action Alternative, no benefits would be expected either.

Land use at the proposed project site is not expected to change with the No Action Alternative. However, further erosion of the islands could cause some areas of the project site to become unusable or inaccessible for fishing, hunting, or camping activities.

3.6 Evaluation of Initial Array

The initial array of alternatives was evaluated using the IWR planning software. Preliminary cost estimates were developed for each alternative and the potential habitat outputs were developed using a multi-species Habitat Evaluation Procedure (HEP) model (USFWS 1980*a*, *b*). HEP is a framework used to evaluate and document habitat losses and habitat gains. HEP documents change through the application of a habitat suitability index (HSI). The HSI value is derived from an evaluation of key habitat components and the life requisites of selected wildlife and fish species. HSI models have been approved for use for species through the model review and approval process developed by the Corps. The Cost Effectiveness-Incremental Cost Analysis (CE-ICA) is described in section 3.6.2 and in more detail in Appendix E, Economics.

3.6.1 Modeling Habitat Benefits

The PDT reviewed published HSIs for 12 species with various life history requirements – eight birds, one fish, one mammal, one reptile, and a guild of native amphibians for potential inclusion in the HEP analysis. Of the several species initially considered, those not selected had habitat requirements that were not scaled to the spatial area of the project site such as large territories where the population would not respond measurably to the proposed project, data for use in the species' model were not available, or they were not key species of interest in this region. Two species – yellow warbler and juvenile Chinook salmon – were selected for the Woodland Island HEP. Table 4 shows the list of species considered for the HEP analysis; more information on the habitat modeling procedures can be found in Appendix F.

Table 4. Selection rationale for species used in the HEP analysis.

Species/Guild Selected	Variables/Attributes	Associated Habitat Type	Rationale for Selection
Yellow warbler	Deciduous shrub crown cover, canopy cover, height of shrub canopy, % hydrophytic shrubs in canopy cover	Riparian and floodplain vegetation communities (particularly cottonwood and willow)	Selected: Yellow warblers occur in the river floodplain; increasing the area of willow scrub-shrub habitat will increase the potential number of warbler territories; each territory is 0.15 ha; a territory is relatively small so notable lift would result from adding more suitable habitat; habitat parameters can be modeled reliably.
Modified model - Native salmonids (mainstem) (juvenile Chinook)	Substrate, depth, and % cover of bank vegetation	Mainstem shallow water margins, floodplain side channels and backwaters	Selected: Dredged material does not require extensive re-shaping and re-contouring to create suitable habitat; substrate quality is not a driving parameter; wide range of depths are usable; site has demonstrated capacity to grow scrub-shrub community at shoreline.
Beaver	Tree canopy closure, tree size class, shrub crown cover, height of	Riparian and floodplain vegetation communities	Not selected: beaver are present on site; probably 1-2 family groups; they have large territories and improving

Species/Guild Selected	Variables/Attributes	Associated Habitat Type	Rationale for Selection
	shrub canopy, species composition	(particularly cottonwood and willow)	aquatic and scrub-shrub habitat will not increase number of family groups.
Great blue heron	Distance between foraging areas and heronry sites, shallow clear water, distance from human activities	Riparian trees, shallow embayments	Not selected: One probable great blue heron nest was observed at the south end of the island; depositing dredged material will not increase the number of mature cottonwood trees in the short-term so no lift will be modeled using herons.
Western pond turtle	Water depth, water temperature, % cover, availability of nesting sites	Off-channel ponds, sloughs, and backwaters	Not selected: Turtles have mid-sized upland territories; depositing dredged material without extensive re-shaping and re-contouring to create upland micro-habitats will not result in lift.
Native amphibians (Northwestern salamander, long-toed salamander, red-legged frog, Pacific treefrog, Oregon spotted frog, roughskin newt)	Permanent water, water velocity, emergent and submerged vegetation, ground cover along water's edge, riparian zone width, water temperature, land use	Slow velocity stream reaches/alcoves, off-channel ponds, sloughs, and backwaters and other wetlands	Not selected: Amphibians have small to mid-sized upland or aquatic territories; habitat parameters are limiting; depositing dredged material without extensive re-shaping and re-contouring to create upland micro-habitats will not result in lift.

3.6.2 Cost Effectiveness, Incremental Cost Analysis

This section describes the model inputs for performing the CE-ICA using IWR Plan. This software was developed to assist with the formulation and comparison of alternative plans. The software can assist with plan formulation by combining solutions to planning problems and calculating the additive effect of each combination, or "plan". Implementation costs used in the model include construction, operation and maintenance, monitoring, real estate, and interest during construction., Benefits were derived by implementing the HEP/HSI modeling process to calculate the average annual habitat units (the output) for each of the project plans. The IWR Planning Suite II, a software evaluation tool, was used to tabulate, graph and chart the cost effective (the alternatives that provide the least cost for a given level of output) and best-buy alternatives (the alternatives that provide the greatest output for the lowest incremental costs).

Once the Average Annual Habitat Units (AAHU) were determined, and the total implementation costs for each of the alternatives were estimated, the software model was used to eliminate the economically inefficient and ineffective solutions. The incremental cost for each of the plans (ordered by output) is displayed in the table below. Once the plans are ranked by increasing levels of output and their associated cost, the average annual cost, incremental cost, incremental output and incremental cost per unit are then calculated and reported. Table 5 summarizes the output levels for the cost effective and "Best Buy" plans, ordered by output.

Table 5. Incremental cost of cost effective and Best Buy plans.

Plan Alternative	Output (AAHU's)	Cost (AA Cost ($))	Average Cost (AA Cost / AAHU)	Incremental Cost (AA Cost ($))	Inc. Output (AAHU's)	Inc Cost Per Inc Output
No Action Alternative	0	0	0			
A -- Place 200Kcyds of Material	15.2	16,174.00	1,064.08	16,174.00	15.2	1064.08
D -- Place 200Kcyds of Material +CG	15.98	17,624.00	1,102.88	1,450.00	0.78	1858.97
B -- Place 300Kcyds of Material	18.24	18,200.00	997.81	576.00	2.26	254.87
E -- Place 300Kcyds of Material + CG	19.21	19,912.00	1,036.54	1,712.00	0.97	1764.95
C -- Place 400 kcyds of Material	22.8	20,226.00	887.11	314.00	3.59	87.47
F -- Place 400 kcyds of Material + CG	24.18	22,509.00	930.89	2,283.00	1.38	1654.35
I -- Place 400 kcyds of Material + W	25.38	33,655.00	1,326.04	11,146.00	1.2	9288.33
L -- Place 400 kcyds of Material + CG + W	26.23	35,689.00	1,360.62	2,034.00	0.85	2392.94

Note: CG = Complex Grading

Note: W = Planting of Willow Stakes

Figure 3 and Figure 4 are Cartesian graphs showing cost and output (AAHUs) for the plans noted in the previous table. The non-cost-effective plans are identified by blue circles, while the cost effective plans are identified by either red triangles or green boxes. The cost effective plans that produce the greatest output for the lowest incremental increase in costs are considered best-buy plans and are displayed as green boxes in the graph below. Figure 4 shows only data from the cost-effective and Best Buy plans.

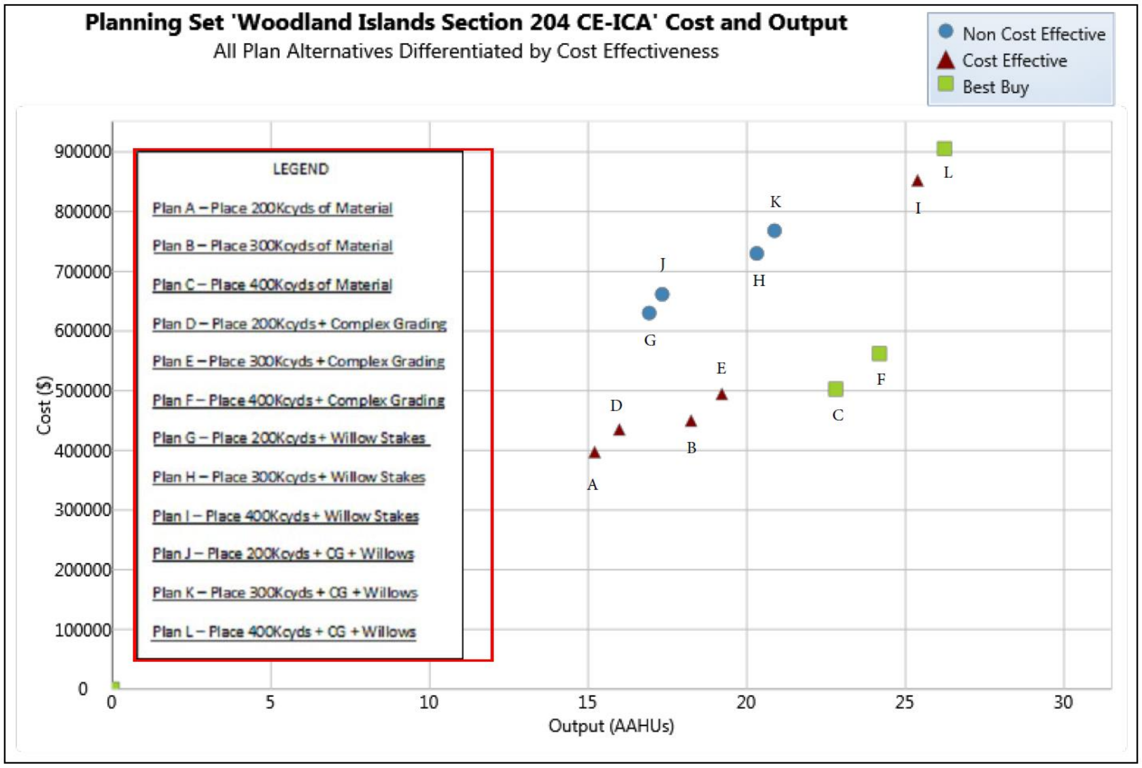

Figure 3. Graph of non cost effective, cost effective, and Best Buy plans.

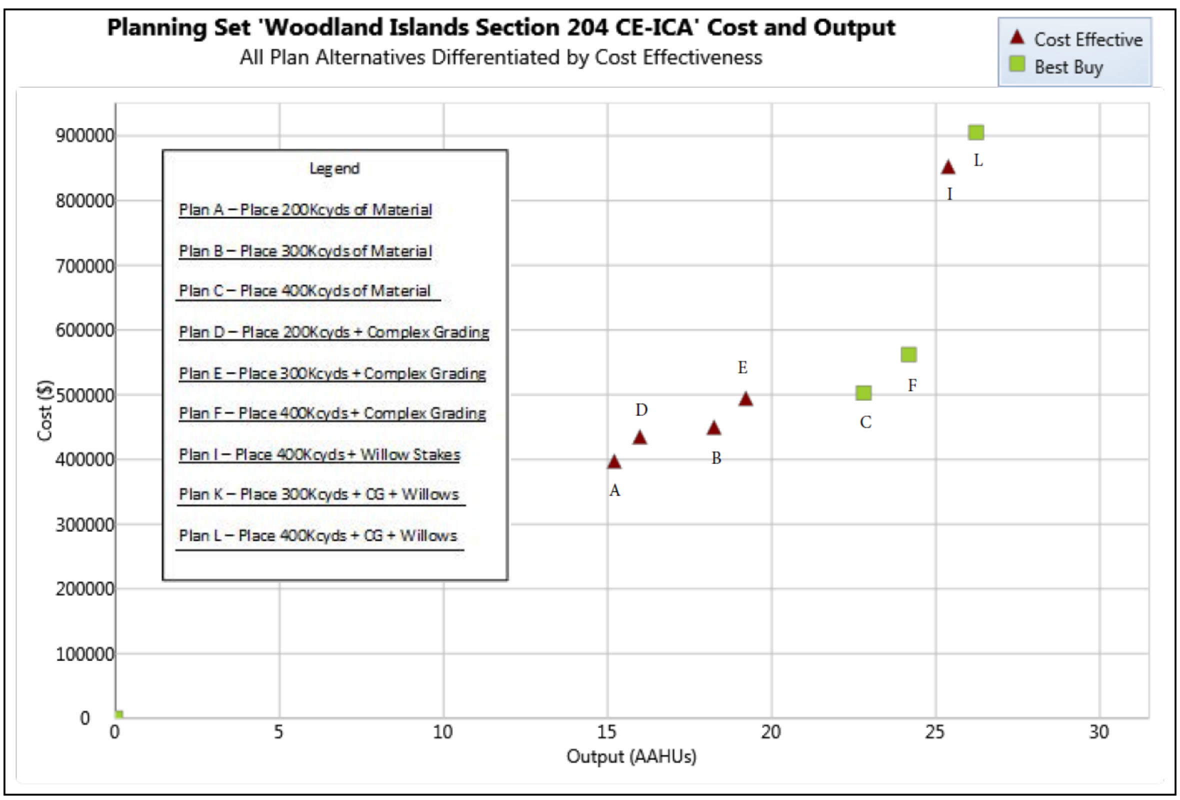

Figure 4. Graph of cost effective and Best Buy plans.

3.7 Final Array of Alternatives

The results of the CE-ICA produced three Best Buy alternatives. These three plus the No Action Alternative make up the final array of alternatives and were moved forward for detailed analysis and discussion in the EA (Section 4). The final array of alternatives are listed below:

- **No Action Alternative:** No placement of dredged material to restore aquatic and terrestrial habitat adjacent to Woodland Islands
- **Alternative C:** Base Measure (placement of 400 kcy dredged material)
- **Alternative F:** Base Measure (placement of 400 kcy dredged material) plus complex grading
- **Alternative L (TSP/Preferred):** Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation

3.7.1 Incremental Cost and Output of the Best Buy Plans

The three Best Buy plans, not including the No Action Alternative, are ranked by increasing output along with their associated cost, and then the average cost, incremental cost, and incremental cost per unit are calculated and reported in the table below:

Table 6. Incremental cost of best buy plans.

Plan Alternative	Output (AAHU's)	Cost (AA Cost ($))	Average Cost (AA Cost / AAHU)	Incremental Cost (AA Cost ($))	Inc. Output (AAHU's)	Inc Cost Per Inc Output
No Action Alternative	0	0	0	0	0	0
C -- Place 400 kcyds of Material	22.8	20,226.00	887.105	20,226.00	22.8	887.105
F -- Place 400 kcyds of Material + CG	24.18	22,509.00	930.893	2,283.00	1.38	1,654.35
L -- Place 400 kcyds of Material + CG + W	26.23	35,689.00	1,360.62	13,180.00	2.05	6,429.27

Note: CG = Complex Grading

Note: W = Planting of Willow Stakes

Figure 5 is a graphic illustration of the incremental benefits (Output) and the incremental costs per unit of output associated with each of the Best Buy alternatives. The advantage of the bar chart is that it visually displays the magnitudes of the incremental benefits (width of rectangle) and incremental costs (height of rectangle) for each of the Best Buy plans.

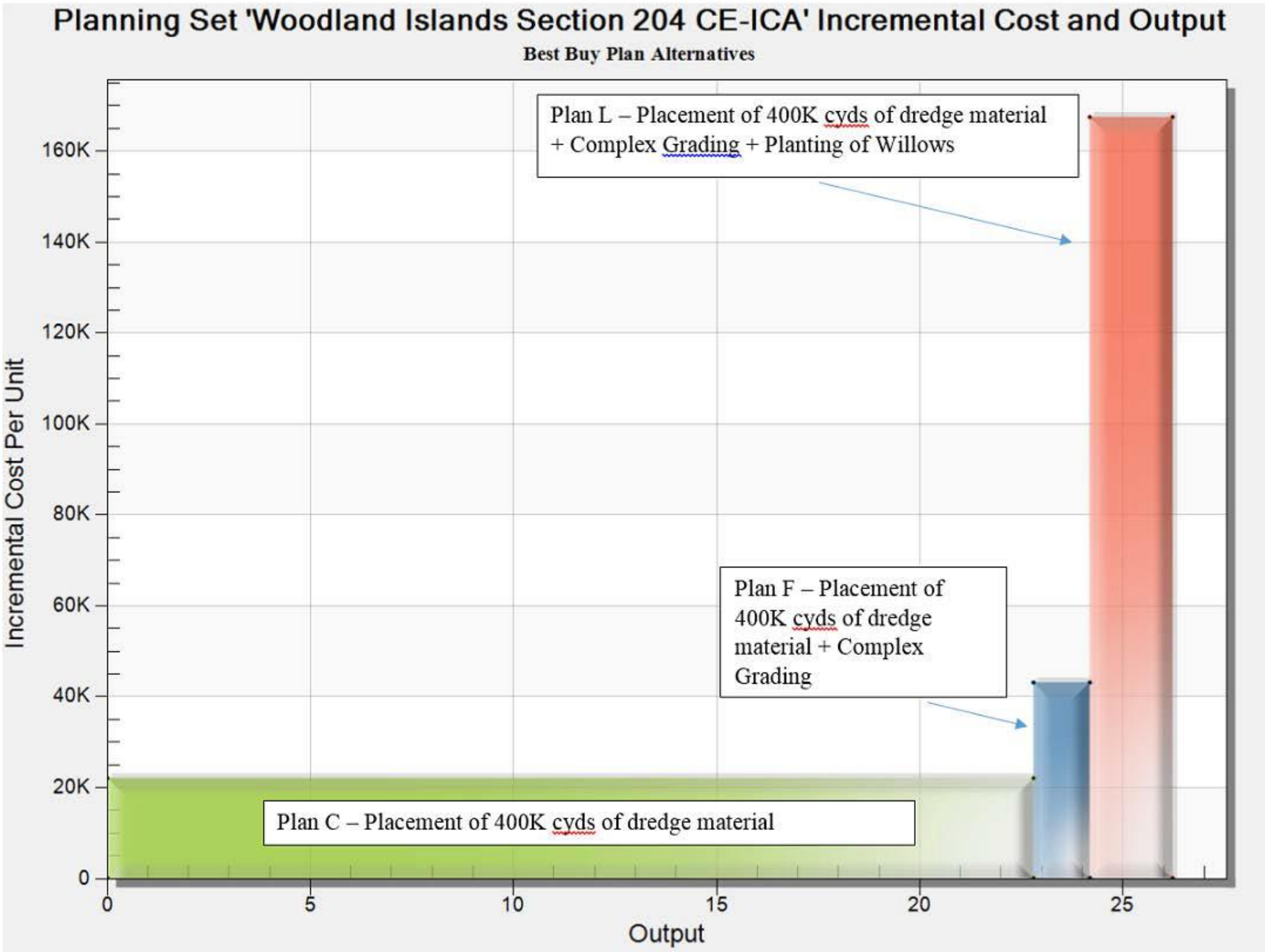

Figure 5. Incremental cost of Best Buy plans.

*3.8 Evaluation and Summary Comparison of Final Array of Alternatives**

The PDT compared and evaluated the Best Buy Alternatives amongst each other and considered other factors beyond the results of the habitat modeling and cost effectiveness and incremental cost analysis. While placement of dredged material (Alternative C) provides the benefits for relatively low costs, the PDT evaluated if it is "worth it" to select one of the other two Best Buy Alternatives.

3.8.1 Alternative F: Base Measure and Complex Grading

This alternative would add topographic diversity, including benches, variable slopes and more sinuous shoreline configurations, and flow-through channels. Factors that the PDT identified for evaluating this alternative include:

- The additional topographic diversity would provide resiliency for habitat establishment under future hydrologic scenarios and climate change impacts;
- Add more aquatic habitat complexity, more quickly;
- Complex grading would allow creation of more juvenile salmon habitat, which supports regional priorities for salmon recovery;
- Allows more topographic complexity for more complex/varied vegetation species to establish;
- Incremental cost increase is less than Alternative L, though not by a large value; and,
- This alternative provides an opportunity to learn for future beneficial use projects

3.8.2 Alternative L: Base Measure, Complex Grading, and Plantings

In addition to the complex grading described above, this plan also includes active planting of native vegetation between elevations of 10 to 14 feet NAVD. Factors considered in evaluating this alternative include:

- It would accelerate the development of target habitats;
- Vegetation planting is a typical practice for similar ecosystem restoration projects on the LCR;
- Would offset invasive establishment and/or shade them out once the planted willows establish;
- Would increase stability and decrease risks from erosion of the placed dredged material;
- Would help substantially reduce or prevent disturbance from incompatible recreation uses such as ATVs and accessing the islands via boat;
- Would reduce the likelihood of the need to obtain additional funding to re-mobilize and plant at a later date if natural vegetation does not establish; and
- Would add a visual cue for boaters to avoid newly created shallow water areas in the side channel area.

3.9 Summary of the Tentatively Selected Plan

Based on the evaluation and comparison of the three Best Buy Alternatives along with the No Action Alternative, the PDT selected Alternative L as the TSP/Proposed Action. As described below, the TSP/Proposed action is also the Preferred Alternative for NEPA processes. Alternative L has the greatest quantity of AAHUs with lower risk of non-native or invasive vegetation establishing than with Alternatives F and C. Alternative L includes placement of 400 kcy of dredged material; additional grading to create increased topographic diversity aimed at increasing habitat value and functionality, as well as stability; and planting of native willow stakes to create an even distribution of willow shrubs across the range of elevations (10 to 14 feet) to provide scrub-shrub habitat and help stabilize the placed dredged material.

Alternative L is also determined to be the National Ecosystem Restoration (NER) plan as defined in ER 1105-2-100. The NER plan reasonably maximizes environmental benefits considering cost effectiveness and incremental cost analyses, significance of outputs, acceptability, completeness, efficiency, and effectiveness. Alternative L is a Best Buy plan and is considered affordable at approximately one million dollars, while providing the greatest protection of the Federal investment. With the addition of plantings and additional grading, the site has increased resiliency and stability to withstand potential shear forces resulting from higher flows due to climate change and the potential resulting change in hydraulics. The implementation of Alternative L establishes important habitat and detrital material for a more complex ecosystem, which provides superior foraging opportunities for juvenile salmonids and improves protection and rearing opportunities for the yellow warblers. The relative impacts of the alternatives are summarized in Table 7.

Table 7. Summary comparison of alternatives.*

Alternative	Species	Habitat	Water Quality	Socioeconomic	Climate	Hydrology	Cultural
No Action	+-	+-	+-	+-	+-	-	+-
Alt. C	+	+	+	+	+-	+	+-
Alt. F	+	+	+	+	+-	+	+-
Alt. L (Preferred)	++	++	++	++	+-	+	+-

(-) = Negative impact
(+-) = Neutral impact
(+) = Positive impact
(++) = Highest benefit relative to the other alternatives considered

Key details of the TSP are summarized below:

Total project cost: $1.39 million (fully funded cost estimate to the midpoint of construction)

Acres restored: 28.2

Average Annual Cost/AAHU: $1,900 (FY 2018 price level) (Rounded)

Total Average Annual Habitat Units: 26.23

Habitat scarcity: The TSP restores nationally scarce habitats including those described in the Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead (NMFS, 2011) and the Columbia Estuary Ecosystem Restoration Program Strategy Report (BPA/Corps, 2012).

Connectivity: The TSP provides connection of existing habitat areas around the woodland islands complex. The plan also provides critical life requisites including a juvenile rearing and refuge habitat for ESA-listed salmonids species.

Special species status: The TSP directly restores habitat for federally listed salmonid species including Chinook salmon, chum salmon, and steelhead. Bull trout may also benefit from the action.

Hydrologic character: System hydrology is not impacted and remains a limiting factor in ecosystem health of the Lower Columbia River Estuary.

Geomorphic condition: Geomorphology is restored to the best attainable condition with dredged material remaining in the system and contributing to shallow water habitat typical in depositional zones (as opposed to being placed at higher elevations or removed from the system entirely.)

Self-sustaining: The recommended plan is designed to be environmentally self-sustaining with little to no O&M costs.

Plan recognition: The TSP is one element of an integrated restoration effort, contributing to a regional plan for restoration of the LCRE.

4 Affected Environment and Environmental Consequences of the Alternatives*

This section includes a description of the existing conditions (affected environment) in the study area and an evaluation and comparison of the environmental consequences of the alternatives carried forward for detailed analysis. The alternatives include the following:

No Action Alternative: No habitat restoration at Woodland Island would take place.

Alternative C: Base Measure (placement of 400 kcy dredged material)

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation

4.1 Physical Environment

4.1.1 Topography/Bathymetry

Existing Conditions

The Woodland Islands and side channel sit atop a shelf roughly 40 feet above the main channel. The pile dike network and islands created from dredged material help keep the 43-foot navigation channel in place while providing relative shelter to the side channel. While most of the island chain is lower than the ordinary high water level (OHW), there are several upland areas above 20 feet NAVD with the tallest over 35 feet NAVD.

Elevation ranges along the thalweg of the side channel are -10 to -5 feet NAVD, or typical water depths of 10 to 15 feet below mean annual low water. Sand bars project downstream from the islands into the side channel, creating shallower areas from 0 to 10 feet NAVD. Along the front side of the islands exposed to the main channel of the Columbia River, the terrain drops gradually toward the longitudinal pile dike around 0 feet NAVD and then more precipitously toward the navigation channel at approximately -40 feet NAVD. Figure 6 shows a contour map of the site.

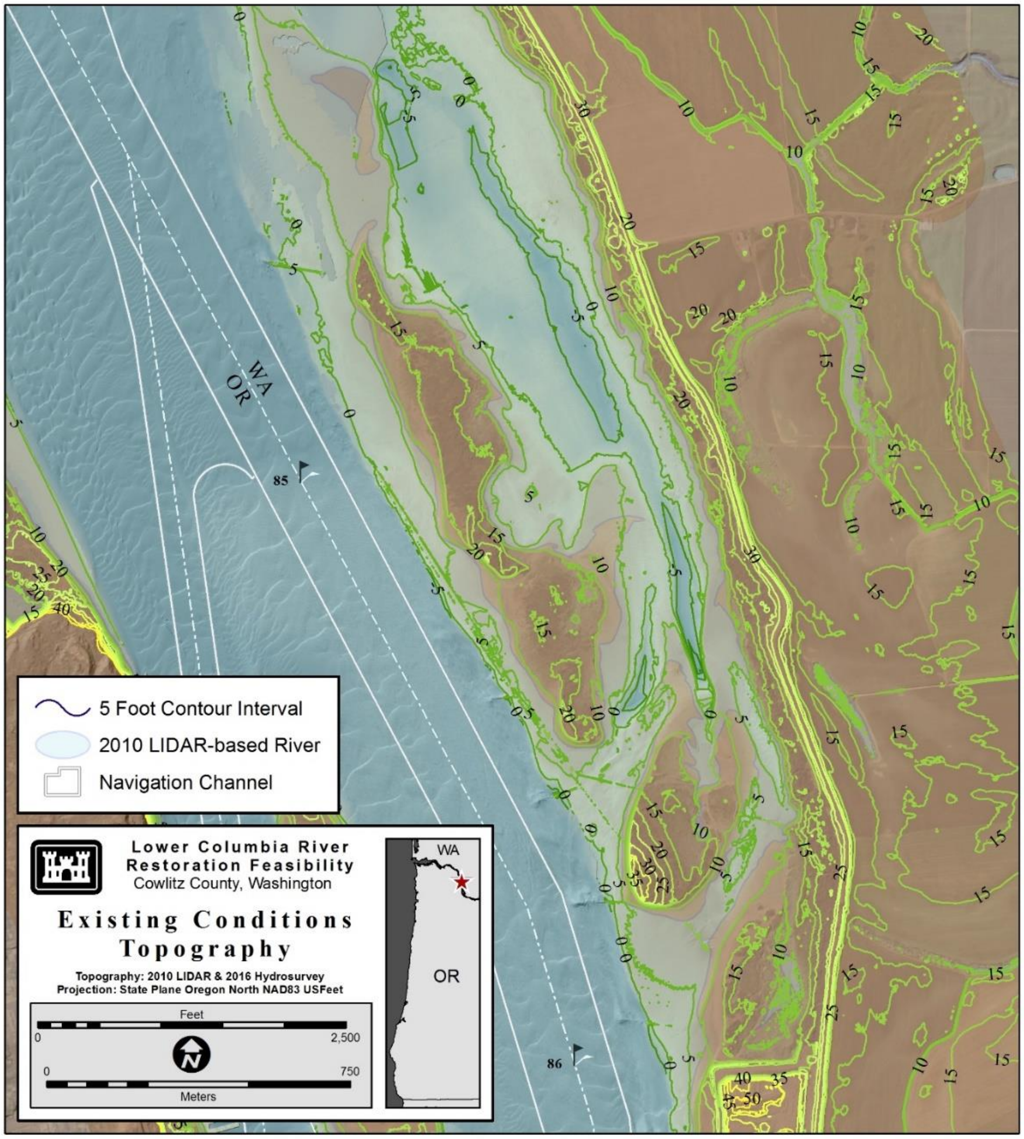

Figure 6. Contour map of the site showing typical ground surface and bed elevations.

Figure 7 shows terrain data focused on tidal, sub-tidal, and deep water elevations. From left to right is shown the deeper channel and the sand bar, as well as the relatively shallow cove. Cross-sections cut from the terrain data show elevations through the sheltered cove on the backside of the north island.

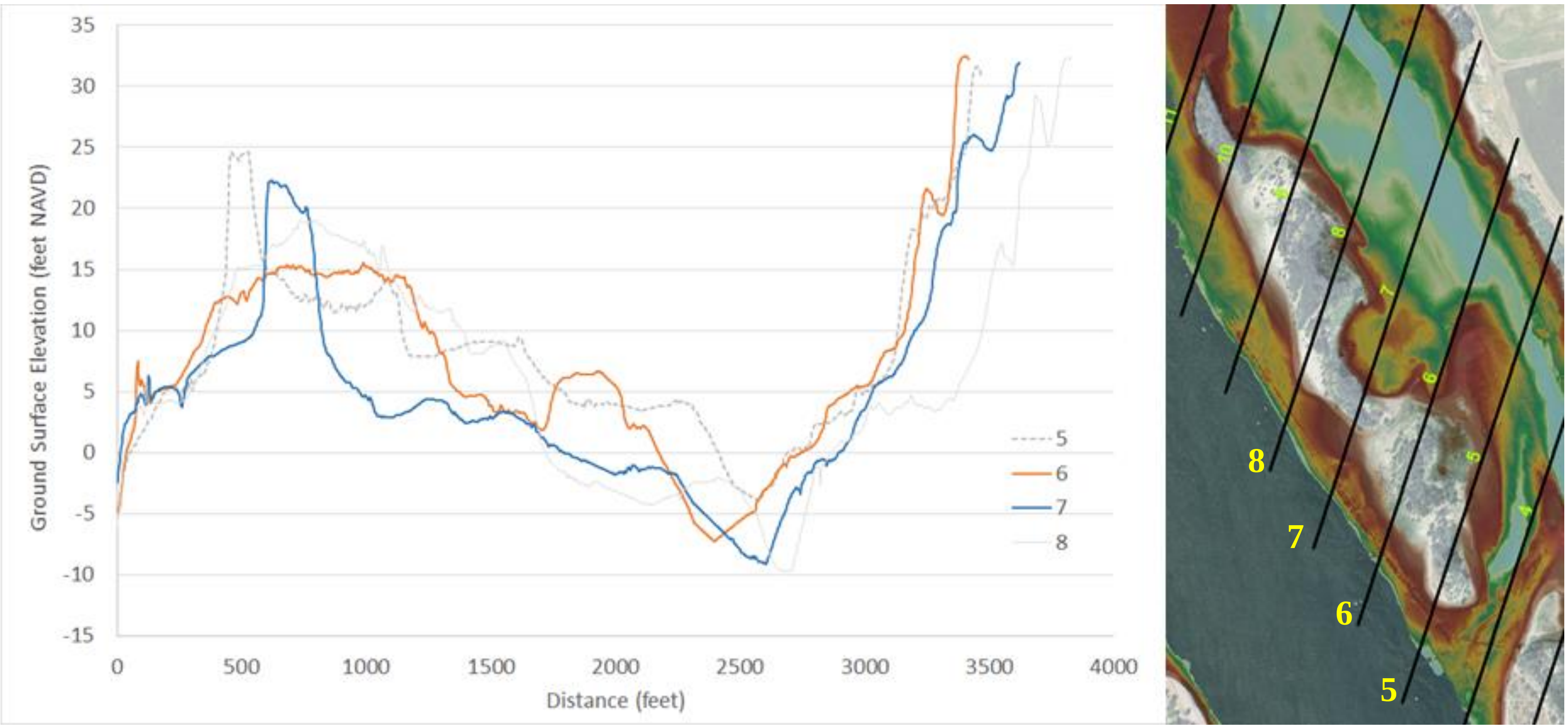

Figure 7. Cross-sections showing typical elevations across the islands and side channel.

Effects of the Alternatives

No Action Alternative

Under the no action alternative, no dredged material from St. Helens Bar would be deposited in the side channel area of the Woodland Islands site. There would be no short term increase in ground surface elevations and most of the side channel would remain deeper water habitat. The ground surface elevations of the islands and side channel would continue to be shaped by erosional and depositional forces consistent with recent patterns. See the fluvial morphology section for further discussion on sedimentation at Woodland Islands.

Alternative C: Base Measure (placement of 400 kcy dredged material)

All of the alternatives considered include pumping 400 kcy of dredged material along the shoreline and into the side channel on the eastern side of the project islands. The dredged material is used to create peninsula-like features that effectively convert deeper water areas to shallow water and upland areas by increasing bed elevations. Compared to other alternatives, Alternative C does not include additional grading or planting following placement. It simply includes creating the two features in the most basic design (angle of repose assumed to be 10:1, top areas are gently sloped at elevations 10 to 14 feet NAVD, no additional contouring, no manual planting.)

The total placement footprint is approximately 30 acres, over which the bed elevations are raised as much as 15 feet. The placed material results in an additional 20 acres at elevation ranges considered intertidal or upland (6 to 14 feet NAVD), and conversion of roughly 10% of the open water side channel. Maximum depths in the channel are expected to remain the same or deepen slightly, while the average elevation in the side channel is slightly increased. A detailed hypsometric analysis was performed on a design terrain that includes complex grading. This analysis is described in the following section. The alternative without complex grading results in a slightly smaller foot print with a larger fraction of the total material placed at higher elevation; otherwise, the analysis represents the topographic/bathymetric changes that would occur with Alternative C.

Placed material is assumed to impact the hydraulic and morphological regime locally in the side channel. See the following sections for discussion of hydraulics and fluvial morphology.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

Under Alternative F the dredged material would be graded to add topographic diversity and expand areas at target elevation ranges. Figure 8 shows the two placement features with the additional topographic diversity resulting from complex grading.

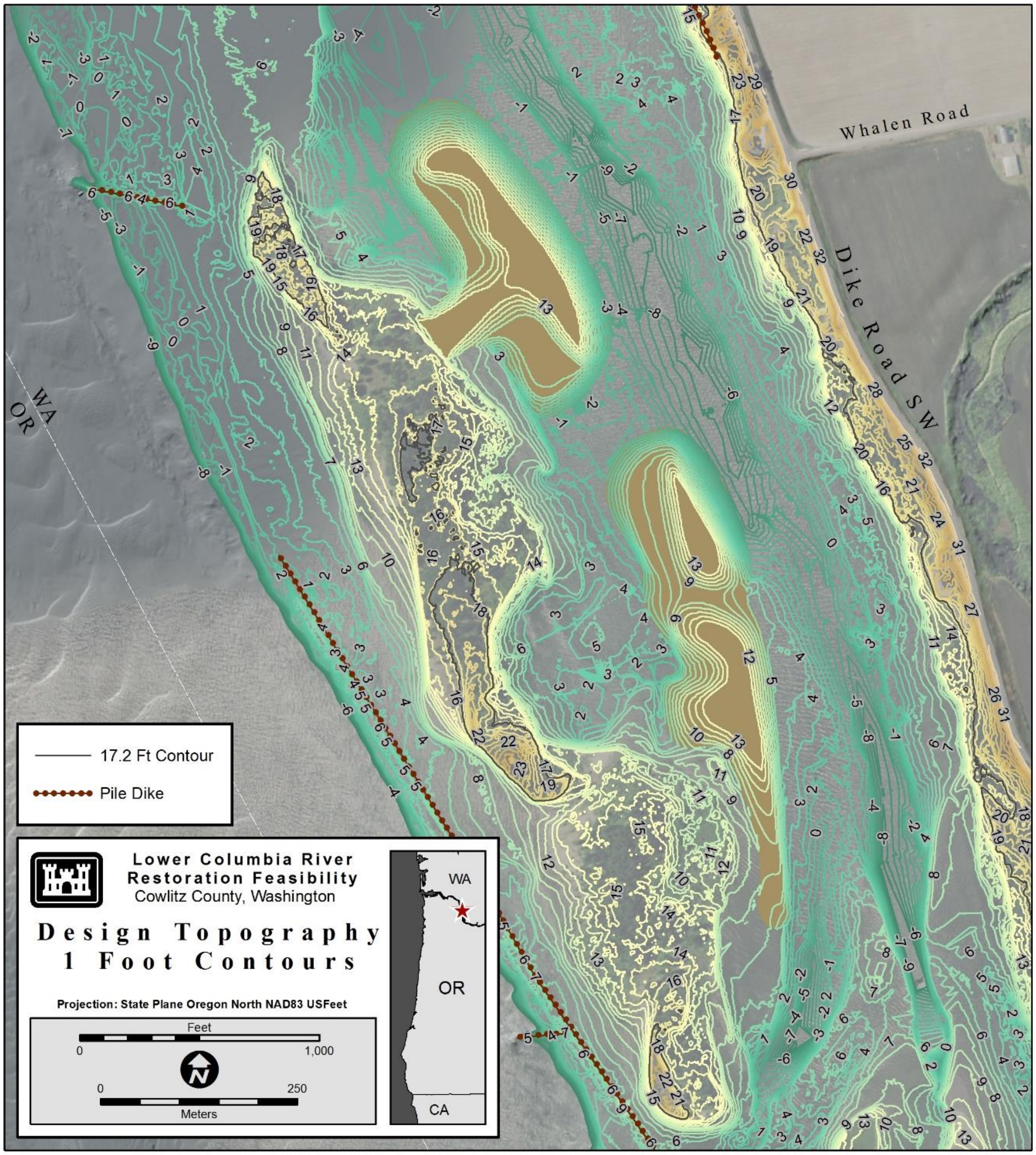

Figure 8. Conceptual terrains depicting added topographic diversity possible with additional grading.

The impacts of complex grading to the expected habitat are related to changes in topography. Through complex grading, shallow water shelves are created in the intertidal range (between elevations 6 and 9 feet NAVD), and shoreline length is increased by creating shallow inlets and pushing upland areas out and thereby reducing the single slope occurring with the basic placement. A cross-feature channel on the upstream placement converts material placed at upland elevations and converts it to intertidal range. The total footprint of the placement area is slightly increased with complex grading as well.

An analysis of the existing terrain and with-project terrain including complex grading was completed to evaluate net increase in selected elevation ranges. Figure 9 depicts the inundation extents at different elevations along with the proposed placement footprints. Figure 10 shows hypsometric curves for the existing and with-project conditions within the placement footprint.

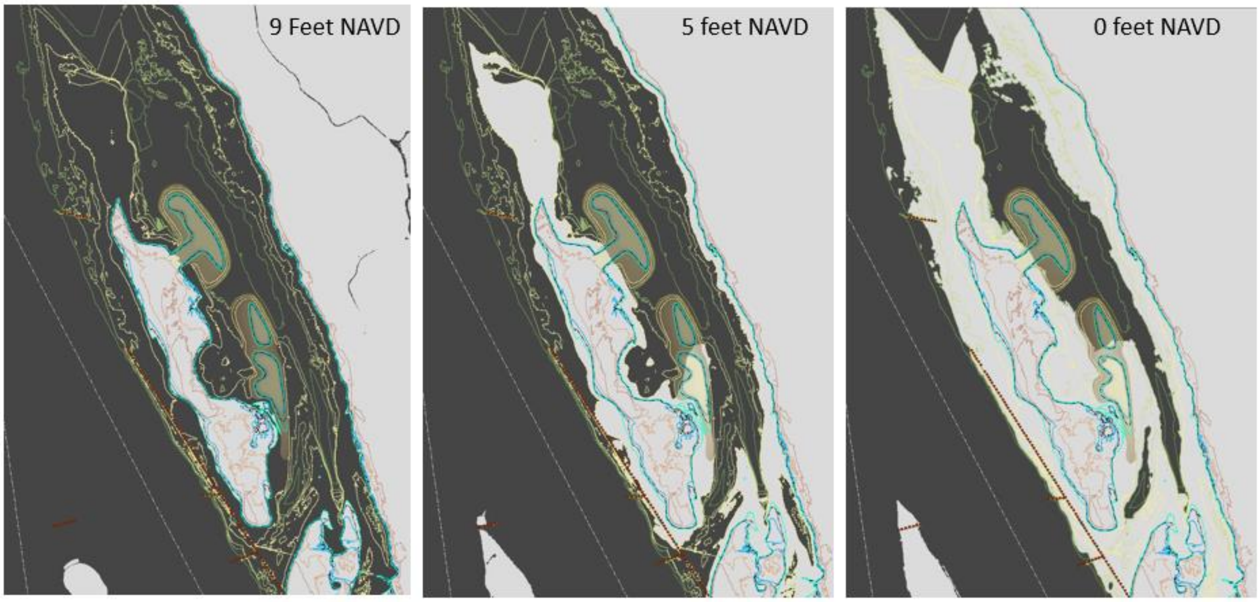

Figure 9. Maps indicating inundated area boundaries for 9 ft, 5 feet and 0 feet NAVD.

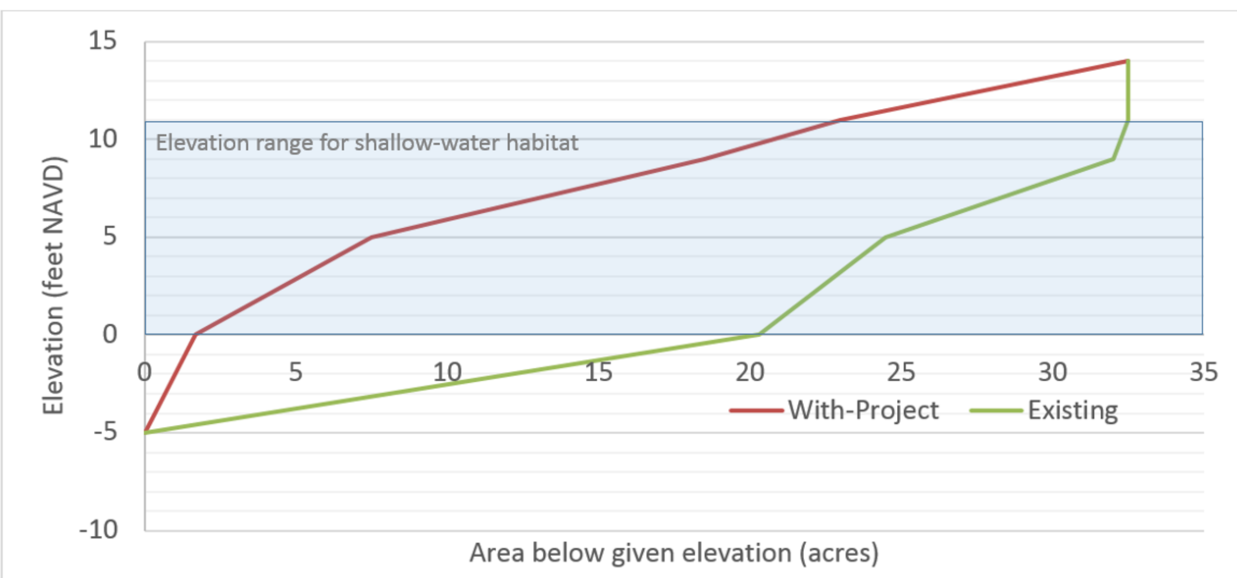

Figure 10. Elevation-area curve from the existing and with-project terrains.

The elevation-area curve in **Error! Reference source not found.**6 shows that within the placement boundaries, nearly two-thirds of the existing area (20 of 32 acres) has bed elevations lower than the targeted shallow water depths, zero to 11 feet NAVD. With the use of dredged material, bed elevations are raised such that less than 10% of the area is below zero feet NAVD, and an additional 8 acres with the shallow-water habitat zone area added. About 10 of the 32 acre footprint would be brought above 11 feet NAVD in order to increase stability and sheltering effect to the larger side-channel area. Target habitat zones as they related to elevation ranges are discussed more in the Hydrology and Hydraulics Appendix (Appendix B).

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

Alternative L is the same as Alternative F but includes strategic plantings in the created upland areas, along the shoreline and in the shallow water habitat zone. Willow plantings would not significantly modify the topography or bathymetry of the eastern edge of the islands, so the elevation-area data reported for Alternative F applies to this alternative. Plantings would play an important role in increasing stability and, therefore, would impact the future topographic conditions of the site. Expected changes in topography and bathymetry associated with erosion, deposition, and general plan form changes are discussed in the Fluvial Morphology section.

4.1.2 Hydrology and Hydraulics

Existing Conditions

The Columbia River drains over 259,000 square miles across most of the Northwestern US and some of Canada, and it has an average annual discharge of over 210,000 cfs. The river is highly controlled with dozens of flood control and water storage projects throughout the basin. The downstream-most project in the basin is Bonneville Dam at RM 146. Discharge from Bonneville and the upstream reservoirs is dominated by the annual spring freshet event, typically occurring from April to July. Below the dam, major tributaries including the Willamette River, Lewis River, and Cowlitz drain into the lower Columbia River reach and can add considerable volume to the Columbia River during winter flood events.

Tidal influences on the Columbia River occurs as far upstream the Bonneville Dam (RM 146). At the Woodland Island sites (RM 84 to 85.5), a strong tidal signal can be seen almost year-round with the most extreme effects including flow reversals occurring during the lower flow months of the summer and fall.

Tidal metrics and measured water level data from the NOAA gauge at St Helens, Oregon at RM 86, directly across from the Woodland Islands site are available on the "Tides and Currents" website (http://tidesandcurrents.noaa.gov/waterlevels.html?id=9439201). Table 8 lists NOAA's tidal data and Figure 11 depicts measured stage data, NOAA tidal metrics, and the 50% exceedance probability flood elevation at the project area.

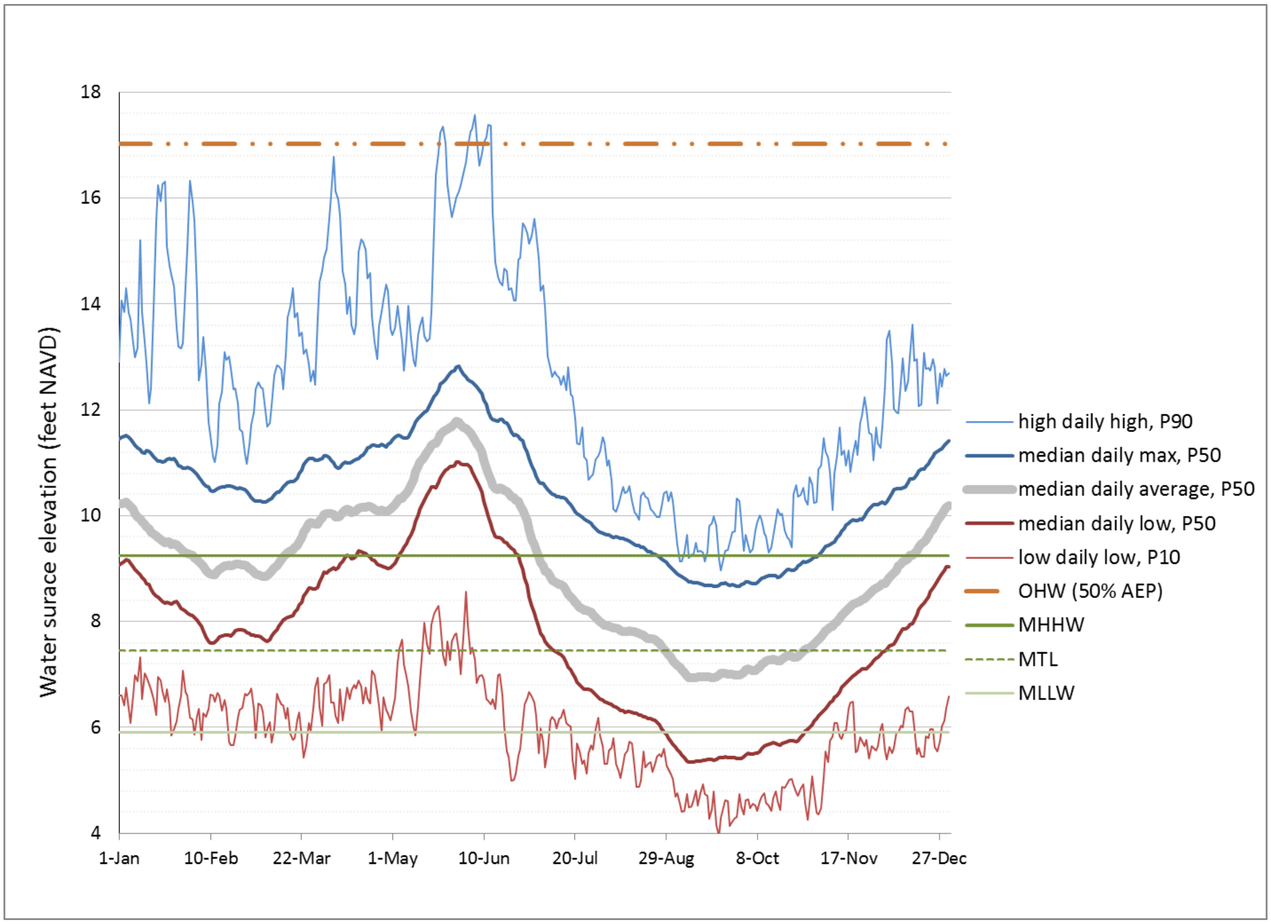

Figure 11. Summary of measured stage data at St Helens, Oregon along with NOAA tidal metrics and OHW.

Table 8. Elevation data for OHW and tidal metrics at Woodland Islands.

St Helens gage (NOAA 9439201) at RM 86.1 (feet NAVD88)	
OHW*	17.10
MHHW	9.24
MHW	8.74
MTL	7.45
MSL	7.44
MLW	6.15
MLLW	5.91
0 feet CRD	4.14
* calculated for RM 85.5	

Much of the islands are frequently inundated during seasonally high water levels including winter rain events, and most of the area is inundated during OHW. Figure 12 shows the islands inundated at four different water surface elevations. A stage hydrograph showing the available record of measured daily data at the NOAA gage at St. Helens just upstream of the Austin Point is also included in the figure.

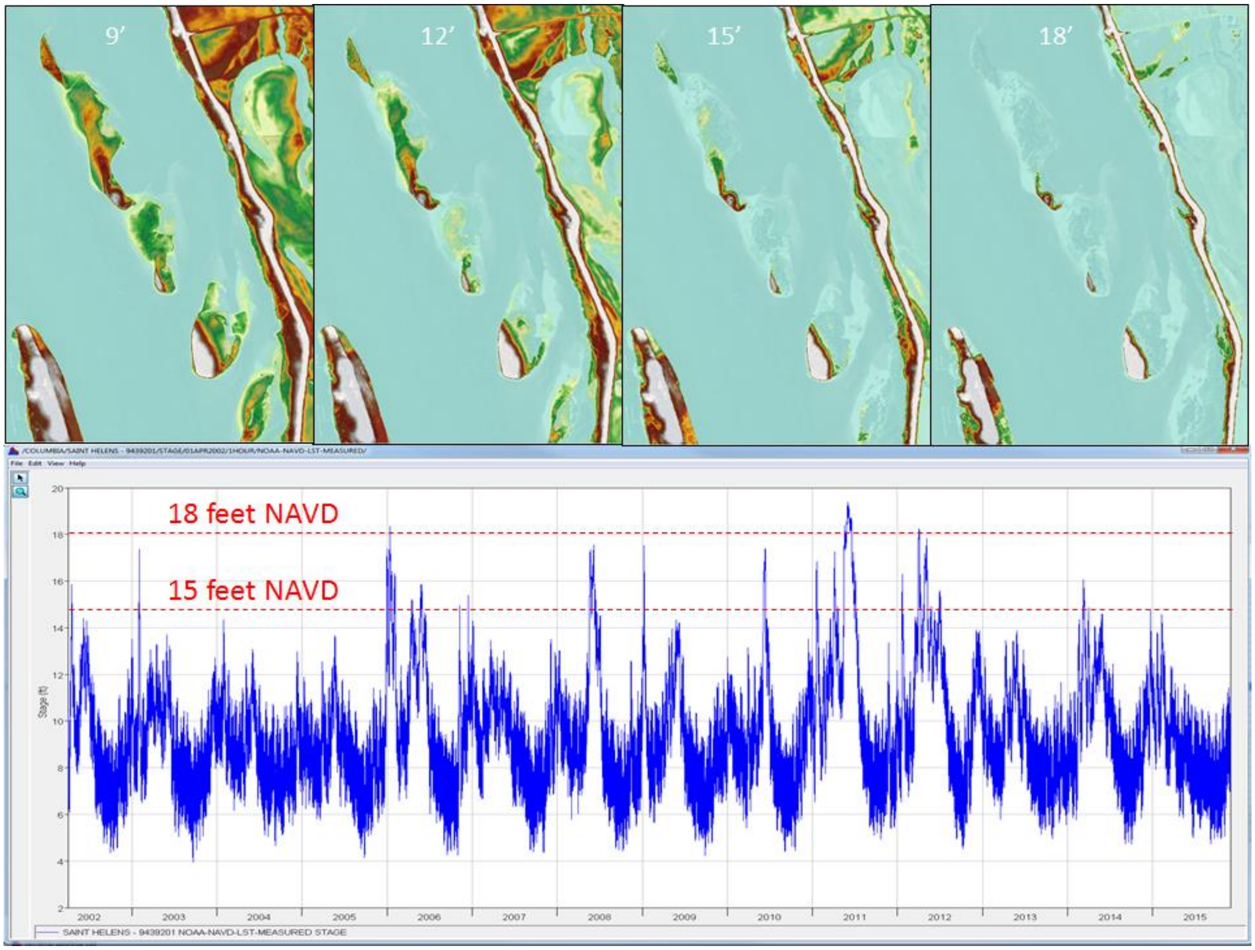

Figure 12. Existing terrain and inundated area graphics and measured water level data. All elevations in feet NAVD88.

During the low water season, an average day flow of roughly 100,000 cfs is flowing by the Woodland Islands site. The island chain is generally out of the water and retards main channel flow from entering the side channel. Some flow passes through the inter-island channels, but velocity quickly dissipates once inside the side channel. Flow reversals are possible in low flow periods at Woodland Islands late in the summer.

Flooding typically occurs during the spring freshet but can also occur as a result of winter rain. For example, in February 1996 the river crested at just over 27 feet NAVD, the fourth highest stage recorded at St Helens. The flood of record occurred in June 1948, which produced a stage of over 31 feet NAVD.

Combined (winter and spring annual peak) probability flood profiles were produced from for the lower Columbia River based on one-dimensional, unsteady flow model results and statistical analysis. The profiles are indicators for expected probability of flooding and for defining critical annual exceedance probability (AEP) flooding events. Table 9 summarizes the flood frequency elevations computed for St Helens at RM 86 at the upstream end of the site.

Table 9. Elevation of key annual maximum frequency discharges.

Event Frequency	Water Surface Elevation (feet NAVD88)
50% AEP (2-year)	17.0
10% AEP (10-year)	21.5
2% AEP (50-year)	24.9
1% AEP (100-year)	26.2
0.2% AEP (500-year)	29.3

A levee on the Washington bank effectively separates the Columbia River from the historic floodplain situated on alluvial materials from the Lewis Rivers. The "Cowlitz 2 (Woodland)" levee located along the Washington bank has an elevation of 30.5 to 32 feet NAVD88, which is well above the 500-year flood elevation. Due to the presence of low hills around St Helens on the Oregon side and the Cowlitz levee on the Washington side, flow is effectively confined to the main channel of the river for all but the rarest floods (<0.2% AEP).

While much of the islands are submerged during high water, flow through the existing side channel is minimal compared to the main channel. The side channel is relatively shallow and much of the cross-sectional area is considered ineffective or not contributing to conveyance due to the presence of the islands and pile dike network.

Effects of the Alternatives

No Action Alternative

Under the No Action Alternative, regular channel maintenance activities would continue with dredged material being placed at other locations in order to maintain the required channel depth. While not necessarily constant over time, channel capacity in this stretch of river will be similar with the bulk of flow concentrated in the main channel and some flow passing across the islands and through the side channel. No dredged material would be placed within the Woodland Islands side channel, and hydraulics in this stretch of the river would remain unchanged. Changes to the 1% AEP flood profile and other similar theoretical metrics could still result from other drivers, such as changes in dam operation within the Columbia River basin or climate change scenarios such as more extreme winter floods or sea level rise. Under the No Action Alternative, hydrology and hydraulics in the project area would not be expected to change in the short term.

Changes in local hydrology (with the site) may result from continued erosional and depositional patterns, which are discussed in the Fluvial Morphology section.

Alternative C: Base Measure (placement of 400 kcy dredged material).

Alternative C includes the placement of 400 kcy of FNC-dredged material in the side channel without additional grading or planting. The created features would not be large enough to affect Columbia River hydrology in the reach (e.g. tidal metrics, average water level) and, because most of the placed material would be within the hydraulic shadow of the existing islands, there is an insignificant impact to the conveyance capacity of the Columbia River in this reach and no change to the water surface profile during large flood events. With no change in AEP water levels, no significant impact to floodplains would be expected under this alternative.

On a more local scale, the placed material can be expected to result in local hydraulic changes both by restricting the flow area and increasing the shelter effect in the side channel. A two-dimensional hydrodynamic model was built using the Corps' Adaptive Hydraulics (AdH) software to explore the existing and with-project impacts. The model results show spatial changes in the velocity data occurring primarily during high and low flood conditions with minor or no effect in river current during low river flow conditions. The impacts diminsh with increasing distance from the channel thalweg and as discharge falls below 250,000 cfs. See Appendix B for more results and detailed discussion. Figure 13 provides a glance at AdH model results during high flow conditions.

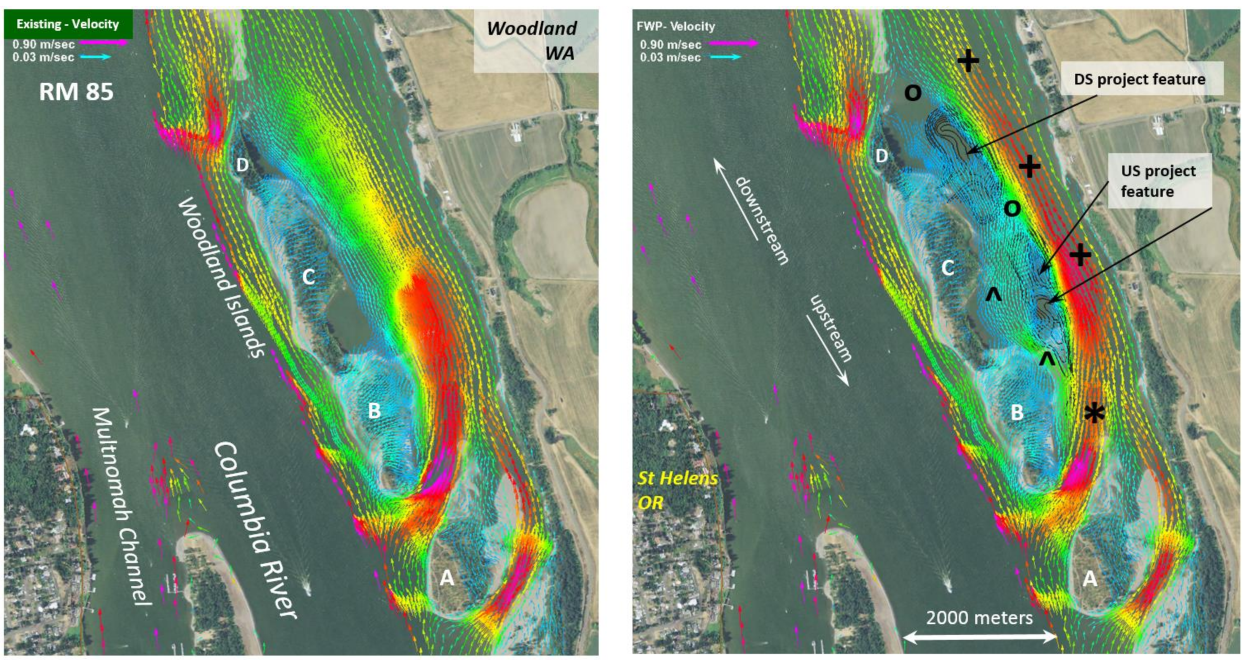

Figure 13. AdH model results showing velocity vectors for existing (left) and with-project conditions (right) during high flow conditions, (650 kcfs peak, similar to 2017 freshet).

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

Alternative F includes complex grading in addition to the base placement of 400 kcy. Alternative F would generally have the same effects on hydrology and hydraulics as Alternative C compared to the No Action Alternative. However, there would be minor increases in the complexity of onsite hydraulics compared to Alternative C. This would include increased circulation in the upstream embayment area, greater sheltered effects along the shoreline, and other localized impacts on the constructed features themselves.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

Alternative L includes plantings in addition to the complex grading of Alternative F. The impacts to hydrology of the Columbia River are still negligible. However, the additional density and height of planted willows will increase roughness on the constructed features and in the side channel overall. The effect of increased roughness on the features will accentuate local hydraulic effects (described for Alternative F), and increase overall impacts of adding material in the side channel (described for Alternative C).

4.1.3 Fluvial Morphology and Navigation

Existing Conditions

The river in this location has been continuously changing since the late 1800s when the major pile dike system was built to train river flows and help maintain a deeper channel for navigation. The pile dike system and tens of millions of cubic yards of dredged material created a new regime that included a relatively narrow, main channel and a relatively protected bay along the WA shore by the 1970s. Since the placement ceased by the end of the 1970s, erosive forces from periodic flooding has shaped the island chain that is there today. Appendix B contains historic imagery of the islands, illuminating the near constant change of the site over the past century. Figure 14 shows the change in island extents using 1977 imagery and 2015 topographic data.

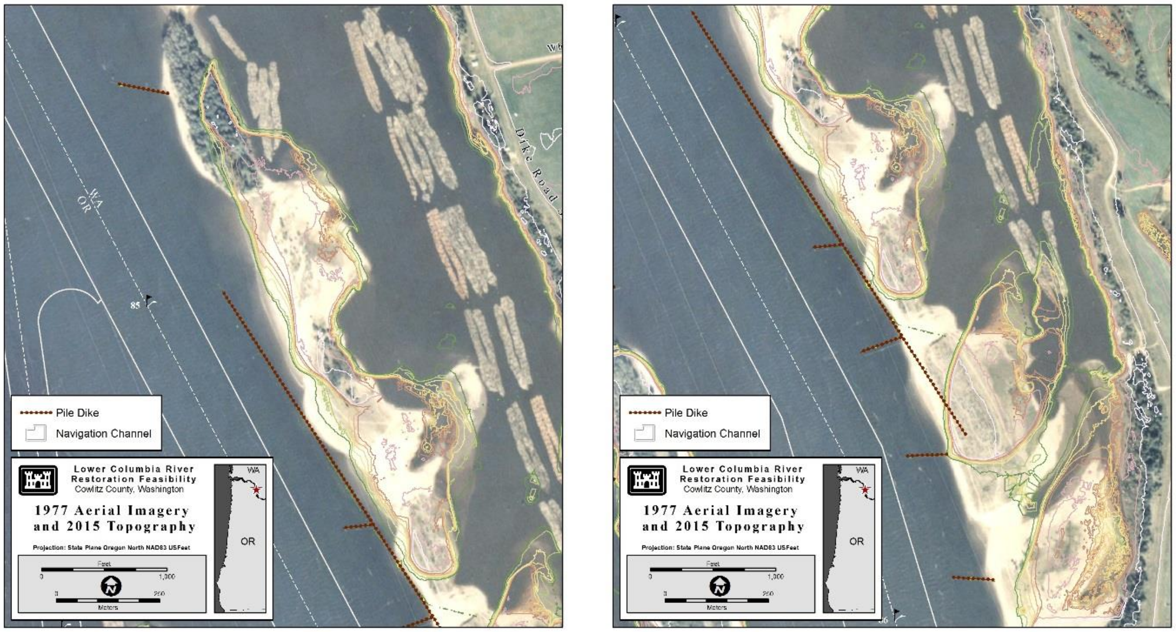

Figure 14. Shoreline migration from 1977 to present.

The existing pile dike network is playing a crucial role both in helping maintain the FNC and in reducing the rate of erosion of the island complex. The pile dikes are anticipated to be maintained such that they provide the existing functionality though the remainder of the planning horizon.

A general trend is active erosion on the upstream and main-channel-side faces of the islands and deposition on the large sand flat forming immediately downstream of the island, or within the protected side-channel sides. For material deposited behind the islands, either intentionally or via erosion, and transport occurring with a flood event, the trend is away from active channels toward the sheltered areas, creating a wrap-around appearance. Figure 15 shows the general erosive and deposition areas. It also shows relatively stable areas on the protected side that have shown almost no change. The black line indicates the 1995 shoreline compared to the shoreline as seen in 2011 shoreline.

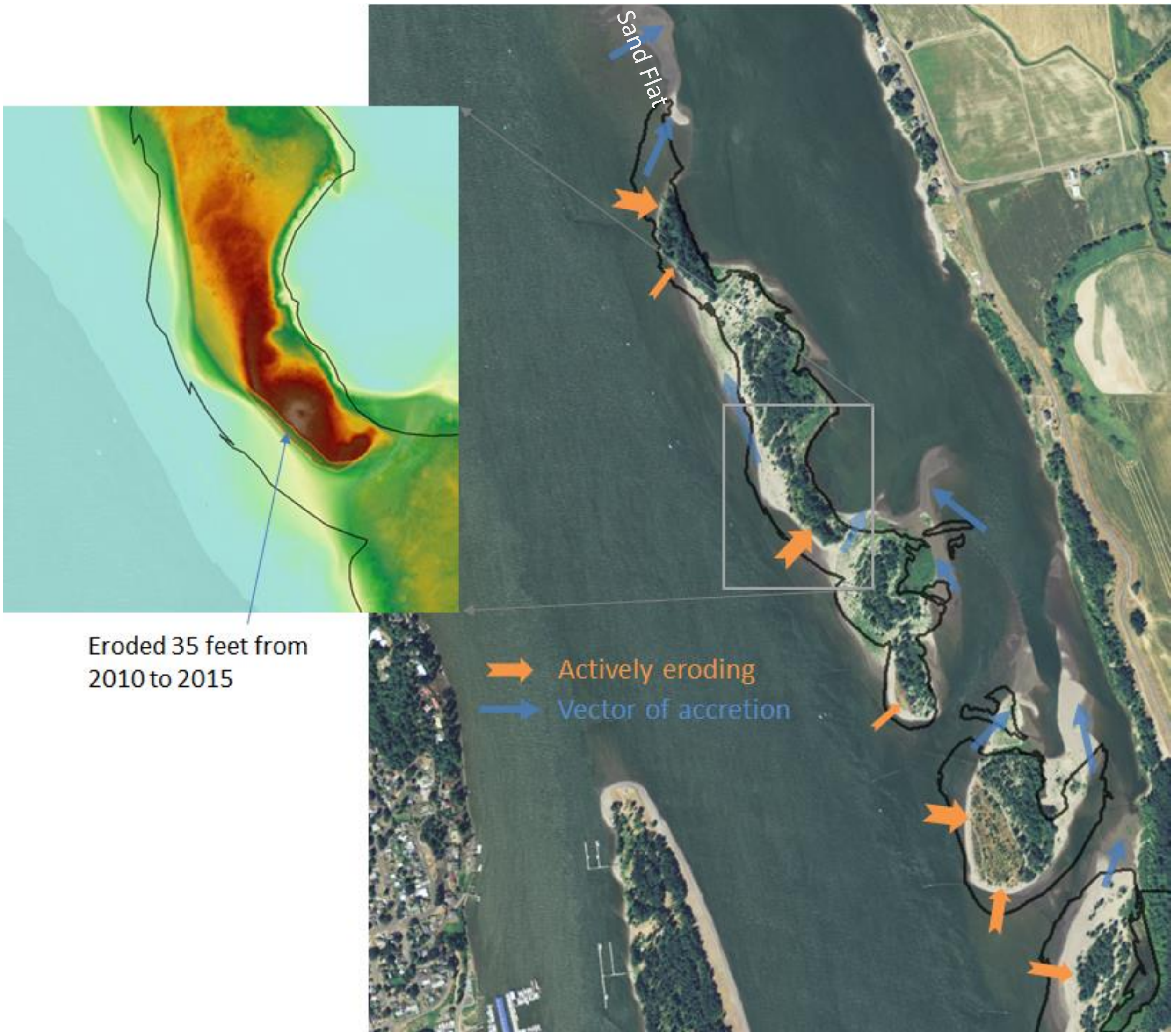

Figure 15. General morphology and detailed comparison of topography from 2010 to 2015.

Rates of erosion and accretion are challenging to estimate due to limited data. Described in greater detail in Appendix B, aerial imagery over the past 50 years shows a loss of approximately 23 acres above OHW, and the loss rate appears to be slowing over the past 30 years. The connecting channels appear to be deepening and widening, but bed elevations appear to be increasing in the hydraulic shadow of the island, particularly in the sheltered embayment areas and on the large sand flat immediately downstream of the islands.

The volume of material that has accreted downstream and in the side channel may be similar to the amount that has eroded from the islands. Material eroded from the front side of the islands is either deposited on the growing sand flat downstream of the islands or is returned to the main channel and FNC downstream. Conversely, it is likely most of the material that has deposited in the side channel area during past flood events has stayed there. Some material may pass through the side channel area and eventually return to the main channel downstream, but the side channel is generally considered a sediment sink and will continue to slowly aggrade.

There are navigation features adjacent to the proposed placement site. Figure 16 shows the project area, bathymetry, and navigation elements including the FNC boundaries and an anchorage area designated by the U.S. Coast Guard for deep draft ships located near RM 84 just downstream of the sand flat. Sediment dynamics related to the FNC and anchorage area are described in greater detail in the Appendix B.

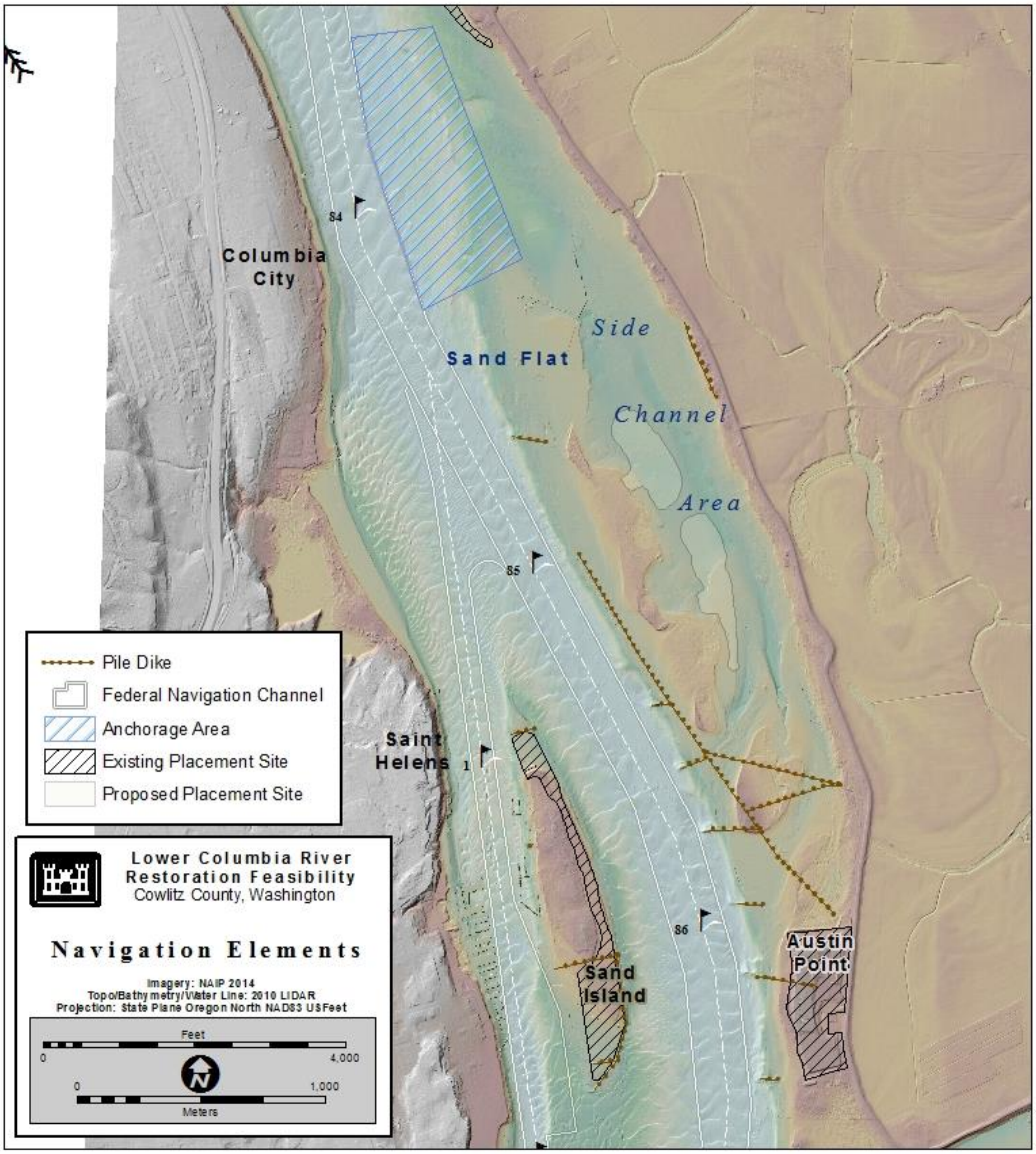

Figure 16. Navigation elements near Woodland Islands.

Effects of the Alternatives

No Action Alternative

Under the No Action Alternative, dredged material would not be placed in the Woodland Islands side channel area; thus, no additional sediment would be made available in the side channel for the subsequent formation of tidal finger channels, tidally submerged peaks and troughs, and other fluvial variations in that could influence the movement of water and sediment throughout the system.

The islands would continue to shift and migrate as they have over the last 50 years with erosion typically on the main channel shoreline and deposition on the side channel shoreline. Bed elevations will continue to slowly accrete in the side channel as island-overtopping floods mobilize material from upland island areas and then deposit material at lower elevations.

No direct adverse or beneficial impacts on these navigation features are anticipated if no action were taken for the proposed project. Maintenance dredging of the FNC would continue to occur as needed and the material would continue to be placed at sites that support maintenance of the FNC. Eroded material from the existing islands will continue to deposit on and grow the existing sand flat, and some material will eventually migrate to the FNC downstream of the project.

Alternative C: Base Measure (placement of 400 kcy dredged material).

Adding 400 kcy of dredged material to the side channel is expected to cause notable changes to the morphological regime within the side channel area. The proposed placed features would provide additional protection to the existing shallow water alcoves, increasing accretion of fines and habitat development in those areas. As flow dynamics are changed, bed elevations are expected to adjust in response, maintaining a similar degree of hydraulic resistance across the reach. There would be a concentration of flow within the side channel outside of the embayment areas, between the features and the WA shore, and a potential for slight bed degradation (less than 2 feet) as the system adjusts to the new hydromorphic regime. The AdH model introduced in the previous section and described in detail in the Appendix B was created to help quantify anticipated with-project changes in hydraulics and fluvial dynamics described in this section.

Periodic flood events would result in redistribution of the newly-placed material on and behind the islands, potentially eroding or burying established habitat areas. Over time, the placed dredged material features will undergo periodic redistribution of material, with some placed material at higher elevations (above 10 feet NAVD) mobilizing and settling at lower elevations, ultimately expanding the extents of the fringe wetland zone (7 to 9 feet).

Similar to the No Action Alternative, the larger island network is expected to continue to morph in response to periodic flooding, with deposition occurring downstream and the side channel area expected to continue slowing filling. Material placed in the side channel area would likely remain in the side channel area, not causing an increase in sediment deposition in the FNC or anchorage area further downstream, so there are no anticipated direct adverse or beneficial impacts on navigation features under this alternative.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

This alternative includes complex grading after placement. The effect of complex grading on the features are less smooth slopes, more stark transitions between different elevation zones, and more hydraulic connection from the side channel to the upstream embayment area.

The effects on fluvial morphology under this alternative would be substantially similar to those discussed above under Alternative C. However, with complex grading, peaks and troughs created with sand would likely be smoothed out somewhat over time by currents and wave action. Depending on the slope of the contours created, and how obliquely currents connect with the sand formations, the surface of the placed dredged material features may change substantially after high water events. The eventual flattening out of shaped features under this alternative is not considered a negative effect and it would not adversely impact fluvial morphology of the system as a whole.

Because the effects on fluvial morphology would be substantially similar to those discussed above under Alternative C, there are no anticipated direct adverse or beneficial impacts on navigation features under this alternative.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

The anticipated effects of Alternative L on fluvial morphology are largely the same as those impacts discussed under Alternatives C and F. However, the presence of vegetation after construction will help anchor the placed material and reduce the risk of erosion and rate of deformation of the constructed features. Alternative L (Preferred) will further concentrate the accumulation of fine material into the marsh flat areas and other relatively low velocity areas, which is expected to facilitate plant grown and development and add to the benefits from plant anchoring and accretion of fines.

Because the effects on fluvial morphology would be substantially similar to those discussed above under Alternative C and F, there are no anticipated direct adverse or beneficial impacts on navigation features under this alternative.

4.1.4 Water and Sediment Quality

Existing Conditions

Section 303(d) of the Clean Water Act (CWA) requires states to identify and establish a priority ranking of those waters within its boundaries that are not able to meet applicable water quality standards. Section 303(d) also requires that states establish total maximum daily loads (TMDLs) necessary to meet the applicable water quality standards for each listed waterbody. The

Columbia River within the project area has been inventoried by the Washington Department of Ecology (DOE) and the Oregon Department of Environmental Quality (DEQ) as having impaired water quality and is listed on the Section 303(d) list for each state. The entire lower Columbia River from Bonneville to the ocean is listed as impaired at some point for multiple pesticides, dioxins, PAHs, dissolved oxygen, temperature, and mercury.

Sediments in the Columbia River navigation channel were sampled near Woodland Island in March 2016 and analyzed for grain size and total organic carbon (TOC). Four sediment samples were collected from the FNC at RMs 82.5, 84.0, 86.0 and 87.0. Gravel content ranged from 1.2 to 3.3%; sand content ranged from 96.6 to 98.2%; and fines (silts plus clay) ranged from 0.1 to 2.1%. TOC was 0.1% across all four samples. These results verify that this reach of the Columbia River is subject to high flow and strong river current. Consistent with the CWA sediment testing regulations (40 C.F.R. § 230.60(a)) and the 2016 Sediment Evaluation Framework for the Pacific Northwest, chemical and biological testing are not required, because the sandy river bottom is unlikely to contain contaminants at concentrations that would adversely affect biological receptors. On behalf of the interagency sediment evaluation team (the Portland Sediment Evaluation Team), the EPA - Region 10 issued a positive dredged material suitability determination memorandum for the Columbia River FNC on 05 July 2017 (EPA, 2017).

Effects of the Alternatives

No Action Alternative

Under the No Action Alternative, no placement of material would occur in the project area and no additional plantings or vegetation growth would be expected; thus, water quality would not change in the short term. Long term changes in regional water quality will continue according to regional drivers. Material will continue to be dredged from St Helens Bar and placed at other regularly utilized or new disposal sites. If future material disposal occurs at in-water disposal sites, similar periodic effects on water quality as those of the other alternatives discussed below would occur, albeit in different locations.

Alternative C: Base Measure (placement of 400 kcy dredged material).

All the alternatives considered, including Alternative C, are likely to result in periods of temporary increased turbidity during placement events (pumping a sand slurry) at the project site. However, sand dredged from the FNC is relatively clean with a low percentage of fines smaller than sand and few chemical contaminants. The dredging operation is required to employ best management practices (BMPs) to minimize turbidity (see

Table 10).

Table 10. Best management measures for minimizing adverse effects of dredging and placement for pipeline dredges.

Measure	Justification	Duration	Management Decision
Pipeline Dredging			
Maintain dragheads and/or cutterheads within 3 feet of the bottom for dredging in the main channel; and 9 feet for the shallow-draft side channels.	This restriction minimizes entrainment of juvenile salmon.	Continuous during dredging operations.	Maintain until new information becomes available that would warrant change.
Dredging in shallow water areas (less than 20 feet) only during the recommended ESA in-water work period for the Columbia River of November 1 until February 28.	The top 20 feet is considered salmon migratory habitat. Dredging or disposal in these areas could delay migration or impact food sources.	Continuous during dredging and disposal operations.	Maintain until new information becomes available that would warrant change.
General Provisions			
The contractor shall not release any trash, garbage, oil, grease, chemicals, or other contaminants into the waterway.	Protection of water resources.	Life of contract or action.	If material is released, it shall be immediately removed and the area restored to a condition approximating the adjacent undisturbed area. Contaminated ground shall be excavated and removed and the area restored as directed. Any in-water release shall be immediately reported to the nearest U.S. Coast Guard Unit for appropriate response.
The contractor, where possible, will use or propose to use materials that may be considered environmentally friendly in that waste from such materials is not regulated as a hazardous waste or is not considered harmful to the environment. If hazardous wastes are generated, disposal shall be done in accordance with 40 CFR parts 260-272 and 49 CFR parts 100-177.	Disposal of hazardous waste.	Life of contract or action.	If material is released, it shall be immediately removed and the area restored to a condition approximating the adjacent undisturbed area. Contaminated ground shall be excavated and removed and the area restored as directed. Any in-water release shall be immediately reported to the nearest U.S. Coast Guard Unit for appropriate response.

There is the potential for hazardous material spills to occur during construction under each of the alternatives. Contract specifications include protocols to minimize the risk of spills and prescribe a process for reporting and cleaning up spills if they do occur.

Oxygenation levels would not be expected to change under Alternative C due to non-restricted flows through the area, which would maintain the current status quo oxygen levels throughout the year. It is also not likely to cause increases or decreases in water temperature in the side channel area. Overall, no significant impacts on water quality would be anticipated under Alternative C.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

Alternative F would result in similar turbidity increases during placement as those discussed under Alterative C. However, increased turbidity would exist for a longer period of time because the post construction grading would require large machinery moving sand to form bathymetric features in water and on the shoreline after placement has occurred. Additionally, the peaks and troughs formed by grading would likely result in varying water temperatures throughout the project site. In areas where sand elevation is lower, water temperatures would be expected to be lower relative to higher elevation features. Pockets of cooler water would provide areas of temperature refuge for migrating salmonids during hot summer months. Oxygenation levels would not be expected to change as a result of this alternative due to non-restricted flows through the area, which would maintain the current status quo oxygen levels throughout the year. Over time, the placement area would become vegetated, which may further reduce water temperatures in areas where shade is provided.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

Under Alternative L the impacts on water quality would be similar to those discussed under Alternatives C and F. Increased turbidity would occur during placement and grading activities. Rather than waiting for vegetation to naturally grow via natural seed source and dispersal, plantings would be used on the project site to expedite formation of favorable terrestrial and aquatic habitats. Therefore, water temperatures may benefit from shade via plantings sooner than under Alternatives C and F.

Wetlands play an important role in water quality in the immediate project area and downstream of the project area. Though the wetlands that would result from this project are not technically considered “treatment wetlands,” they would be expected to act as sinks for non-point source pollution in the river that could originate from agricultural land use, vessel traffic, and upstream chemical releases. Over time as the wetlands become more established, water quality is likely to continue to improve. The planting plan would result in the greatest potential benefit to water quality in the shortest amount of time because it would reduce the amount of time mature wetlands would be established in the system. Alternative L has the potential to result in the greatest water quality benefit in the shortest amount of time when compared to other alternatives considered.

4.1.5 Climate Change

Existing Conditions

Climate is governed by incoming solar radiation and the greenhouse effect. The greenhouse effect is the result of certain atmospheric gases absorbing long-wave radiation emitted from the Earth. Absorption of this long-wave radiation in the atmosphere, as opposed to being transmitted into space, warms the Earth. Greenhouse gasses include (in order of importance to the greenhouse effect) water vapor, carbon dioxide, methane, nitrous oxide and ozone.

Human (anthropogenic) activities such as the burning of fossil fuels (adding more greenhouse gasses to the atmosphere) and clearing of forests (removing a natural sink for carbon dioxide), have intensified the natural greenhouse effect, increasing the rate of global warming. Carbon dioxide emissions from the burning of fossil fuels are the most substantial source of anthropogenic greenhouse gas emissions. Global atmospheric concentrations of carbon dioxide have risen almost 100 parts per million (ppm) since their pre-industrial (1750) value of 280 ppm (OCCRI 2010).

Natural factors, which include solar variation and volcanic activity, also contribute to climate change. However, strong scientific evidence suggests that these factors alone do not fully explain the observed accelerated global warming of the past few decades (OCCRI 2010).

Effects of the Alternatives

No Action Alternative

The No Action Alternative would not change direct or indirect effects on climate change caused by status quo dredging and placement activities. The Corps implements strategies that minimize the project actions that could contribute to climate change including equipment upgrades that reduce greenhouse gas emissions and hydrologic modeling efforts use to inform project elements in the face of rising sea levels and changing climatic conditions. These strategies would continue to be implemented under the No Action Alternative.

Alternative C: Base Measure (placement of 400 kcy dredged material)

Like under the No Action Alternative, placement of dredged material on the side channel of the Woodland Island project site would have no effects on climate change. However, the effects of climate change as they relate to the proposed action could lead to a change in the timing of precipitation, the extent of snowpack, and rain-on-snow events. Changes in weather patterns could influence seasonal river flows, subsequently affecting the scale and timing of erosion and deposition in the lower Columbia River, thereby influencing the timing of dredging and placement of materials. The Corps assumes that any effects climate change might have across the project area during this timeframe would be negligible and effects on any aquatic or terrestrial habitat would be immeasurable. After vegetation becomes established, the habitat it forms, as well as benthic habitat created by the placement, would likely help to buffer effects of climate change for species using the habitat. Alternative C would not result in significant direct or indirect effects on climate change. The Corps would continue to implement strategies that minimize the project's contribution to climate change.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

Alternative F is similar to Alternative C in that they both include placing the same amount of material in the same area. However, Alternative F would include post placement grading. Shaping sand to create and encourage establishment of usable habitat features would not contribute to global climate change. The Corps works to minimize its contribution to climate change by updating equipment with high efficiency engines that meet low emissions standards and by planning its projects to take into account potential long-term impacts of climate change on any given project. Thus, the impacts on climate change under Alternative F would be similar to those under Alternative C.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

Alternative L (Preferred) would also not contribute to global climate change and may, in fact, constitute the best alternative for hedging against effects of climate change on the project through the inclusion of a planting plan. The effects of placement and grading are largely the same as those discussed under Alternatives C and F. However, the addition of plantings after placement are likely to help anchor sediment in place during anomalous flows or weather events, and would provide increased, though negligible, amounts of oxygen producing vegetation in a shorter amount of time relative to the other alternatives considered.

4.1.6 Air Quality

Existing Conditions

The EPA sets national air quality standards for six common pollutants (also referred to as "criteria" pollutants). These standards, known as National Ambient Air Quality Standards (NAAQS) consist of standards for carbon monoxide (CO), lead, nitrogen dioxide (NO2), ozone, particulate matter (PM2.5 and PM10) and sulfur dioxide (SO2). Detail on the NAAQS are provided in Table 11 (Oregon DEQ 2012). The EPA has separated Oregon into 25 geographic monitoring areas, which are rated hourly based on compliance with the NAAQS. Failure to consistently meet these standards results in the area being designated as a Nonattainment Area. An area can also be designated as a Maintenance Area if it has a history of nonattainment, but is now consistently meeting the NAAQS. The project area is not a Nonattainment Area and is not designated as a Maintenance Area.

Table 11. National Ambient Air Quality Standards.

Pollutant	Average Time	National Ambient Air Quality Standard (NAAQS) Violation Determination	Federal Primary Health Standard (NAAQS) Exceedance Level	State Standard Exceedance Level
Carbon monoxide	1-hour	Not to be exceeded more than once/year.	35 ppm	35 ppm
	8-hour	Not to be exceeded more than once/year.	9 ppm	9 ppm
Lead	Calendar Quarter	Quarterly arithmetic mean.	0.15 µg/m^3	0.15 µg/m^3
Nitrogen dioxide	Annual	Annual arithmetic mean.	53 ppb	53 ppb
	1-hour	3-year average of the maximum daily 98th percentile one hour average.	100 ppb	NA
Ozone	8-hour	3-year average of the annual 4th highest daily maximum 8-hour average concentration.	75 ppb	75 ppb
PM2.5	24 hour	98th percentile of the 24-hour values determined for each year. 3-year average of the 98th percentile values.	35 µg/m^3	35 µg/m^3
	Annual Average	3-year average of the annual arithmetic mean.	15 µg/m^3	15 µg/m^3
PM_{10}	24 hour	The expected number of days per calendar year with a 24-hour average concentration above 150 µg/m^3 is equal to or less than 1 over a 3-year period.	150 µg/m^3	150 µg/m^3
Sulfur dioxide	1 hour	3-year average of the maximum daily 99th percentile one hour average.	75 ppb	NA

ppm (parts per million), ppb (parts per billion), µg/m^3 (microgram per cubic meter)

No Action Alternative

The No Action Alternative would not change the project area's ability to meet air quality standards. Similar to the other alternatives, there would be a temporary and localized reduction in air quality during the periodic placement of dredged material from the St. Helens Bar at the regular disposal sites due to emissions from the dredge during dredging and placement of dredged materials and from any earth-moving equipment used at the disposal site. These impacts would be minor and temporary in nature and would cease once dredging and placement is completed.

Alternative C: Base Measure (placement of 400 kcy dredged material).

Alternative C would not change the project area's ability to meet air quality standards. As with the other alternatives, there would be a temporary and localized reduction in air quality during placement due to emissions from the dredge during dredging and aquatic placement of dredged materials, and from any earth-moving equipment used at the project site. There also would be temporary and localized increases in noise levels from this equipment. These impacts would be minor and temporary in nature, and would cease once dredging and placement is completed.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

Alternative F would not change the project area's ability to meet air quality standards. As with the other alternatives, there would be a temporary and localized reduction in air quality during placement due to emissions from the dredge during dredging and aquatic placement of dredged materials, and from any earth-moving equipment used at the placement site. The duration of these impacts would likely be a bit longer than the No Action Alternative and Alternative C due to the additional time required to complete the complex grading. There also would be temporary and localized increases in noise levels from this equipment. These impacts would be minor and temporary in nature, and would cease once dredging and placement is completed.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

The effects of Alternative L on air quality would be the same as those for Alternative F. It would not change the project area's ability to meet air quality standards. There would be a temporary and localized reduction in air quality during placement due to emissions from the dredge during dredging and aquatic placement of dredged materials and from any earth-moving equipment used at the placement site. The duration of these impacts would likely be a bit longer than under the No Action Alternative and Alternative C due to the additional time required to complete the complex grading. These impacts would be minor and temporary in nature and would cease once dredging and placement is completed.

4.2 Biological Environment

4.2.1 Aquatic, Wetland and Riparian Habitat

Existing Conditions

The shoreline area (data point B-1) contains willow fringe wetlands, which are dominated by willows, red osier dogwood, and reed canary grass (Figure 17). The circled area in Figure 18 is an area of riparian vegetation dominated by cottonwood trees (mature and sapling), willows and, reed canary grass. Most of the vegetation in this area is at an elevation of 10 feet NAVD. The area is sheltered from high flow velocities due to the large sand deposit immediately upstream that protects this area.

Figure 17. Representative photos of willows and reed canary grass areas.

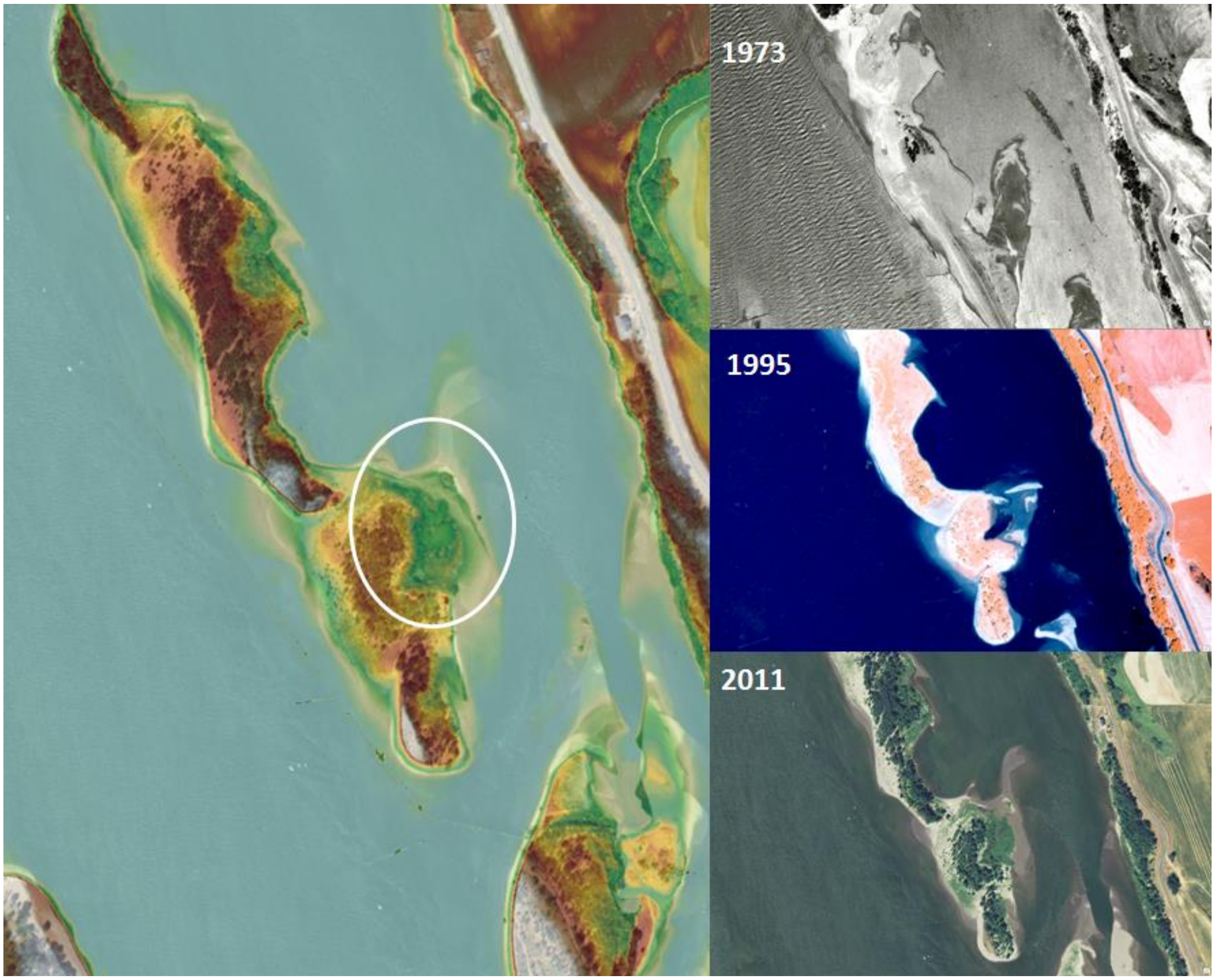

Figure 18. Evolution of existing wetland habitat on the backside of the islands.

As illustrated in the 1973 photo, amidst consecutive years of dredged material placement along the islands, a small sheltered cove was established. The lower elevation finger extending north was most likely created during the December 1964 flood, which would have overtopped nearly the entire island complex, scouring low spots on the island and depositing the eroded material immediately downstream. By 1995, this cove had mostly closed off, leaving a small pond sheltered by sand bars. A lone tidal channel is shown connecting the pond to the river. By 2011, the pond had filled in and a dense shrub/reed canary grass population has established in the area.

Wetland data points (A-1, B-1, Ref) and ponar sediment samples (see Figure 20 and Figure 19) were taken on 15 April 2016 to document existing wetland habitats and surface sediment conditions. Inland of the shrub-emergent fringe wetlands are forested wetlands dominated by cottonwood and Oregon ash trees and an open understory. Beaver activity is ubiquitous within the wetlands and riparian forests of the study area.

Ponar samples taken within the crescent-shaped protected area are dominated by silty clay mixed with very fine sand. Some submerged aquatic vegetation (*Elodea* sp.) was also recovered, along with medium-grained sand and midge larvae at the Ponar A-2 sample location. A fine layer of organic material over a layer of medium-grained sand (presumed to be old dredged material) indicated the area has not been recently disturbed and is likely to support vegetative growth if newly placed material raises the bottom elevation and more organic material accretes over time.

The existing pile dikes are preserving habitat on the downstream side of each structure and they are helping to keep the islands in place. The pile dikes need to be maintained to prevent further erosion of the islands that would support and preserve wetlands created through this beneficial use project. Pile dike maintenance is separately authorized for navigation and is not part of this project plan. However, the presence and functionality of pile dikes in the project area should be considered throughout the planning process because of the important role they would play in the long-term stability of the improved habitat resulting from this project.

Figure 19. Forested wetland (A-1) on Island A (left) and Ponar A-2 sediment sample.

Figure 20. Location of habitat data points and Ponar sediment samples.

The effects of pile dikes on salmonid species and habitat has been debated for many years. A study supporting the Corps 1999 Supplemental BA for Columbia and Lower Willamette Rivers, Navigation Channel Maintenance Dredging Program (USACE 1999), evaluated the potential for pile dikes to cause adult salmonids to be delayed during migration and the potential to cause juveniles to move offshore and be subjected to increased predation in deeper water. To evaluate the extent of this impact hydroacoustics were used to determine the behavior of fish near a pile dike during several consecutive 24 hour periods between July 26 and August 5, 1996. The study indicated that juvenile salmon readily moved past the pile dike during the day when they were migrating. Most moved around the end of the pile dike system while only a few moved through it. Predation was found to be limited since there were only a few larger fish found near the pile dike. Previous studies on the feeding behavior of pike minnow and other larger fish near this pile dike have indicated that they were not eating juvenile salmonids to any extent (Dawley et al. 1986). The behavior of juvenile salmonids around the pile dike changed at night. Most fish stopped moving at night and they appeared to use the areas as a nighttime holding area as their number increased dramatically at the downstream side of the pile dikes where current velocities were much reduced.. Consequently, the study indicated that juveniles are reacting to the pile dikes like any other structure in the river. This may be beneficial since much of the natural shoreline structure that provided nighttime holding areas has been removed as a result of development or shoreline disposal (USACE 1999).

Effects of the Alternatives

No Action Alternative

Under the No Action Alternative, the western shorelines would continue to move and shift with changes in river flow and environmental conditions. Erosion of the western side of the islands would continue. This erosion is slowly removing riparian and forested wetland habitat that has been established on top of the islands and along the shorelines. Without placement of material on the eastern side of the islands the eastern shore would continue to slowly accrete in certain areas and degrade in other areas. In areas of natural accretion, some shrub wetland vegetation could be established, but without additional sand to support such growth, it is unlikely it would withstand natural forces such as extreme high water events.

Organic material would continue to deposit within forested wetland areas of the islands. No anthropogenic disturbance to the existing upper layer of loamy sand or vegetation would take place. However, no new areas would be created to support the accretion of new organics and growth of pioneer vegetation.

Alternative C: Base Measure (placement of 400 kcy dredged material).

Under Alternative C, the placed material is likely develop into useful foraging and rearing areas for salmonids and some birds. The placement of dredged material would encourage the establishment of additional habitat and foraging areas for threatened species and would likely contribute to recovery efforts. Additionally, the new shoreline edge on the western side of the island and its associated shallow water habitat would be available for use by aquatic species after placement and the action would restore shallow water habitat on the eastern side of the island to its prior location in the river. Along the eastern shoreline of the placements, a single plane slope graded at approximately 10-15 degrees would be created to reduce the risk of wake stranding of juvenile salmonids. Wake stranding is not a risk along shorelines within the protected embayment areas.

As with Alternatives F and L, minimal adverse impacts on fringe wetland vegetation may occur during placement activities, but the ultimate expansion of suitable habitat for salmonid species and terrestrial species would outweigh any short-term impacts shoreline placement activity may have on the fringe vegetation. Construction would likely require the cutting of a 100- to 150-foot-wide path through the willow-dominated, shrub wetland portion of the island, but these areas would be replanted within a year and are expected to re-vegetate quickly.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

Under Alternative F, the anticipated effects on aquatic and riparian vegetation would likely be somewhat more diverse compared to those under Alternative C. In essence, the varied bathymetric features that would be created under this alternative would be expected to result in more niches, resulting in greater species richness of aquatic and riparian organisms. The formation of troughs and peaks in the placed sand would create areas of cool and warmer waters, with more or less exposure to sunlight and/or shelter from current velocities in the side channel. Such variations in channel features would foster growth and use of more varies plant and aquatic species. Therefore, the benefits of this alternative compared to Alternative C would likely be greater given that an increase in habitat diversity would be expected.

As with Alternatives C and L, minimal adverse impacts on fringe wetland vegetation may occur during placement activities, but the ultimate expansion of suitable habitat for salmonid species and terrestrial species would outweigh any short-term impacts shoreline placement activity may have on the fringe vegetation. Construction would likely require the cutting of a 100- to 150-foot-wide path through the willow-dominated, shrub wetland portion of the island, but these areas would be replanted within a year and are expected to re-vegetate quickly.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

Under Alternative L, the placement of dredged material would encourage the establishment of additional habitat and forage areas for threatened species and would likely contribute to recovery efforts. Additionally, the new shoreline edge on the western side of the island and its associated shallow water habitat would be available for use by aquatic species after placement and the action would restore shallow water habitat on the eastern side of the island to its prior location in the river.

As with Alternatives C and F, minimal adverse impacts on fringe wetland vegetation may occur during placement activities, but the ultimate expansion of suitable habitat for salmonid and terrestrial species would outweigh any short-term impacts of shoreline placement activity may have on the fringe vegetation. All construction designs require the cutting of a 100- to 150-foot-wide path through the willow-dominated, shrub wetland portion of the island, but these areas would be replanted within a year and are expected to re-vegetate quickly.

Though disturbance of riparian habitat, sediments, and soils would be a direct impact of this alternative, the long term establishment of larger and more diverse wetland and riparian system with salmonid rearing habitat in the side channel far outweigh the impacts of placement of dredged material at the project site.

4.2.2 Aquatic and Terrestrial Wildlife, Including Invasive Species

Existing Conditions

The Columbia River supports a wide variety of aquatic and terrestrial wildlife species. Species information was obtained from National Marine Fisheries Service (NMFS), United State Fish and Wildlife Service (USFWS), ODFW, and WDFW. Aquatic and terrestrial wildlife species inhabit or periodically utilize the project site, the deep-draft channel, nearby dredged material placement sites, and adjacent waters. The project site currently supports a diverse array of wildlife and aquatic species. Fish species that occur in the project area include: smallmouth bass, largemouth bass, bullhead, carp, catfish, channel crappie, crawfish, eulachon, yellow perch, northern pikeminnow, Chinook salmon, chum salmon, coho salmon, sockeye salmon, American shad, steelhead trout, white and green sturgeon, suckerfish, coastal cutthroat trout, and walleye.

Submerged sediment around the islands is suitable habitat for lamprey larva (ammocoetes), which are likely to use the area for rearing. Larval Pacific lamprey act as filter feeders in fine sediment for 3-7 years before out-migrating, so multiple age classes may be present. Mid-summer is likely to be the time of year when lamprey would be most vulnerable to stress. Additionally, mid-summer coincides with emergence and settling into the fine sediment (S. Tackley, personal communication, April 7, 2016). Lamprey are an important natural resource for northwestern Native American Tribes.

Wildlife species that use the island could include but are not limited to many birds (e.g., terns, cormorants, gulls, pelicans, resident and migratory songbirds, eagles, osprey, crows, waterfowl, and shore birds), mammals (mice, nutria, beaver, Columbian white-tailed deer), and reptiles and amphibians. Beaver activity (several small dams, ponds, and trails to open water) was observed during an April 2016 site visit by USACE staff, and shrubs and trees gnawed by beavers were seen during a USACE site visit in January 2017.

In April 2016, greater sandhill cranes were heard calling from a nearby location but were not present on the island, and great blue herons were seen flying through in the area. One great blue heron nest was seen in a tall cottonwood on the north end of the island. Other birds observed on the project site include osprey, cormorants, and sparrows.

Emergent and submerged aquatic vegetation included *Zostera marina, Potamogeton richarsonii, Ceratophyllum demersum, Elodea canadensis,* macroalgae *(Viva* spp., *Enteromorpha* spp.), and benthic microalgae communities (diatoms, primarily of the genera *Navicula* and *Achnanthes)* (McIntire 1984).

Historical data on benthic algae production are not available. Sherwood et al. (1990) estimated that benthic microalgae production in the fluvial portion of the lower Columbia River has declined approximately 15% since before 1870. This loss may be related to a general decline in shallow flats and channels associated with marshes that were diked or filled. They suggest that possible reasons for this decrease are a reduction of the tidal prism, a net increase in sediment in the estuary, and reduction in river flow, resulting in decreased mixing, increased stratification, altered response to tidal forcing, and decreased salinity intrusion length and transport of salt into the estuary.

The benthic algae production within the estuary has always tended to be limited to shallower areas (above the MLLW) and sheltered areas such as Youngs and Trestle Bays (Thomas 1983, CREDDP 1984). Indications are that the percentage of these habitat areas has increased by approximately 7% from 1870 levels, including 3,620 acres in Baker Bay (Thomas 1983, Sherwood et al. 1990).

Production of benthic microalgae is vital to the lower Columbia River salmonid food web because microalgae serve as the primary food source for the benthic infauna. A species of particular importance in the estuary and the river is the amphipod, *Ameriorophium salmonis.* It is a microscopic organism and important as a prey item for juvenile and adult salmonids, as well as other fish species (Bottom et al.2011). It occurs in both fresh water and estuarine environments and burrows into the bottom in primarily silty sands during the day. It migrates up into the water column at night to feed. This amphipod is abundant in the estuary and throughout the upriver area in suitable habitat. Its distribution in the estuary is dependent primarily upon salinity. Holton and Higley (1984) found that it prefers a salinity range from 0 to 14 parts per thousand (ppt) and that its distribution in the estuary changes with seasonal changes in salinity patterns. This species also can recolonize a disturbed area rapidly. McCabe et al. (1996) determined that population levels recovered relatively rapidly after a ferry access channel was dredged in the upper river. Complete recovery of the disturbed population was evident in less than one year.

Other groups of benthic invertebrates present in the river and estuary include oligochaetes, polychaetes, and nemertean worms, as well as mysids and insect larvae (Sandborn 1975). These groups, particularly the segmented worms, are generally associated with finer-grained organic sediments. Two clam species, *Macoma balthica,* and the Asian clam, *Corbicula lumninaria,* also are abundant in the CR. *Corbicula* occurs in the fresh water while *Macoma* occurs only in the estuary. Epibenthic species (larger invertebrates) in the river and estuary are crayfish, *(Pacifastacus trowbridgii),* Dungeness crab, and sand shrimp *(Crangon* spp.). Crayfish are distributed throughout freshwater parts of the river, while Dungeness crab occurs primarily in the lower estuary and ocean.

WDFW and ODFW, along with regional invasive species management groups, have identified the priority invasive species for prevention from establishment or eradication efforts. Invasive species have the potential for widespread native ecological disruption by displacement of native plants and animals, reduction in habitat and species biodiversity, competition with native organisms for limited resources, and degradation of habitats. Once an introduced species becomes established, the species becomes increasingly difficult and expensive to control; invasive species also can negatively affect the economic viability of a region.

High priority invasive species are those most likely to generate ecological and economic losses within the Lower Columbia River. Some species are already established within the system; other species have been discovered but are yet established, while other species are not within the system. Table 12 outlines which species are established or likely to disrupt the Lower Columbia River system.

Table 12. High priority invasive species in the Lower Columbia River.

Species	Status
Terrestrial Plants	
Butterfly bush (*Buddleja davidii*)	Present
Common crupina (*Crupina vulgaris*)	Present
Garlic mustard (*Alliaria petiolata*)	Present
Giant hogweed (*Heracleum mantegazzianum*)	Present
Himalayan blackberry (*Rubus armeniacus*)	Present
Kudzu (*Pueraria montana var. lobata*)	Eradicated
Scotch broom (*Cytisus scoparius*)	Present
Aquatic plants	
Caulerpa seaweed (*Caulerpa taxifolia*)	Eradicated
Common reed (*Phragmites australis*)	Present
Eurasian water milfoil (*Myriophyllum spicatum*)	Present
Parrot's feather (*Myriophyllum aquaticum*)	Present
Purple loosestrife (*Lythrum salicaria*)	Present
Saltmeadow cordgrass (*Spartina patens*)	Present: not established
Water chestnut (*Trapa natans*)	Not present
Terrestrial animals	
Feral swine (*Sus scrofa*)	Present
White garden snail (*Theba pisana*)	Not present
Aquatic animals	
American bullfrog (*Lithobates catesbeianus*)	Present
Chinese mitten crab (*Eriocheir sinensis*)	Reported sightings, not confirmed
Common snapping turtle (*Chelydra serpentina serpentina*)	Present
Crayfish (*Orconectes neglectus, O. rusticus, Procambarus clarkii*)	Present
Green crab (*Carcinus maenas*)	Present
New Zealand mud snail (*Potamopyrgus antipodarum*)	Present
Nutria (*Myocastor coypus*)	Present
Red-eared slider (*Trachemys scripta elegans*)	Present

Species		Status
	Zebra/quagga mussel (*Dreissena polymorpha, D. rostriformis bugensis*)	Not present
Fish		
	Asian carp (*Hypophthalmichthys nobilis, H. molitrix, Mylopharyngodon piceus*)	Present
	Atlantic salmon (*Salmo salar*)	Present: not established
	Northern snakehead (*Channa* spp.)	Not present
	Oriental weatherfish (*Misgurnus anguillicaudatus*)	Present

Effects of the Alternatives

No Action Alternative

Under the No Action Alternative, the existing habitat on the project islands would not be actively changed and no additional shallow water habitat for aquatic and wildlife species would be created. Aquatic species and wildlife would continue to be affected by natural forces such as erosion and high flow events. Wildlife and aquatic species would also continue to use the islands and surrounding waters, but the size of the site would not increase and may even decrease as the erosive forces of the river continue to shift, erode, and overtop various portions of the site, which could result in less habitat suitable for wildlife and aquatic species.

Alternative C: Base Measure (placement of 400 kcy dredged material).

Under Alternative C, dredged material would be strategically placed on the eastern side of the islands to increase the bottom elevation to encourage growth of scrub-shrub and emergent wetland plant species such as willows, cottonwood trees, and herbaceous cover species. Increases in habitat are expected to increase the amount and types of species that use the area. During staging and placement activities, wildlife that currently use the area such as beavers, sea birds, migratory birds, and amphibians, may be temporarily disturbed by noise and displacement. Lamprey larva are expected to also be found in the submerged fine grained sand surrounding the island. Placement of sand on side channel side of the islands would likely bury lamprey in the area. Dredged material placement during the low flow of the river may be recommended since it is thought that many lamprey larvae are flushed down the river during high flows. Mid-summer is when lamprey larva emerge and settle into fine sediments; thus, this is also the time of year when they are most vulnerable to disruption. The time of year when placement activity would impact lamprey larva the least would be the late summer or early fall, which is aligned with the proposed schedule for construction.

On the project site, extensive beaver activity was observed. Beavers can serve an important role in maintaining wetland habitat by creating ponds and deeper channels that lead into and out of open water. This network of water holding and channelization can be vital in summers when water levels are low and water temperatures are relatively high. The placement of dredged material would likely expand and improve habitat for beavers, thus potentially expanding the network of beaver channels and ponds. It would also likely facilitate the recruitment and movement of woody debris, which can benefit salmonids using the side channel as a place of rest, refuge, and foraging.

Placement of dredged materials may provide avenues for invasive aquatic species to colonize or to be re-distributed in the lower Columbia River. The rate or intensity of invasive species dispersal is not expected to increase above that which may already be occurring with the placement of dredged material at other sites. The use of BMPs to prevent the spread of invasive species such as inspecting and cleaning equipment, which is required through contract specifications, would further reduce the potential for increasing invasive species.

This alternative would rely on natural vegetation recruitment to achieve the objective of habitat restoration. Compared to the Alternative L (Preferred Alternative), in the short-term, there would be fewer and younger plant species on the site. However, a non-planting alternative would allow natural forces to determine how much and what types of vegetation would be established within the system. Though the anticipated effects of this alternative on the existing aquatic and terrestrial environment may initially be adverse, particularly as compared to the No Action Alternative, those effects would be temporary in duration and would likely result in overall habitat improvements over time; therefore, the adverse effects are not considered significant.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

Potential impacts of this alternative are substantially similar to those discussed under Alternative C. However, Alternative F would include post placement grading with heavy equipment designed to move sand into strategic shapes that would form troughs and peaks to encourage a mosaic of aquatic and shoreline habitat. The direct and short-term impacts to aquatic vegetation under this alternative are equal to those anticipated under the other alternatives considered, with the exception of the No Action Alternative. Compared to the No Action Alternative, placement and grading would result in temporary adverse impacts on existing aquatic vegetation and shoreline area that are used by terrestrial organisms. However, the Corps anticipates the long-term effects of this action would be beneficial to aquatic and terrestrial plant and animal species. Varying elevations in the submerged shallow-water environment would likely encourage recolonization of more varied species of aquatic and terrestrial vegetation. As a result, habitat types that would be expected to develop over time would offer greater structural complexity than under the No Action Alternative or Alternative C.

This alternative would also rely on natural vegetation recruitment to achieve the objective of habitat restoration. In the short-term, there would be fewer and younger plant species on the site. However, natural forces would determine how much and what types of vegetation would be established within the system. Though the anticipated effects of this alternative on the existing aquatic and terrestrial environment may initially be adverse, particularly as compared to the No Action Alternative, those effects would be temporary in duration and would likely result in overall habitat improvements over time; therefore, the adverse effects are not considered significant.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

This alternative has similar anticipated benefits and impacts as Alternative F but with the additional habitat benefits of post-construction plantings. The goal of this measure is to have an even distribution of willow shrubs across the range of elevations (10 to 14 feet NAVD) to provide scrub-shrub habitat, and to stabilize the placed dredged material. Plantings would not only help anchor sand in place, it would encourage rapid development of scrub-shrub and emergent wetland habitat. Plantings would have minimal adverse impacts on the terrestrial and aquatic environments during installation. Once established, plantings are likely to result in moderate benefits for species that utilize shoreline and submerged habitats.

The Corps has developed a monitoring plan that would implement an adaptive management approach for this project. The monitoring plan can be found in Appendix D of this document. In summary, the Corps is targeting 80% survival of willow plantings two years after construction, and riparian scrub/shrub habitat occurring along the shore line should cover at least 75% of the inward side of the new embayment area after five years. Willow establishment and survival will be documented at years 1, 2, 3, 6, and 10 years after initial planting, and plant species composition and cover will be monitored in years 1, 3, and 5. If planting survival is less than 80% after two years, new willows will be planted to replace those lost. If riparian habitat does not establish because of a lack of seed source, the inward side of the embayment area will be seeded with native seeds.

The overall impacts of Alternative L on aquatic and terrestrial vegetation are expected to relatively minor and short-lived compared to the long-term benefits that are anticipated. Though the anticipated effects of this alternative on the existing aquatic and terrestrial environment may initially be adverse, particularly as compared to the No Action Alternative, those effects would be temporary in duration and would likely result in overall habitat improvements over time. Further, these habitat benefits are anticipated to be realized sooner than under Alternatives C and F due to the addition of post-construction plantings. For these reasons, none of the anticipated direct or indirect adverse effects of Alternative L, when compared to the No Action Alternative would be significant.

4.2.3 Threatened and Endangered Species

Existing Conditions

ESA-Listed Species Under NMFS Jurisdiction

The federally listed threatened and endangered species or managed fisheries under the jurisdiction of the NMFS that may occur in the proposed project area are shown in Tables 13, 14 and 15.

Table 13. ESA-listed anadromous salmonids under NMFS jurisdiction.

Evolutionarily Significant Unit	Status	Critical Habitat	Federal Register (FR) Citation
Chinook Salmon (*Oncorhynchus tshawytscha*)			
Snake River spring/summer run	Threatened	Yes	70 FR 37160; 28 June 2005
Snake River fall run	Threatened	Yes	70 FR 37160; 28 June 2005
Lower Columbia River	Threatened	Yes	70 FR 37160; 28 June 2005
Upper Columbia River spring run	Endangered	Yes	70 FR 37160; 28 June 2005
Upper Willamette River	Threatened	Yes	70 FR 37160; 28 June 2005
Coho Salmon *(Oncorhynchus kisutch)*			
Lower Columbia River	Threatened	Proposed	70 FR 37160; 28 June 2005
Chum Salmon (*Oncorhynchus keta*)			
Columbia River	Threatened	Yes	70 FR 37160; 28 June 2005
Sockeye Salmon (*Oncorhynchus nerka*)			
Snake River	Endangered	Yes	70 FR 37160; 28 June 2005
Steelhead (*Oncorhynchus mykiss*)			
Snake River Basin	Threatened	Yes	71 FR 834; 1 January 2006
Lower Columbia River	Threatened	Yes	71 FR 834; 1 January 2006
Middle Columbia River	Threatened	Yes	71 FR 834; 1 January 2006
Upper Columbia River	Threatened	Yes	71 FR 834;1 January 2006
Upper Willamette River	Threatened	Yes	71 FR 834; 1 January 2006

Table 14. ESA-listed fish species under NMFS jurisdiction.

Species	Status	Critical Habitat	Federal Register (FR) Citation
Southern DPS* Green Sturgeon (*Acipenser medirostris)*	Threatened	Yes	71 FR 17757; 7 April 2006
Southern DPS* Pacific Eulachon (*Thaleichthys pacificus*)	Threatened	Yes	75 FR 13012; 18 March 2010

*DPS = Distinct Population Segment

Table 15. Essential Fish Habitat (EFH) in the action area.

Fishery Management Plan with EFH	EFH affected	EFH conservation plan
Pacific Coast Salmon	Yes	Yes
Pacific Coast Groundfish	Yes	Yes
Coastal Pelagic Species	Yes	Yes

Juvenile salmon from the Evolutionary Significant Units (ESU) listed above are known to rear and reside in the area based on past studies near the project site and based on fish catches in similar habitats in the Columbia River estuary. Below are highlights of the study results:

- Marked (hatchery) and unmarked juvenile salmon stocks use the mainstem and off-channel areas year-round and are represented by a variety of stocks and size classes. Chinook salmon have been the most abundant (Sather et al., 2016).
- Chinook salmon stock diversity is highest near Sauvie Island, Multnomah Channel and the project area, and includes a diverse mixture of stocks from the entire Columbia River basin (Roegner et al. 2015, Teel et al. 2014). For example, Upper Columbia River spring Chinook, Upper Columbia River summer / fall Chinook, Snake River fall Chinook, Middle Columbia River steelhead, Upper Columbia River steelhead, Lower Columbia River Chinook, Lower Columbia River coho, Upper Willamette River Chinook, Upper Willamette River steelhead, and Spring Creek fall Chinook have all been observed and/or detected in Multnomah Channel (Roegner et al. 2015).
- Many juvenile salmon populations (and life histories) are present in the Columbia River estuary year-round. Actively migrating (stream type) juvenile Chinook salmon and steelhead use off-channel, freshwater tidal habitats most prominently during their spring and summer migrations; and sub-yearling juvenile salmon (lower Columbia River coho and Chinook) are common in winter. In addition, some population of sub-yearling Chinook salmon use off-channel habitats in summer time on their seaward migration, while other populations use the estuary autumn through winter (Johnson et al. 2015).
- Chinook salmon stock composition in the lower river follows distinct seasonal patterns (Roegner et al. 2015, Teel et al. 2014). Fry are most common January through June and fingerlings most common April, May and June (when hatchery fish substantively contribute to the total catch). Densities of unmarked juvenile Chinook are highest in winter and spring; while densities are lowest in fall (Johnson et al. 2015).
- Residence time varies depending upon the species and season. Residence time is shorter (hours) during times of active and peak emigration, and longer (days to month(s)) during over wintering rearing periods (Johnson et al. 2015).
- Chinook salmon stocks of varying size classes use vegetated riparian areas, debris strewn shorelines and secondary channels (Roegner et al. 2015)

NMFS Consultation History

The Corps has previously consulted with NMFS on the Columbia River FNC O&M program addressing effects to the ESA-listed species and Essential Fish Habitat (EFH) stated above. NMFS issued the following biological opinion (BiOp) in 2012 for the Corps' dredging program:

- National Marine Fisheries Service. 2012. *Reinitiation of Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Columbia River Navigation Channel and Operations and Maintenance, Mouth of the Columbia River to Bonneville Dam, Oregon and Washington (HUCs 1708000605, 1708000307, 1708000108).* NMFS No. 2011/02095. Northwest Region. Seattle, Washington, 11 July 2012. (2012 BiOp)

The NMFS 2012 Biological Opinion outlines Reasonable and Prudent Measures (RPMs) that, if followed, would avoid jeopardizing the continued existence of ESA-listed species or adverse modifications to their critical habitats within the jurisdiction of the NMFS. The RPMs include measures for timing of work conducted, water quality monitoring sampling and monitoring, operational constraints, and construction requirements for in-water, upland, and shoreline dredged material placement sites. The NMFS 2012 BiOp concluded that the FNC O&M program is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of their designated critical habitats. The 2012 BiOp also included conservation recommendations to offset potential adverse effects on EFH.

ESA-Listed Species Under USFWS Jurisdiction

The federally listed threatened and endangered species under the jurisdiction of USFWS that may occur in the proposed project area are shown in Table 16.

Table 16. ESA-listed wildlife species under USFWS jurisdiction.

Species	Status	Critical Habitat	Federal Register
Marbled Murrelet (*Brachyramphus marmoratus*)	Threatened	Designated	57 FR 45328 45337; 1 October 1992
Bull Trout (*Salvelinus confluentus*)	Threatened	Designated	63 FR 31693 31710; 10 June 1998
Streaked Horned Lark (*Eremophila alpestris strigata)*	Threatened	Designated	78 FR 61506; 3 October 2013
Yellow-billed Cuckoo (*Coccyzus americanus*)	Threatened, proposed	(none)	78 FR 61621; 3 October 2013
Golden Paintbrush (C*astilleja levisecta*)	Threatened		62 FR 31740: 11 June 1997

USFWS Consultation History

The Corps has previously consulted with USFWS on the O&M dredging program of the FNC to address effects to many ESA-listed species in their jurisdiction. Several species have been delisted and no longer require ESA consultation, which include the bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), brown pelican (*Pelecanus occidentalis*), and the Aleutian Canada goose (*Branta canadensis leucopareia*).

- United States Fish and Wildlife Service. 2002. *Biological and Conference Opinions for the Columbia River Channel Improvement Project.* Tracking number 02-1743, 02-4943. Oregon State Office. Portland, Oregon. 20 May 2002.
- United States Fish and Wildlife Service. 2010. *Letter of Concurrence for Operations and Maintenance of the Columbia River Federal Navigation Project*. Reference number 13420-2010-I-0165. Oregon State Office. Portland, Oregon. 29 September 2010.
- United States Fish and Wildlife Service. 2014. *Biological Opinion for Continued Operations and Maintenance Dredging Program for the Columbia River Federal Navigation Channel in Oregon and Washington (2014 – 2018).* Reference number 01EOFW00-2014-F-0112. Oregon Fish and Wildlife Office. Portland Oregon. 6 June 2014.

The effects of Columbia River FNC O&M dredging program on Columbia River bull trout (*Salvelinus confluents*), marbled murrelet (*Brachyramphus marmoratus*), and Columbian white-tailed deer (*Odocoileus virginianus leucurus*) were previously addressed in the 29 September 2010 informal ESA consultation with the USFWS (USFWS reference #13420-2010-I-0165). The Corps' 2010 Biological Assessment for the Columbia River dredging and dredged material placement program received a Letter of Concurrence from USFWS on 29 September 2010, as listed above.

In addition to the above-listed consultations, NMFS and USFWS prepared a joint 2008 programmatic BiOp to cover nine categories of restoration actions including side channel/off-channel habitat restoration and reconnection.

- NMFS/USFWS 2008 Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Washington State Fish Passage and Habitat Enhancement Restoration Programmatic.

Effects of the Alternatives

No Action Alternative

Under the No Action Alternative, no direct adverse impacts to threatened or endangered species are anticipated. However, without placement of dredged material at the project site, no benefits to threatened and endangered species would be expected either. The existing habitat would not be improved to become suitable rearing habitat for juvenile salmonids traversing through the area, nor would terrestrial habitat be expanded. Though no direct adverse impacts to threatened or endangered species are anticipated under the No Action Alternative, no benefits would be expected either. Although overwintering salmonids would likely use the side channel as a place of rest and refuge before moving down the river, there would not be an increase in habitat quality and availability for ESA-listed species, which limits their productivity and survival.

Alternative C: Base Measure (placement of 400 kcy dredged material).

Under Alternative C dredged material would be strategically placed on the eastern side of the islands to increase the bottom elevation to encourage growth of shrub fringe wetland plant species such as willows, cottonwood trees, and herbaceous cover species. Increases in habitat are expected to increase the amount and types of ESA-listed species that use the area. During staging and placement activities, there will be temporary increases in turbidity and disturbance to any listed species that may be present. Placement of sand on either side of the islands would likely bury lamprey and benthic and epibenthic fauna in the area. BMPs required for dredging operations would be employed to minimize turbidity and effects to benthic fauna. Construction would likely occur in late summer and fall, which would minimize adverse effects on ESA-listed species and benthic species.

The placement of dredged material will likely expand and improve habitat for beavers, thus potentially expanding the network of beaver channels and ponds, thus increasing the quantity and diversity of aquatic habitats for ESA-listed fish species. It will also likely facilitate the recruitment and movement of woody debris, which can benefit salmonids using the side channel as a place of rest, refuge, and foraging.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

Under Alternative F, dredged material would be strategically placed on the eastern side of the islands similar to Alternative C, and the anticipated effects are substantially the same. Alternative F includes the additional measure of complex grading, which would utilize heave equipment to shape sand into discernable features with varying depths and elevations to create a network mosaic of submerged and shoreline habitats. ESA-listed species would likely realize more benefits under this alternative than Alternative C or the No Action Alternative due to the increased variety of habitat forms that would result.

Different elevations of substrate are geared toward creating different types of habitats. Based on the site specific plant community evaluation, the shoreline is delineated by 10 feet NAVD. This was selected as the interface of scrub-shrub wetland where vegetation cover is initially inundated. This elevation lies within mean low and high river stage during the assumed period of occupation by salmonids. This alternative, would rely on natural recruitment of vegetation, which would ultimately benefit those species utilizing this zone of focus. The initial effects of placement of material and post placement grading would temporarily disturb habitat for several ESA-listed species. However, those minor impacts are likely to give rise to species benefits in the form of increased usable habitat area, increased forage and resting opportunities, and buffer from climatological effects during high flows and warm summer months. Overall, the anticipated effects of this alternative compared to the No Action Alternative are not expected to be significant.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

Alternative L includes the additional measure of post placement plantings. Plantings would be placed in areas of the project site that are exposed to erosive forces that could compromise habitat restoration results, along the graded shoreline, as well as in areas that are cleared for construction purposes.

The studies highlighted under the existing conditions above indicate a high probability of juvenile Chinook, steelhead, and coho use (and composition) are likely to occur at the project site after construction. Neither sockeye, chum, eulachon, nor lamprey were documented in the above-listed studies. However, it is anticipated that they may use the project site, and the Corps expects that they will indirectly benefit from restoration actions by feeding on prey exported from shrub fringe and forested wetland habitats.

The project under Alternative L is likely to benefit other ESA-listed species, in addition to salmon. The increase in wetland vegetation would benefit bull trout, green sturgeon, and Pacific eulachon for many of the same reasons habitat restoration would benefit salmonids, such as by providing cover, detrital and nutrient input to the food web, increased diversity of shallow water and wetland habitats, and increased prey resources. Additionally, upland and fringe wetland habitat restoration would benefit migratory birds such as eagles and osprey. Expansion of the partially submerged island footprint would benefit brown pelicans that are increasingly using the Columbia River estuary during the summer months.

The placement of dredged material under Alternative L would have similar effects to ESA-listed species as discussed above for Alternatives C and F. A post placement planting plan would be implemented in addition to dredged material placement to restore various wetland habitat types on the eastern side of the project site islands. The objective of the project is to not only create more wetlands on and around the site but to diversify the types of habitat available to salmonids traversing this reach of the Columbia River. Currently, the tidally submerged habitat is relatively uniform with little vegetation. However, if the elevation of the submerged shoreline is raised adequately to allow penetration of light while also allowing total inundation during high tide each day, pioneer plant species would expand the current boundary of shoreline vegetation towards the channel, which would increase the area of suitable habitat for salmon. Furthermore, placed sand can be shaped in a manner that promotes the formation of peaks and troughs that would provide deep pools for warm water refuge and higher areas for vegetative growth. Trees and shrubs would provide shading to maintain cooler water during the summer months, and downed trees would provide woody debris which attract salmon prey species and provide areas for fish to hide and rest.

To preserve the anticipated habitat improvements, the pile dikes bordering the FNC channel side of the island should be maintained. Pile dikes do provide perching areas for a variety of birds. The issue of pile dikes serving as piscivorous bird perches is addressed in the NOAA Fisheries' 2005 and 2012 Biological Opinions for the Reinitiation of Columbia River Navigation Channel Operations and Maintenance Mouth of the Columbia River to Bonneville Dam, Oregon and Washington, and in the NOAA Fisheries Biological Opinion for Operation of the Federal Columbia River Power System (NMFS 2008), which are hereby incorporated by reference. Subsequent to these BiOps, NMFS determined that pile dikes as bird perches are not a significant source of avian predation, and they rescinded the 2012 reasonable and prudent measure that requires all derelict pilings be removed. Additionally, placement of dredged material between the existing pile dike and the FNC side of the island would help hedge against further erosion and protect the habitat restoration investment. Pile dike maintenance and dredged material placement are managed under the Corps navigation operations and maintenance program. If pile dike maintenance and placement behind the Woodland Island pile dike were to be implemented, it would be through the Corps Navigation program.

If the project proceeds as outlined in this FS/EA, the activity would likely be covered under the NMFS restoration programmatic consultation. The impacts of this project are consistent with the the findings of the 2012 BiOp because the activities fall within those analyzed in the BiOp and are not likely to result in additional or different impacts than those considered in the formal consultation. Furthermore, the impacts of this project are consistent with the range of activities analyzed in the joint NMFS/USFWS 2008 programmatic BiOp and are not likely to result in additional or different impacts than those considered in the formal consultation.

The potential effects of the Proposed Action alternative for bull trout, and Columbian white-tailed deer are consistent with the USFWS 2010 determination and is not expected to result in adverse effects. Consequently, the Proposed Action is not expected to require re-initiation of informal consultation with USFWS. In addition, the Corps determined the Proposed Action would have "no effect", northern spotted owl (*Strix occidentalis caurina*), Oregon silverspot butterfly (*Speyeria zerene*), golden paintbruch (*Castilleja levisecta*), yellow-billed cuckoo (*Coccyzus americanus*), streaked horned lark (*Eremophila alpestrisstrigata*), marbled murrelet (*Brachyramphus marmoratus*), and water howellia (*Howellia aquatilis*). Therefore, these species do not require ESA consultation.

Overall, the anticipated effects of this alternative on the LCRE or the greater Columbia River system are not expected to be significant compared to the No Action Alternative, but the project under Alternative L could provide a noticeable increase in available habitat in the Woodland Islands area and benefit salmonids traversing this reach of the Columbia River.

4.3 Cultural and Historic Resources

Existing Conditions

Experts believe colonization of North America occurred during the later phases of the Pleistocene, roughly 12,000 to 60,000 years B.P. Sea levels during the Pleistocene averaged anywhere from 197 to 984 feet below current levels today. The lower sea levels led to the existence of land bridges, the most famous being Beringia, that allowed Pleistocene fauna and humans to migrate to the Americas. Many archeologists also speculate some early migrants to America utilized a coastal route to arrive at their destinations during this time period (Bartholomew and Rayle 2017, Fladmark 1983, Aikens, Connolly, and Jenkins 2011). The current evidence suggests that the first arrivals of humans to North America falls within a period of 13,000 to 20,000 years B.P.

The project area is located in the Lower Columbia River within an area historically occupied by Chinookan-speaking peoples (Aikens, et al. 2011). The Lower Columbia River is a naturally and culturally rich area populated by Native Americans for several thousand years prior to European contact. Early hunter-gatherer societies left evidence of their presence in the area in the form of artifacts and features that date back to the Early and Middle Archaic periods (6000-1600 years B.P.) as they travelled along the river. During the Middle to Late Archaic periods (3500 years

B.P. to contact) ethnographic and archeological evidence document the growth of numerous permanent village sites occupied continuously for the last 3000 years (Aikens, et al. 2011, Bartholomew and Rayle 2017).

The people of the Lower Columbia River depended heavily upon the fish for their primary food source, but they also hunted other wildlife and gathered various plants to contribute to their diet. Archeological sites contain the bones from various animals such as elk, deer, and fish, but also the remnants of clams and mussels. A variety of artifacts have been found such as fishhooks, fishing weights, projectile points, pottery, and other items used in everyday life that help to document their history. They lived in cedar plank houses and traded extensively with other groups including those much further upriver in the Columbia Plateau, the coastal groups, and those in the Valley. This extensive trade pattern is indicated by the introduction of non-local obsidian and items only previously found along the coast (Bartholomew and Rayle 2017).

Lewis and Clark were not the first Americans to venture along the Columbia River, but they had the biggest influence on the subsequent colonization of the west. Lewis and Clark ended their trek to the western coast in 1805 and wintered in the area of the Columbia River at Ft. Clatsop until 1806. They discovered the amazing resources the area offered, especially the abundance of furs. The fur trade brought many people west and John Jacob Astor's Pacific Fur Company founded a base along the Columbia River in what is now Astoria, Oregon (Bartholomew and Rayle 2017).

Fur traders established networks with the local Native Americans who dwelled along the river and moved further up the river well into Washington. Settlers began to show up in droves in the 1830s, starting their own farms or livestock raising. Hearing of the resources the area had to offer, many more emigrants took to the Oregon Trail to find their fortunes, whether it be farms or gold, in the Oregon territory. This influx of Americans had a negative effect on the Native Americans. The Native Americans were forced from their traditional homes and relocated to reservations in Oregon and Washington. This forced relocation greatly impacted their way of life and has had long lasting consequences on the Native Americans. However, the Chinookan-speaking peoples, as well as several other Native American groups who lived along the river, still practice their traditional culture today with the Columbia River being a primary component to their way of life.

The settlement of the Oregon Territory continued into the late 1800s with most people arriving by way of the Oregon Trail. The demand of timber contributed to the American development of the Oregon Territory, which was then made a state in 1859. Finding an abundance of natural resources, people began to export these items out of Oregon by way of the Columbia River. The first gristmill and sawmill was established in what is now St. Helens, Oregon, in 1850 and is located directly across from what is now Woodland Island.

The Army Corps of Engineers did not have an office in the area until the establishment of the Portland District in 1871. However, with the Columbia River being an important source of transportation of goods for the economy, they began to dredge the river in order to keep the channel open with the work being handled out of the San Francisco Office. The maintenance of not only the Columbia River, but also the Willamette River, led to the establishment of the Portland District Office.

The Portland District's Office had a primary goal to eliminate any impediments to the navigation of the rivers. The first recommendation to achieve this mission involved the removal of the St. Helens bar, which had become a difficulty to many of the larger vessels navigating the river. Dredging of the St. Helens Bar began in 1873, and has been maintained to this day. The material that made up St. Helens Bar would be placed in the area that would become Woodland Island (Bartholomew and Rayle 2017).

The Northern Pacific Railroad reached St. Helens in 1884 which boosted the local economy and helped lead to the establishment of a new mill. Automobile traffic led to the construction of the Columbia River Highway, which allowed alternate transportation along the river. However, the river remained the primary resource for the exportation of goods (Bartholomew and Rayle 2017).

Woodland Island is located in the Lower Columbia River within the state of Washington. Placement of dredged material removed from the St. Helens Bar produced what is now the southern portion of Woodland Island. The northern most portion of Woodland Island is documented as extant in aerial photographs of the area from 1929, but it is possible the island developed from the placement of dredged material prior to 1929. The Division of Geology and Earth Resources at the Washington Geologic Survey describe the islands as comprising of Holocene fill and modified land (Washington Geologic Survey 2017; Bartholomew and Rayle 2017).

A cultural resources survey that includes historic background research and a literature review, on the ground survey, and shovel testing was completed of the Woodland Islands in December of 2016. A historic shipwreck, date unknown and possibly related to the transportation of lumber, is located to the east of Woodland Island along the Washington Shore outside of the proposed placement area and will not be impacted. No other cultural or historic resources eligible for inclusion on the National Register of Historic Places (NRHP) under the National Historic Preservation Act (NHPA) (36 C.F.R. part 800) were identified.

Effects of the Alternatives

No Action Alternative

There would be no changes to Columbia River cultural resources as a result of the No Action Alternative. Not using Woodland Islands for habitat restoration would have no direct or indirect impacts on historic or cultural resources.

Alternative C: Base Measure (placement of 400 kcy dredged material).

Woodland Island has been subject to a full Class III cultural resources inventory that determined no historic properties are present on the islands. Further, while the northern section of the island could possibly be an original landform, the rest of the island is a man-made dredged material island. No human habitation or other use of the island with the exception of dredge disposal has occurred. Therefore, using the islands for beneficial dredge placement for habitat creation does not have the potential to cause direct or indirect effect on cultural resources.

Multi-beam bathymetry data taken in July 2014, and reviewed by Corps cultural resources staff, revealed no anomalies on the river bottom at the proposed placement location. A historic shipwreck is located to the east of the proposed project location along the Washington shoreline. This shipwreck is located well outside of the proposed placement zone and will not be affected by the proposed project.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

For the reasons stated under Alternative C, Alternative F has no potential to affect historic or cultural resources.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

This alternative has the same effects as those in Alternatives C and F; it has no potential to effect historic or cultural resources.

4.4 Socioeconomic Effects and Environmental Justice

Existing Conditions

The project area is located in Cowlitz County, Washington. The project site is not populated but approximately 1.3 million people live along the lower Columbia River. The river runs through the Pacific Northwest's second largest population center, the Portland/Vancouver metro area. According to the most recent census data (US Census, 2016), Cowlitz County is home to 105,160 residents. Approximately 15.7% of those residence have household incomes below the poverty line, and approximately 17.4% of the population are minorities.

A wide range of property uses and activities are observed along the Columbia River and associated upland sites, such as: agricultural, commercial, ecosystem restoration, industrial, recreational, residential, etc. A fair amount of properties adjacent to the Columbia River rely on the river for important and critical components of agricultural and commercial operations on their property including Cowlitz County. The Columbia River is the gateway for global imports from the Columbia-Snake River navigation system, and the primary economic driver for Cowlitz County is manufacturing. The second greatest economic contributor is merchant wholesaler sales followed by retail sales and health care/social assistance revenue (US Census, 2016).

The Columbia River and its tributaries support treaty, non-treaty commercial, and recreational fisheries including salmon, steelhead, groundfish, crabs, and lamprey. These fisheries are highly regulated by state, federal, and tribal entities. A wide range of fish and aquatic species are harvested from the Columbia River. There are 13 ESA-listed of salmon that migrate into the Columbia River system. Additionally, five other ESA-listed fish species use the Columbia River system in some capacity. Overall, there are over 120 species of fish and aquatic species that are harvested from this region.

The Columbia River is major recreational resource for a variety of shoreline, on-water and in-water activities. Recreational use of the Columbia River occurs year-round; river-based tourism and recreational activities are the driving economic force for a lot of the towns situated along the Columbia River. Fishing, hunting, swimming, water sports, and sightseeing are among the most popular activities to engage with the Columbia River. The project area is a popular recreational fishing location and is used as a beach landing for transiting boats, and day-use recreators. Many attempts have been undertaken by various agencies to quantify the recreational opportunity spectrum for the Columbia River. Given the wide range of recreational opportunities and large geographic range the Columbia River encompasses, it is difficult to fully encapsulate the extrinsic and intrinsic value of recreation for this reach of the river.

No Action Alternative

Under the No Action Alternative, no direct or indirect adverse or beneficial impacts on the socioeconomic environment are anticipated. Dredged material would continue to be placed at existing sites or in-water.

Alternative C: Base Measure (placement of 400 kcy dredged material).

Fishing opportunities may temporarily be lost during the construction phase of the project, which is estimated to last approximately two months. However, those lost fishing opportunities would be short duration and there is a high likelihood that ample fishing opportunities are available in nearby locations for the same species that would have otherwise been targeted. Because there is no estimate of recreational fishing for this project location, it is impossible to quantify a monetary value for lost fishing opportunities. However, given the short duration of project construction and the small spatial footprint of the project, direct impacts to the fishing community are likely to be negligible.

The placement of dredged material is intended to benefit ESA-listed salmonids and other fish and wildlife species by providing increased refuge and foraging habitats and increased prey resources, and thus, may contribute to the productivity and survival of these species. Increases in fish and wildlife populations would help to maintain and increase the value of recreational and commercial fishing in the region as well as providing improved hunting and other recreational opportunities. These effects are not quantifiable and are anticipated to be less than significant. Additionally, no adverse effects for environmental justice communities are likely to accrue as a result of this action, regardless of which alternative is chosen for final implementation.

River pilots have expressed concern regarding the possibility of the placed material to migrate downstream into the U.S. Coast Guard designated anchorage. Two-dimensional hydrodynamic modeling was performed to assess potential changes in sediment transport dynamics and identify potential impacts in the area. No impacts to the FNC are anticipated and there would be no alteration of vessel traffic beyond what is typically done to accommodate dredging activities at the St. Helens bar. See section 4.1.3 in this report and section 1.2 in Appendix B for more discussion.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

The anticipated effects of Alternative F are substantially the same as those under Alternative C. However, this alternative would include post placement grading, which may result in slightly larger benefits to the fishing community as more habitat features would be created through the shaping of placed dredged material.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

The anticipated effects of Alternative L are substantially the same as those under Alternative F. However, adding post-placement plantings may result in socioeconomic benefits accruing to the community faster than the other two alternatives under consideration. Plantings would expedite habitat development, which, in turn, would be expected to result in the previously discussed benefits being realized sooner relative to alternatives that do not include a planting plan.

4.5 Visual Effects

Existing Conditions

The project area is currently dominated by forested tidal floodplain, low and high emergent tidal marsh, tidal channels, and intertidal mud/sand flats. There are no structures on the island and it is only used for recreational purposes, but it also provides habitat for several species birds, beavers, and Columbian white tailed deer amongst others. The Woodland Islands are rimmed with a gently sloping shoreline, which is sparsely vegetated with willows, various species of sedges (Caryx spp.), and reed canary grass. The upland portion of the islands are dominated by mature cottonwood trees, Oregon ash, with a groundcover of Himalayan black berry and scotch broom.

The Washington shoreline adjacent to the project area is lined with privately owned residences, which have the proposed construction site of the project area in full view. In October 2017, Corps staff met with adjacent property owners to share information on the proposed project and to get feedback on potential concerns. One issue raised was the duration of construction, and how the project site would modify the viewscape for those residences. The potential effects on the viewscape are discussed below.

No Action Alternative

Under the No Action Alternative, no changes to the viewscape would occur. The shoreline vegetation on the project site would remain the same.

Alternative C: Base Measure (placement of 400 kcy dredged material).

Under Alternative C, placement of material on the side channel side of the islands would be visible to adjacent homeowners. Construction would include the use of large equipment to move the dredge pipe into place and to clear a 100- to 150-foot-wide swath of vegetation across the island. Equipment would include a backhoe, dozers, and bobcat. The pipe and staging equipment would be visible for the duration of placement activities. The total duration of the project from initial staging, vegetation clearing, and placement could be as long two months. The project would likely be constructed during the early fall when water is at its lowest elevation. The pipe expelling a slurry mixture would be visible, and pumping work would occur around the clock seven days a week. Working around the clock would enable the construction phase of the project to be completed in a shorter amount of time than if work were limited to a typical working day time period.

During placement, increased turbidity may be noticed in the side channel waters, but the sand to be placed in the area is medium to fine sand and settles out of the water column quickly. Therefore, increased turbidity or cloudiness in the water would only be evident during active pumping. As placement continues, the shoreline would appear to expand outward into the side channel. Overall, the shoreline would immediately appear to be larger and would be comprised of clean Columbia River sand with no vegetation. Disturbed vegetation through the middle of the island would be replanted and, while it may appear to be sparsely vegetated at first, it would be expected to grow quickly and fill in the areas of removed vegetation.

Under this alternative, plantings would not be added to the newly created features. In the long-term, under this alternative, natural vegetation recruitment would likely take several years to colonize the shoreline area and produce the desired habitat features. The shoreline site may look relatively barren in the space of time between placement, natural seeding, and eventual germination/growth. After vegetation has been fully established, the side channel shoreline would likely appear to be substantially vegetated with willows, saplings, and wetland shrubs and grasses.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

The viewscape impacts under Alternative F are largely the same as those discussed under Alternative C. However, this alternative includes the added component of complex grading after placement. The resultant view would be different from that of construction under Alternative C by the length of time it may take to apply complex grading after placement. Creating bathymetric features with placed sand may take several days longer than if the sand were simply pumped into the side channel and left to settle. However, the Corps still anticipates that the overall construction duration would not exceed two months. After sand is graded to create desired contours, the site may look rougher and the shoreline would likely appear to be extended outward into the side channel. The newly created features would not be planted with willows under this alternative, therefore the visual effects of natural vegetation recruitment in the long-term would be the same as described under Alternative C.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

Alternative L (Preferred) includes the added component of post-construction plantings on the placed dredged material features. Construction staging and implementation would result in the same visual impacts discussed under Alternatives C and F. However, the stark boundary of sand placement with the constructed features would be softened with willow plantings, which over just a few years would colonize approximately 80% of the shoreline area. Plantings would be monitored for the first two years, and failed plantings, below 80% cover, would be replaced. Residents along the project river reach are likely to favor a large-scale planting effort in between each placement event and after all placements are complete. A robust planting plan is more likely to result in an aesthetically pleasing project site in less time when compared to the other alternatives under consideration.

4.6 Land Use

Existing Conditions

A portion of Woodland Island on the downstream end is privately owned. The remainder of the island area and submerged lands are owned by the State of Washington. The islands are used primarily for recreational purposes such as hunting, fishing, camping, and all-terrain vehicle (ATV) use. The sand bar extending from the downstream end of the island is a popular location for kite boarders. Access to the project site can only be gained by boat so it is not easily accessible by the public, but it may be used as a recreational area. Maritime and recreational activities may occur within the vicinity of the project area.

A system of pile dikes was constructed at St. Helens Bar to concentrate flow and help maintain navigable depths within the FNC, reducing the O&M dredging requirements. The Woodland Islands were formed using dredged material on the protected side-channel side of the pile dikes. The islands work together with the pile dikes as a flow control structure, and the pile dikes also function to prevent migration and erosion of the islands. A comprehensive survey of the pile dikes in the Columbia River (USACE 2011), and it was determined that many pile dikes need repair, including those located within the project area.

Effects of the Alternatives

No Action Alternative

Land use at the proposed project site would not change under the No Action Alternative. However, further erosion of the islands could cause some areas of the project site to become unusable or inaccessible for fishing, hunting, or camping activities.

The Corps plans to continue to maintain these pile dikes because they are integral to maintaining the FNC in the Lower Columbia River. Because the Woodland Islands work together with the pile dikes as a flow control structure, maintaining stability of the islands may be considered in future FNC O&M planning. Placement of dredged material between the existing pile dike and the FNC side of the island to reconnect the pile dikes to the islands would help hedge against further erosion.

Alternative C: Base Measure (placement of 400 kcy dredged material).

Under Alternative C, placement of dredged material to improve and expand habitat at the project site may indirectly result in increased recreational access (by narrowing the distance between the island and the adjacent Washington shoreline) and recreational activity (e.g., as a boating destination, sunbathing, ATV use, etc.) on the islands. Before vegetation establishes, the large features constructed from dredged sand may attract boaters from nearby St. Helens and beyond as a new beach.

More riparian shrub wetland habitat could attract greater numbers of ducks, fish, and other animals that are targeted by recreational and commercial harvesters. This activity could increase use of the island, which may result in vegetation trampling, increased trash and debris, and wildlife disruption/displacement.

The Corps and its project partners do not anticipate this activity to increase significantly and evidence suggests the potential benefits to salmonids and other wildlife would outweigh any adverse impacts of increased recreational use of the project site.

Placing 400 kcy of dredged material in the side channel area behind Woodland Islands may have a positive impact on the function of the Woodland Islands and pile dikes as a flow-training structure. Using the area as habitat restoration will increase the value of the existing pile dikes and Islands as integral to preserving the habitat, existing and created, within the side channel.

Alternative F: Base Measure (placement of 400 kcy dredged material) plus complex grading.

The anticipated effects of Alternative F are the same as those described under Alternative C.

Alternative L (Preferred): Base Measure (placement of 400 kcy dredged material), complex grading, and additional planting of vegetation.

Similar to Alternatives C and F, the placement of dredged material could indirectly result in increased recreational access and activity on the islands, although this is not anticipated to be a significant effect. The magnitude of plantings introduced into the project area would likely have a limited additional effect on land use compared to Alternative C. A full-scale planting regime would immediately help prevent further erosion of the site, thus maintaining the island’s availability for the above-mentioned uses. It would also decrease the appeal of the project area as a sandy beach for recreating. Once established, mature vegetation may help to deter access to the site. Currently, there is no plan to restrict access to the island.

4.7 Cumulative Impact Analysis*

The "cumulative impact" is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." (40 C.F.R. § 1508.7.) The temporal scope for this Cumulative Impacts Analysis (CIA) covers the period from the most recent major action in 2003 for the Columbia River Navigation Improvement Project Oregon and Washington (Final Supplemental Environmental Impact Statement) (USACE, 2003) through the project's fifty year planning period of analysis (2068). The spatial scope for this CIA includes the area directly and indirectly impacted by the Columbia River O&M program activities, and includes the many tributaries, streams, and side channels influenced by this stretch of the Columbia River (RM 3.0 to RM 106.5 of the Columbia River).

4.7.1 Past Actions

The past actions considered in this CIA are those that continue to have present effects on affected resources. Together, the nine actions listed below create the conditions currently present within the action area.

- Construction, maintenance, and periodic reconstruction of the jetties at the mouth of the Columbia River by the Corps.
- Construction, maintenance, and periodic reconstruction of pile dikes, levees, and bridges in, over, or adjacent to the Columbia River
- Continued use, maintenance, and operation of multi-purpose dams in the Columbia River and Willamette River basins
- Navigation facilities (including both commercial and recreational docks and marinas) constructed and maintained by various ports along the Columbia River
- Corps' annual maintenance dredging and placement activities
- Recreational facilities established by federal, state, and local agencies
- Federal permits for aquatic and wetland impacts within the lower Columbia River, lower Willamette Rivers, and tributaries
- Commercial and residential development that has occurred in the area
- Adding a shoreline placement site at Rice Island and an in-water re-handling sump near Howard Island

4.7.2 Current Actions

Present actions include those projects that are currently being scoped, developed, planned, and implemented within the next year.

- Pile dike repairs along the Columbia River basin
- Ongoing operations and maintenance of dam/hydropower facilities
- Management of a piscivorous bird colony on East Sand Island.

- Ongoing placement actions to rebuild the lower Columbia River estuary streaked horned lark population
- Small-scale habitat restoration activities carried out by non-profit groups (Lower Columbia Fish Enhancement Group, Columbia Land Trust, Fish First, Trout Unlimited, and Friends of the East Fork Lewis River) on the Lewis River (adjacent to project site) and Columbia River tributaries

4.7.3 Reasonably Foreseeable Future Actions

The following actions were identified as being reasonably foreseeable to occur over the next ten years:

Corps actions

- Maintenance of Columbia River pile dike system at East Sand Island, West Sand Island, and Cottonwood Island
- Development of a new 20-year Lower Columbia River FNC
- Maintenance Plan and EIS
- Continued operations and maintenance dredging of the FNC

Corps permit actions

- City of Warrenton Hammond Boat Basin dredging
- City of Portland Parks and Recreation in-water placement of dredged materials
- Port of St Helens in-water placement of dredged materials
- Oregon LNG terminal (FERC) at the mouth of Skipanon Channel
- Karlson Island Restoration Project
- Reconstruction/Upgrade of Westport Ferry Terminal

Non-Corps Actions

- Columbia River Carbonates Woodland Marine Terminal and mitigation plan
- WDFW Shilapoo Wildlife Refuge salmon habitat restoration plan

4.7.4 Combined Effects of Past, Present, and Reasonably Foreseeable Actions

When determining the cumulative effects of a particular action, the action agency is required to examine the additive effects of past, present, and reasonably foreseeable future actions within the defined temporal and spatial boundary of the CIA. The LCRE is a large area where many actions have taken place, are being implemented, and are being planned. This CIA examines the combined effects of those actions, on the physical, biological, and socioeconomic environments. Of these actions, the most influential for this project are the pile dike maintenance program, ongoing FNC channel maintenance dredging, and the proposed Columbia River Carbonates mitigation site that would be located adjacent the project area. In summary, the Corps has preliminarily determined that the proposed action to restore scrub shrub and emergent wetland habitat on the east side of Woodland Islands would not result in cumulatively significant effects on the human environment when combined with effects of past, present, and reasonably foreseeable future actions.

Physical Environment

Beneficial use of dredged material at Woodland Islands is intended to offset, to some degree, various adverse effects on the river morphology, hydrology, and water quality that were caused by many past river management actions. Similar dredged material placements in the past inadvertently resulted in development of high quality riparian habitat. The project would not result in any FNC modifications and would not interfere with channel maintenance activities. The side channel morphology would change slightly in the placement area, but in the broader context of the river system, this alternation would not significantly add or detract from the status quo hydrologic environment. Pile dike maintenance at Woodland Island would likely result in cumulative benefits to the developed side channel habitat. Restoring full function of the training structure that spans the length of the FNC side Woodland Island would not only ensure the entire system of pile dikes in the area work together to direct flow to the FNC to reduce the need to dredge but would also help protect the island from erosion and, thus, protect the habitat restoration site.

Two future proposed projects may eventually work to compliment habitat restoration at Woodland Islands: the proposed Columbia River Carbonates mitigation work, and salmon habitat restoration at Shilapoo Wildlife Refuge located 27 miles upstream of the proposed project site. The Columbia River Carbonates project, located within the Woodland Islands side channel area along the WA shore, would include construction of a fixed commercial offshore marine terminal with a fully enclosed over-water conveyor system that would transfer limestone from barges to an onshore stockpile facility. The proposed marine terminal project would be at RM 82 located on the east bank of the Columbia River on a floodplain approximately four miles long and two miles wide named the Woodland Bottoms. Direct effects of this project include but are not limited to pile driving, loss of 0.86 acres of riparian vegetation, 39,813 CY of fill, and 450 feet of bank hardening with rip rap. A mitigation plan has been drafted for the Colombia River Carbonates project and includes the following mitigation actions:

- Place four large wood structures along the shoreline at the development site
- Place eight large wood structures along the shoreline at the mitigation site
- Create three off-channel areas (total of 6,970 square feet) for migrating and rearing juvenile salmonids
- Enhance 0.76 acres of shoreline plant communities by controlling invasive species, installing native plants, and removing garbage
- Restore 0.60 acres of floodplain and riparian plant communities by controlling invasive species, installing native plants, and removing garbage
- Close mitigation site to vehicular traffic, blocking vehicles that drive through the river to the island
- Preserve and protect the 6.34-acre offsite mitigation area through a deed restriction and long-term maintenance plan

The applicant proposes to do as much mitigation on the development site as feasible. While the proposed project requires all the area landward of the OHW level have a viable operation, the shoreline waterward of the OHW level is available for enhancement. Four large wood structures are proposed along the shoreline. The two center structures will be placed as far waterward as feasible. As requested by the WDNR, large wood structures on the north and south property boundaries will be placed higher on the bank to block vehicle access to the development site's shoreline. The offsite mitigation site is located 2.5 miles south of the development site and is located on the Columbia River mainstem upstream from the project (Figure 21). The map below illustrates the relative locations of the Corps habitat restoration project area and the Columbia River Carbonates mitigation site.

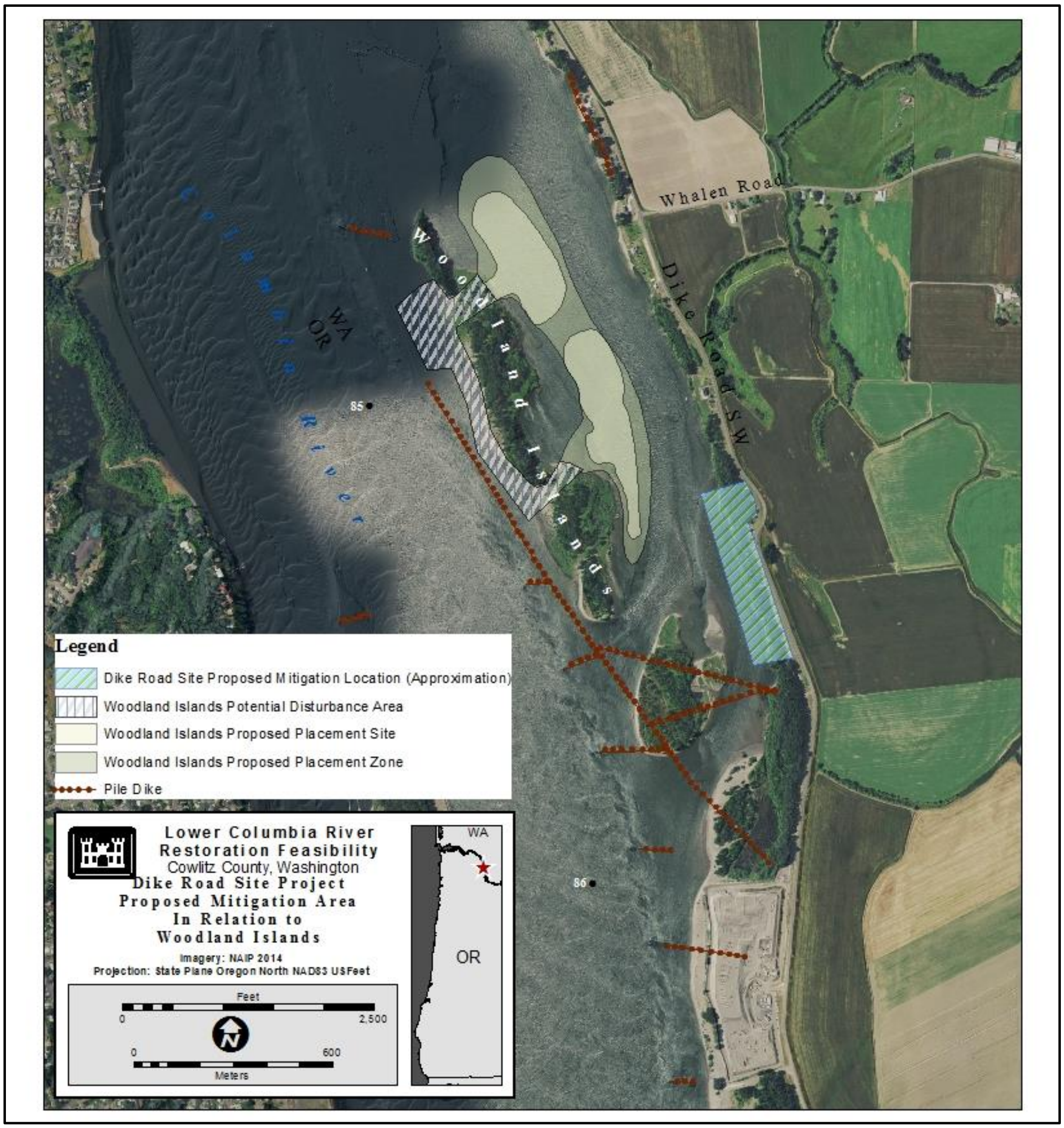

Figure 21. Map illustrating relative locations of the Columbia River Carbonates mitigation site (blue rectangle).

Approximately 27 miles upstream of the Woodland Island project site, WDFW is planning a salmon habitat restoration project at Shilapoo Wildlife Refuge. This project would include removal of several dikes, levies, and gates that currently keep water in place for water fowl habitat. Under the proposed project, most of the area would become inundated by the natural flows of the Columbia River creating a large swath of salmonid habitat. This project would not directly affect the Woodland Island project. However, it would add to the cumulative benefits that are likely to accrue for juvenile salmonid species migrating down the river.

Overall, the proposed Woodland Island project would not be expected to result in significant effects on the physical environment when examined individually or when combined with the additive effects of all other past, present, and future actions.

Biological Environment

Cumulative effects on the biological environment that would result from the Woodland Island habitat restoration efforts are expected to be beneficial, even when combined with effects of other past, present, and future projects. Pile dike maintenance reduces the need to dredge, which is favored over increased dredging. Habitat restoration and mitigation projects in nearby locals would help to support species use of a substantial reach of the river and provide increased opportunities for juvenile salmonids to find a variety of forage and rest areas as they proceed down the river. Biologically, the projects mentioned above would complement each other by forming a patchwork of improved and ideal habitats for terrestrial and fish species. Combining the effects of past, present, and future actions, with potential impacts of the Woodland Island habitat restoration project, would not result in significant adverse effects on the on the biological environment. Overall, ESA-listed species, benthic organisms, riparian vegetation, and terrestrial specie would benefit from this project and several others in within the bounds of this CIA.

Socioeconomic Environment

The socioeconomic environment would continue to benefit from this project, as well as the many others taking place and already implemented on the river. In large part, infrastructure maintenance and industrial development comprises the backbone of the economic environment along the Columbia River. Maintenance actions such as pile dike repairs and dredging creates employment opportunities and facilitates transport billions of dollars of commerce. Terminal facilities and construction thereof, also create employment opportunities and allow for specialized commerce shipping along an extremely important financial corridor. Additionally, habitat restoration and preservation projects serve to bolster commercial and recreational use opportunities along the river. The cumulative effects of these opportunities and actions are likely to benefit the socioeconomic environment, and would not result in significant adverse effects when examined individually or together.

5 Tentatively Selected Plan

5.1 Description of the Plan (NER Plan)

The Corps' objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to NER (outputs) are increases in the net quantity and quality of desired ecosystem resources. The NER Plan must reasonably maximize ecosystem restoration benefits compared to costs, consistent with the Federal objective. The selected plan must be shown to be cost effective and justified to achieve the desired level of output.

5.1.1 Project Description

The TSP/Proposed Action, which is also the Corps' "Preferred Alternative" for NEPA purposes, includes placing dredged material on the back side of the middle Woodland Island to create low velocity shallow water and riparian shrub habitat. The created habitat adds to the existing habitat diversity, and is compatible with the existing and created shallow water and wetland habitats on the back side of the island. The project includes a measure to support vegetation establishment through plantings, which also helps prevent invasive species from establishing. The TSP also includes a measure to add topographic complexity by doing additional grading that will shape the placed dredged material. A monitoring plan is included in the project as a part of the adaptive management strategy. No costs or features (local betterments) over the NER Plan have been identified for implementation.

Figure 22 depicts terrain data of the proposed features. Additional drawings and typical profiles are included in the Dredging and Construction Appendix.

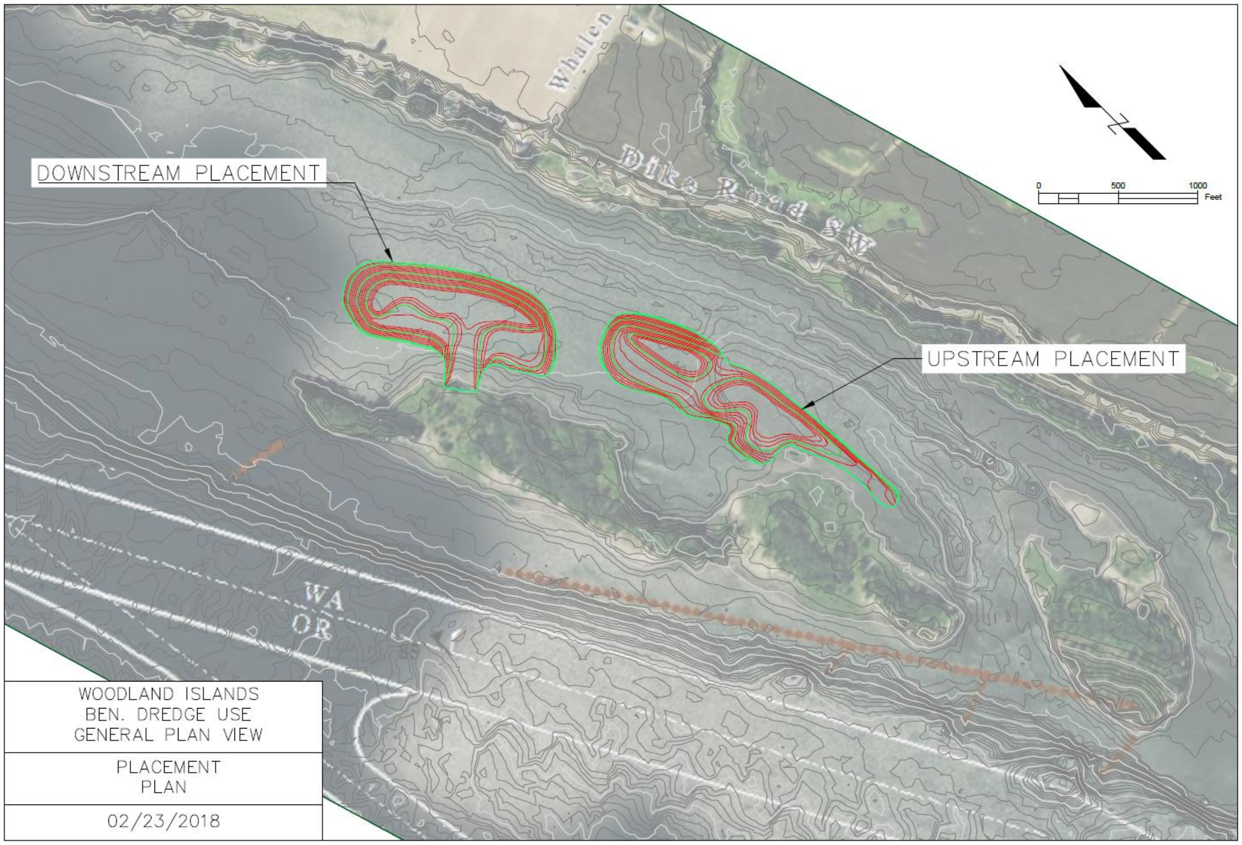

Figure 22. Terrain features associated with the Tentatively Selected Plan.

5.2 Effects of the Tentatively Selected Plan

Anticipated effects of the TSP, Alternative L, which includes placement of 400,000 CY of dredged material, complex grading, and post placement plantings, are expected to be mostly short-term associated with construction, and are not expected to be significant. Overall, habitat restoration at Woodland Island would expand usable habitat for aquatic and terrestrial species, to include ESA-listed salmonids, and may help offset, to a small degree, some of the habitat modifications that have taken place over many years on this reach of the LCRE. The reader is referred to Section 4.0 of this document for a detailed discussion of potential effects.

5.3 Design and Construction Considerations

5.3.1 Construction

The placed material features would be constructed using the pipeline dredge *Oregon*, a 30-inch cutter-suction dredge owned by the Port of Portland. The source of the sand will be the St. Helens Bar reach of the 43-foot authorized FNC. A pipeline system would be required to connect the dredge Oregon to the project site on the side-channel side of the island. This includes a submerged pipeline to cross the channel, a floating pipeline near the downstream end of the longitudinal pile dike, two cross-island pipelines, and a parallel-pipe discharge system. On the island, a landing beach, two cross-island access roads, and shoreline access road would be necessary to build and maintain the pipelines and to access the placement features. The site preparation work, pipeline creation, and pumping activities are described in greater detail below.

Site preparation

The existing beach on the north end of the island would be used to land two barges carrying pipeline materials and equipment (dozers, a loader, an excavator, a temporary job shack, etc.). Additional material may need to be pumped onto the beach to create a safe landing slope.

Two cleared, 150-feet-wide, cross-island access areas would be needed for the pipelines and equipment. Actual disturbance areas would be minimized, generally, and any disturbed areas would be re-graded and replanted following construction. There could be a need to raise the elevation of the crossing area. In order to do that, the dredge may pump sand into the area, and dozers would push it up to the desired elevation.

A 75- to 100-foot-wide road would be needed to connect the landing beach to the southern cross-island access. This would be located along the existing shoreline, minimizing disturbance to vegetated upland areas, and it would be built using the sand along the existing beach.

Pipeline creation

The shoaling is located primarily on the Oregon side of the channel, which means that the Port will employ the submerged pipeline to cross the channel without affecting traffic. The dredge would place and anchor sections of floating pipeline to reach the project area by accessing the island near the downstream end of the longitudinal pile dike that runs parallel to the shoreline of the island.

On shore, 5000 feet of pipeline would be available to connect to the placement locations. The shore-based pipeline would connect to the floating pipeline near the landing beach and extend across the island to the placement locations. At the end of the cross-island pipelines, a "wye" (literally a y-shaped switch) would be placed to switch to a parallel pipe system, which would allow for material to be pumped through one leg of pipe while pipe is added to the other, thereby avoiding the need to temporarily stop dredging and pumping. A wye could also be placed at the landing beach to allow for seamless pumping from one feature to the other.

Pumping and Placement

Once the supply pipeline and wye are setup, dredged material in the form of a sand-water slurry would be pumped from the dredge through the pipeline, across the island, and onto the shore-end of the peninsula-shaped placement area. As sand settle from the slurry and the ground elevation rises, dozers would be used to push the material to create berms that contain the slurry and help form the feature. Simultaneously, pipe would be added to the closed section of the wye and the second leg would be extended further out the peninsula. In this manner, alternating between parallel legs, pumping could occur continuously, growing the peninsula from the shoreline to the distal end of the feature until the design volume has been placed. Once pumping of one of the features is completed, the shore crew would switch the operation and begin constructing the other feature.

Additional grading

After a feature is created, additional grading would be required to achieve the final design surface. Dozers would primarily be used to move material above low water levels (6 to 8 feet NAVD), and a long-reach excavator could be used to excavate to lower depths where needed and to cast material as far as possible from shore, extending shallow water shelves.

Planting

The TSP includes willow plantings, using a landscape/habitat restoration contractor (not Port personnel). Several species of willows, and possibly a few other species of shrubs such as red-twigged dogwood and snowberry (both observed mixed occasionally with willows on the island), would be planted to create dense stands of willows from above the high water mark (the wrack line) up to about four feet higher in elevation (in a range of elevations from 10 to14 feet NAVD.). These elevations will support willows but the soils should be too moist to support scotch broom or Himalayan blackberry, which are the two common invasive shrubs observed on the island.

The conceptual planting plan would involve planting the site using native willow stakes that are ~3 feet in length. About 80% of each stake would be inserted into the moist sand, and the remainder would extend above ground. The willow stakes would be spaced about five feet apart (or further, depending on site conditions), and could be planted evenly or in patches. Dense stands of shrubs would help stabilize the sand from erosion and would provide nesting and foraging habitat for many species of warblers, sparrows, and other songbirds, and other wildlife species.

Several species of willows grow commonly in the Columbia River basin floodplain and could be used for restoration planting. As a reference point, demonstration plantings of Scouler's, Hooker's, and Pacific willows, which had grown to greater than six feet in height in approximately five years, were observed at a few sites on Sauvie Island in the Willamette River, about 30 miles south of Woodland Island, in summer 2017 (Figure 23).

Figure 23. Scouler willow stake (example planting from NRCS manual) (left) and approximately five year old willow shrub observed at Sauvie Island, Columbia County, OR (summer 2017) (right).

5.3.2 Schedule

Construction is anticipated to occur during the end of the 2018 dredging season, likely starting as late as mid-October. The placement operations are expected to take at least four weeks to complete assuming a typical work schedule for the Dredge *Oregon* (24 hours per day, five days per week, with no noise or lighting restrictions), a pumping rate of roughly 20 kcy per day, and decreased efficiency due the additional construction constraints. Additional grading and planting activities could overlap with placement but are expected to extend the construction duration by approximately one week. Additional restrictions to operations and challenges with water levels could result in a longer construction duration, which may require an earlier start date or reduction in volume of material placed. Mobilization and site preparation are expected to take an additional 3 to 4 days at the beginning of the project.

5.4 Real Estate Considerations

WDNR's aquatic lands are required to support the project and a one-year Temporary Work Area Easement (TWAE) from a single private landowner will be required for access and construction of the restoration features. Figure 24 shows the location of the private parcel, temporary construction area, and potential disturbance areas.

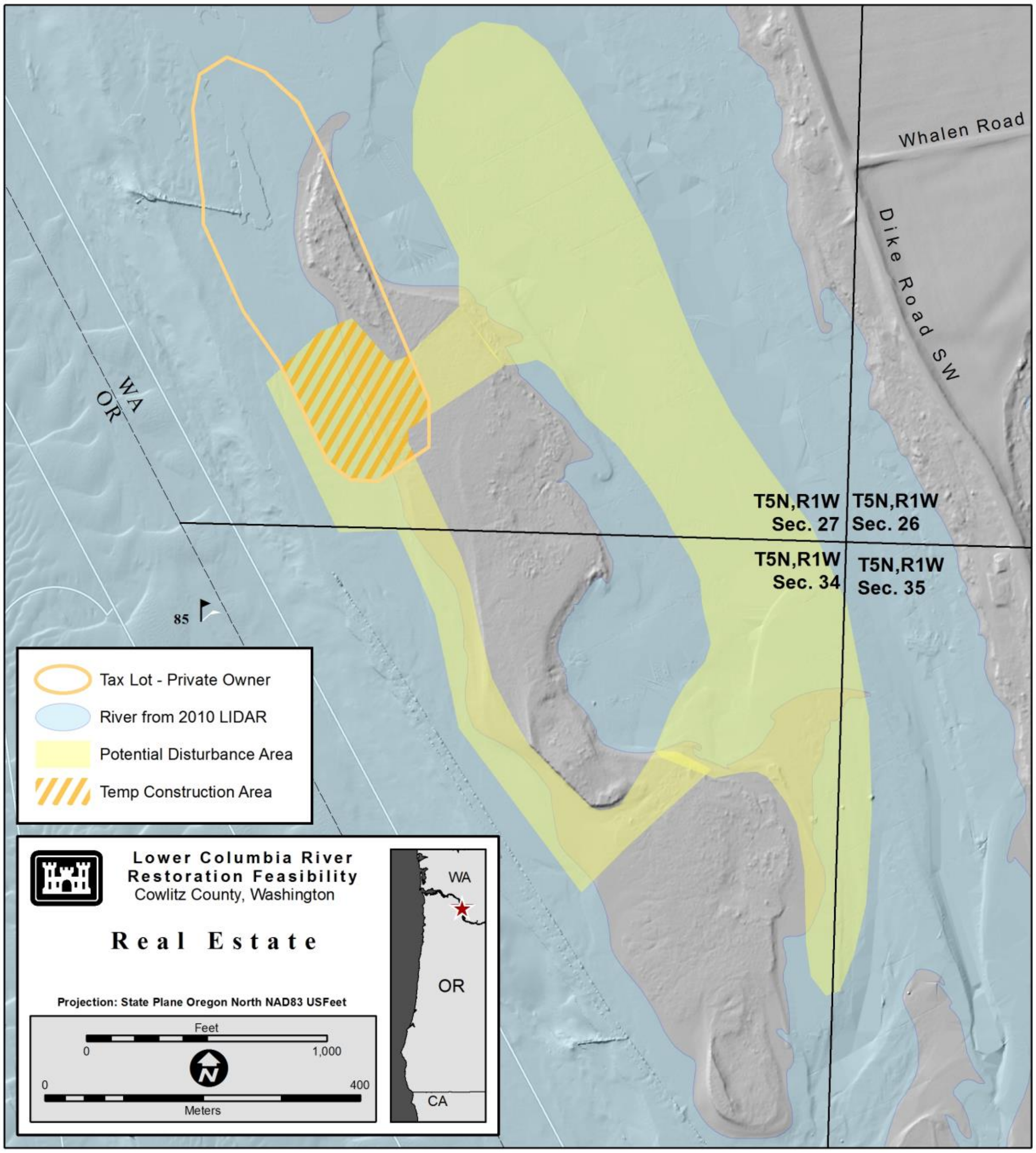

Figure 24. Real estate interests required for the project.

Navigational servitude will be exercised for all lands below the ordinary high water mark of the Columbia River, a navigable waterway. The nexus to navigation comes from the source of the material used for the proposed project, i.e. dredging from the FNC that is necessary to keep that channel clear for navigation purposes. The navigational servitude includes the right to deposit that material elsewhere in navigable waters.

WDNR has been verbally notified of the intent to exercise navigational servitude on their aquatic lands. A copy of the TSP has also been forwarded to the WDNR for their awareness. WDNR anticipates full support of the project. Their intent is to grant the Corps a ROE to document use of the area in accordance with their normal record keeping process. The Corps will accept the ROE to accommodate WDNR but shall not be obliged to comply with their requirements.

The Corps would share the TSP along with real estate maps with the WDNR to keep them abreast of the Project's Real Estate developments on an ongoing basis, and would send a notification letter to WDNR of the federal government's intent to exercise its navigational servitude rights at least 90 days prior to project construction.

5.5 Cost Estimate

The total project cost for the recommended plan is $1.39M. This cost estimate is meant to be a budgetary estimate for the entire duration of the project. This means in addition to the contracted construction costs, the estimate also includes costs for planning, engineering, design, and construction management. Moreover, due to the preliminary nature of the design, the cost estimate also includes calculated contingency to accommodate details unforeseen at this time. Lastly, as the work will be occurring in the future, the cost estimate is escalated to the anticipated midpoint of construction to account for steadily rising costs in this sector of the economy.

The cost for this project represents only the incremental cost above the comparable cost to place the equivalent quantity of dredged material at Sand Island, the closest disposal site within the Corps' O&M navigation project. This plan would increase the cost of the existing dredging project by $827,287. The additional cost would be cost-shared with the non-federal sponsor, CREST. The additional cost includes placement of the dredging material, complex grading (section 3.4.3) and planting vegetation (section 3.4.5). These cost are summarized in Table 17:

Table 17. Project first costs ($1,000) shared among non-federal and federal partners, FY 2018 price level.

	Contributions			Projected Federal Cash Expenditures		
Phase	**Total**	**Non-Federal**	**Federal**	**FY 2018**	**FY 2019**	**FY 2020+**
Base Plan (Routine O&M Dredging and Placement at Sand Island)	**$1,645**		**$1,645**			
Recommended Plan (CAP Section 204)						
Engineering Design, Plans and Specs	**$190**	**$66.50**	**$123.50**	**$115.5**	**$2**	**$6**
Construction Cost of Recommended Plan	**$1,070**	**$374.50**	**$695.50**	**$352.2**	**$343.3**	
Construction Management	**$105**	**$37**	**$68**	**$68**		
LERRD (creditable outlays)	**$28**	**$28**		**$28**		
Total CAP Section 204 Increment	**$1,393**	**$506**	**$887**			

5.6 Monitoring and Adaptive Management

Appendix D includes a description of the monitoring and adaptive management strategy for the proposed action. Topography and vegetation are the key elements that will be modified by the project and are the key indicators of project performance. In summary, a series of project success targets such as geomorphic stability and vegetation cover would be monitored for two or more years following construction. The primary adaptive management action is to conduct additional planting or seeding if needed.

Compared to more typical ecosystem restoration projects, there is some uncertainty as to how the project area will respond to the tentatively selected plan. Based on other dredged material sites (including Woodland Islands itself) a functional ecosystem will develop, but the timeframe and exact trajectory is unknown. The PDT selected the site and developed the measures with this uncertainty in mind and, as outlined in Appendix B, determined that the anticipated variability of the site over time is acceptable and appropriate.

5.7 Summary of Cumulative Effects of the Tentatively Selected Plan (Agency Preferred Alternative)

Anticipated effects of Alternative L (400 kcy placement, complex grading, post placement plantings), the Corps' Preferred Alternative, when combined with those of past, present, and reasonably foreseeable future actions are not expected to be cumulatively significant. Overall, habitat restoration at Woodland Island would expand usable habitat for aquatic and terrestrial species and may help offset, to a small degree, some of the habitat modifications that have taken place over many years on this reach of the LCRE. The reader is referred to Section 4.7 of this document for a detailed discussion of potential cumulative effects.

5.8 Summary of Environmental Consequences

Section 4 provides a compressive discussion of environmental effects of each alternative under consideration. In summary, the proposed project would benefit the biological and socioeconomic environment. It would have neutral effects on the physical environment including hydrology, water quality, and river morphology.

5.9 Risk and Uncertainty

Project authorization and funding must align with the dredging cycle and material availability in the St. Helens shoal. The shoal is dredged typically every three years. Currently the shoal is expected to have ample volume for dredging in 2018, so project construction in 2018 would be ideal. Furthermore, dredging will likely need to occur in 2018, after which, ample material for a Woodland Islands project would likely not be available again until 2020 or 2021. The actual material that can be dredged is a function of several factors, most notably related to the amount of material deposited over winter and during the spring freshet, and dredging needs are often determined on a year-to-year basis following annual bathymetric surveys.

6 Other Applicable Laws

6.1 National Environmental Policy Act

The National Environmental Policy Act of 1969 (NEPA), as amended, requires that federal agencies consider the environmental impacts of proposed actions and alternatives to the proposed action. This integrated FS/EA satisfies the requirements of NEPA. The final FS/EA will include the outcome of all inter-agency coordination. If the FS/EA leads to a FONSI or mitigated FONSI, the FONSI would be signed and made public along with the final FS/EA.

6.2 Endangered Species Act

In accordance with Section 7(a)(2) of the Endangered Species Act of 1973 (ESA), as amended, federally funded, constructed, permitted, or licensed projects must take into consideration impacts to federally listed or proposed species and their critical habitats within NMFS and USFWS jurisdiction.

As discussed in Section 4.2.3, the Corps does not anticipate adverse impacts to federally-listed or proposed species or their critical habitats as a result of the Proposed Action. The Corps is consulting with NMFS and the USFWS through programmatic/informal consultations for the Proposed Action. The results of those consultations will be included in the final FS/EA.

6.3 Clean Water Act

The Clean Water Act (CWA) regulates the release of pollutants into waterways.

Section 401 **–** Requires certification from the state that a discharge to waters of the U.S. in that state would not violate the states' water quality standards. This project fits within the scope of activities that are covered under the Nationwide Permit program, specifically Nationwide Permit 27, which applies to "Aquatic Habitat Restoration, Establishment, and Enhancement Activities." The Corps is coordinating with the Washington Department of Ecology on impacts to water quality and compliance with Section 401 of the CWA, according to the Nationwide Permit conditions.

Section 402 **-** Requires a National Pollutant Discharge Elimination System (NPDES) permit for certain regulated discharges of pollutants or combinations of pollutants. No Section 402 permit is required for this project.

Section 404 **–** Regulates the discharge of dredged or fill material into waters of the United States. The Corps has permitting responsibility under Section 404 of the CWA. The Corps does not issue itself a permit under the regulatory program, but rather demonstrates compliance with the substantive requirements of the Act via a Section 404(b)(1) equivalency analysis.

Only when there is no practicable alternative would any discharge of fill or dredged material occur in waters of the U.S., including wetlands. The proposed beneficial use of dredged material requires that dredged material be strategically placed in water to create new aquatic habitat and enhance existing habitats. Because there is no alternative to discharging dredged material in Waters of the U.S. to increase the bottom elevation to increase shrub fringe wetland habitat and the project fits within the scope of Nationwide Permit 27, the Proposed Action complies with Section 404(b)(1) of the CWA through the equivalency analysis included as part of the permit.

6.4 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) encourages coastal states to develop and implement coastal zone management plans that are consistent with national policies to preserve, protect, develop, and where possible, restore or enhance, coastal zone resources. Section 307 of the CZMA requires that any federal action occurring in or outside of the coastal zone which affects coastal land or water uses or natural resources must be consistent to the maximum extent practicable with the state's Coastal Management Program. The CMZA does not apply as the project area is not within the coastal zone.

6.5 Clean Air Act

The Clean Air Act of 1970 (CAA), as amended, established a comprehensive program for improving and maintaining air quality throughout the United States. The intent of the Act is achieved through permitting of stationary sources, restriction of toxic substance emissions from stationary and mobile sources, and the establishment of National Ambient Air Quality Standards. Title IV of the Act regulates noise pollution. See Section 4 for detailed discussion of the impact of the Proposed Action on air quality. The Proposed Action would have temporary short-term intermittent reduction in air quality during construction from construction equipment emissions. There would also be temporary short-term intermittent increase of noise levels from the operation of construction equipment. Noise impacts would be minor and temporary in nature and would immediately return to background levels at the completion of the project. Based on the information described in Section 4, the Proposed Action would be in compliance with the CAA.

6.6 National Historic Preservation Act, Archaeological Resources Protection Act, and Native American Graves Protection and Repatriation Act

The National Historic Preservation Act of 1966 (NHPA), as amended, sets forth national policy and procedures regarding historic properties, defined as districts, sites, buildings, structures, and objects included in or eligible for the National Register of Historic Places (NRHP). Section 106 of NHPA requires federal agencies to consider the effects of their undertakings on such properties and to allow the Advisory Council on Historic Preservation (ACHP) the opportunity to comment on those undertakings, following regulations issued by the ACHP (36 C.F.R. part 800).

The Archaeological Resources Protection Act (ARPA) applies when a project may involve archaeological resources located on federal or tribal land. ARPA requires that a permit be obtained before excavation of an archaeological resource on such land can take place.

The Native American Graves Protection and Repatriation Act provides for the protection of Native American and Native Hawaiian human remains and cultural items. It establishes requirements for the treatment of Native American human remains and sacred or cultural objects found on federal lands.

To determine the potential effect of a project on known or unknown historic properties, the following items are analyzed: the nature of the proposed activity and its effect on the landscape; the likelihood that historic properties are present within a project area; whether the ground is disturbed by previous land use activities and the extent of the disturbance; reviewing listings of known archeological or historic site locations, including site data bases and areas previously surveyed or listings of sites on the NRHP. In this case, since the project area had never been subject to a cultural resources survey, the Corps required that a comprehensive cultural survey be done in December of 2016. No cultural resources eligible for the NRHP were discovered as a result of the survey. See Section 4.3 for discussion of cultural and historical resources at the project area and the effects of the Proposed Action on those resources.

The Corps professional cultural resources staff has made a determination of no potential to effect historic properties, as defined under 36 C.F.R. part 800, for the Proposed Action based on this information.

The Corps consulted under 36 C.F.R. part 800 with the Washington Department of Archeology and Historic Preservation (DAHP), the Confederated Tribes of the Siletz Indians, the Confederated Tribes of the Grand Ronde Community of Oregon, the Cowlitz Indian Tribe, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes and Bands of the Yakama Nation, the Nez Perce Tribe, and the Confederated Tribes of the Umatilla Reservation. Concurrence for the determination of no potential to effect under NHPA was received 4 December 2017 from DAHP. No other responses were received.

6.7 Executive Order 13175, Consultation and Coordination with Indian Tribal Governments

This order requires federal agencies to establish regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications and to strengthen the United States government-to-government relationships with Indian tribes. Government-to-government coordination for cultural and natural resources was coordinated via letter correspondence dated August 29, 2016, with the Confederated Tribes and Bands of the Yakama Nation, the Cowlitz Indian Tribe, the Confederated Tribes of Grand Ronde, the Confederated Tribes of Siletz Indians of Oregon, the Confederated Tribes of the Umatilla Indian Reservation, the Nez Perce Tribe, and the Confederated Tribes of the Warm Springs.

6.8 Bald and Golden Eagle Protection Act

This Act provides for the protection of bald and golden eagles by prohibiting the taking, possession, and commerce of such birds, except under certain specified conditions. The proposed project is not within 660 feet of an active or alternate eagle nest, thus, no nests would be affected during the breeding season (between 1 January and 15 August). The Proposed Action would not disturb bald or golden eagles and therefore *complies with* the Bald and Golden Eagle Protection Act.

6.9 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) directs federal agencies to prevent the loss and damage to fish and wildlife resources; specifically, wildlife resources shall be given equal consideration in light of water-resource development programs. Consultation with the USFWS is required when activities result in the control of, diversion or modification to any natural habitat or associated water body, altering habitat quality and/or quantity for fish and wildlife. On November 28, 2017, the Corps consulted with the USFWS, who determined the Proposed Action did not require FWCA coordination. Additionally, on December 1, 2017, the Corps consulted with NMFS, who also determined FWCA coordination was not necessary for the Proposed Action.

6.10 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) is designed to actively conserve and manage fishery resources found off the coasts of the United States and to support international fishery agreements for the conservation and management of highly migratory species. The MSA established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for fisheries regulated under a federal fisheries management plan. Federal agencies must consult with the NMFS on all federal actions authorized, funded, or carried out by the agency that may adversely affect EFH. Section 6.2 provides more description of NMFS-related BiOp requirements. The project will comply with all terms and conditions of the applicable BiOps by employing BMPs where necessary and avoiding impacts wherever possible.

6.11 Marine Mammal Protection Act

This Act established a federal responsibility to conserve marine mammals within waters of the United States. With certain specified exceptions, the Act establishes a moratorium on the taking and importation of marine mammals, as well as products taken from them, and establishes procedures for waiving the moratorium and transferring management responsibility to the states. Marine mammals could potentially occur in the project area. It is possible that the proposed action could disturb the federally-listed pinnipeds with the movement of dredges through the network as material is placed. However, it is unlikely the effects would rise to the level of harm or harassment.

6.12 Migratory Bird Treaty Act and Executive Order 13186, Migratory Birds

The Migratory Bird Treaty Act (MBTA) makes it unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not. Under the MBTA, "migratory birds" essentially include all birds native to the U.S. and the Act pertains to any time of the year, not just during migration. The dredge program contractors will implement BMPs for the protection of migratory birds, parts, nests, eggs or products. The Proposed Action could displace birds by causing flushing, altering flight patterns, or cause other behavioral changes. However, it is not expected that these effects would rise to the level of "taking" any migratory bird. Dissuasion of birds from placement sites has been evaluated. Adverse effects to streaked horned larks were evaluated in the 2014 USFWS BiOp. The anticipated effects of the Proposed Action on streaked horned larks falls within the scope of actions covered under the 2014 BiOp; therefore, the effects determination for streaked horned larks remains unchanged relative to the proposed activities.

Executive Order 13186 further strengthens the MBTA, the Bald and Golden Eagle Protection Act, the FWCA, the ESA and the NEPA. Federal actions resulting in the "take" of a migratory bird are required to develop a Memoranda of Understanding with USFWS to promote the conservation of migratory bird populations and resources. Activities related to the handling and consideration of migratory bird species under the Columbia River O&M program were coordinated with USFWS in 2014 and are documented in the subsequent, previously referenced, 2014 USFWS BiOp. There is no anticipated take of any migratory birds resulting from the proposed activities; therefore, the actions are in compliance with this order.

6.13 Wild and Scenic Rivers Act

This Act applies only to rivers designated by Congress as "wild and scenic" to safeguard the special character of these rivers. Under this Act, federal agencies may not assist the construction of a water resources project that would have a direct and adverse effect on the free-flowing, scenic, and natural values of a federally designated wild or scenic river. The Columbia River is not designated as a Wild and Scenic River along this reach; therefore, this Act is not applicable to the proposed action.

6.14 Executive Order 12898, Environmental Justice

This order requires federal agencies to minimize adverse impacts on subsistence, low-income or minority communities, ensuring no persons or group of people bear a disproportionate burden of negative environmental impacts resulting from the execution of this country's domestic and foreign policies. No subsistence, low-income or minority communities would be affected by the proposed activities because the project area is uninhabited and, therefore, there would be no change in population, economics or other indicator of social well-being. Consequently, the Proposed Action is in compliance with this Order because no environmental justice implications exist for the proposed project.

6.15 Executive Order 11990, Protection of Wetlands

The purpose of this executive order is to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. In planning their actions, federal agencies are required to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided. Potential impacts on wetlands as a result of construction activities for this project are discussed in Section 4 of this document.

6.16 Executive Order 11988, Floodplain Management

Executive Order 11988, Floodplain Management, requires federal agencies to consider how their actions may encourage future development in floodplains, and to minimize such development. The proposed action does not further affect development of floodplains or the management of floodplains; therefore, the activities are *in compliance* with this order.

7 Agencies Consulted and Interested Parties

Early and continuing coordination with the general public and appropriate public agencies is an essential part of the environmental process to determine the scope of environmental documentation, the level of analysis, potential impacts and avoidance, minimization, and/or related environmental requirements. Agency consultation for this project has been accomplished through a variety of formal and informal methods

This draft FS/EA will be released for a 30-day public review period. Review comments were requested from federal and state agencies, as well as various interested parties. Responses to public comments will follow.

In addition to the posting of the draft FS/EA on the Corps website, a notice requesting comments regarding this draft FS/EA was sent to the following agencies and groups:

U.S. Fish and Wildlife Service
National Marine Fisheries Service
U.S. Environmental Protection Agency
U.S. Coast Guard
Bonneville Power Administration

Confederated Tribes of Siletz

Confederated Tribes of the Grand Ronde
Confederated Tribes of the Warm Springs
Cowlitz Indian Tribe
Confederated Tribes of the Umatilla Indian Reservation
Nez Perce Tribe
Confederated Tribes of the Yakama Nation

Columbia County, Oregon

Washington State Historic Preservation Office (Washington Department of Archaeology and Historic Preservation)
Washington Department of Ecology
Washington Department of Fish and Wildlife
Washington Department of Natural Resources

American Rivers
Columbia River Channel Coalition
Columbia River Estuary Study Taskforce
Columbia River Inter-Tribal Fish Commission
Lower Columbia River Estuary Partnership
Northwest Environmental Advocates
Pacific States Marine Fish Commission
Pacific Northwest Waterways Association
Portland Audubon Society
Salmon for All
Save Our Wild Salmon

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