FINDING OF NO SIGNIFICANT IMPACT (FONSI) and RECOMMENDATION

CLOVER ISLAND ENVIRONMENTAL RESTORATION PROJECT
Kennewick, WA

May 2017

1. INTRODUCTION/PROPOSED ACTION

The U.S. Army Corps of Engineers (COE), Walla Walla District (Corps) is proposing to develop aquatic and riparian habitat on Clover Island. Clover Island is a 16-acre man-made island located between river miles 329 and 328 on the Columbia River in Kennewick, Washington.

2. PURPOSE AND NEED

The purpose of this project is to restore long-term native riparian and Endangered Species Act (ESA) protected fish (juvenile salmonids) habitat and ecosystem functions directly related to National Ecosystem Restoration (NER) objectives in a way that meets the requirements of Cost Effectiveness and Incremental Cost Analyses (which seeks to optimize ecosystem benefits). As juvenile salmonids outmigrate, they seek shallow water habitat to rest and feed. Riparian and shallow water habitats provide critical rearing sites for these ESA-listed juvenile salmonids, along with other birds, wildlife, and aquatic species. Riparian vegetation also improves water quality by providing shade to help cool water temperatures along the shoreline, and encourages macroinvertebrate communities as forage for juvenile salmonids. This project is needed to restore degraded aquatic and riparian ecosystem structure, function, and dynamic processes to a less degraded and more natural and better functioning condition. The recommended action would re-create the riparian and shallow aquatic habitat and refugia critical to ESA-listed salmonids, which was lost through impoundment of the McNary pool.

Impoundment of the McNary pool in the 1950s flooded shallow benches along much of the reservoir shoreline, resulting in the overall degradation of riparian and aquatic habitat throughout the entire reservoir. In addition, construction of the Tri-Cities Levees eliminated natural shallow water aquatic habitat and removed riparian vegetation. Since the McNary project was completed, steep, riprapped embankments and deep water along the shore are the norm.

At the request of the Port of Kennewick (Port), the Corps proposes entering into partnership with the Port to undertake a Section 1135 ecosystem restoration project under the Continuing Authorities Program (CAP) on Port-owned land at Clover Island in Kennewick, Washington. This area lies within a reach of the Columbia River where the shoreline has been damaged by the

operation of McNary Lock and Dam and the associated fluctuations of the McNary pool (Lake Wallula) and only approximately 18% of the suitable riparian and shallow aquatic habitat remains. The proposed project would restore ecosystem function to riparian and shallow aquatic habitat for ESA listed species along the northern shoreline of Clover Island.

3. ALTERNATIVES CONSIDERED

The Corps considered 11 action alternatives and the No Action alternative in evaluating the potential for ecosystem restoration at Clover Island. The following alternatives were identified as reasonable and best buys for the effort.

No Action Alternative: Under the no action alternative, there would be no effort to restore riparian vegetation along the Clover Island shoreline to help provide resting and rearing areas for young salmonids. The shoreline would continue to remain sparsely vegetated and devoid of any meaningful shallow water habitat. Although the "no action" alternative does not meet the project purpose and need, under Council on Environmental Quality guidelines it serves as the project baseline for comparing alternatives and therefore was carried forward for analysis.

Alternative 1, Maximized Habitat Restoration A: is a balanced approach to ecosystem restoration and provides a submerged bench with aquatic habitat, emergent wetland in the "notch" along the north shoreline of Clover Island, and multi-storied riparian shrub and tree plantings on the maximum available stabilized slope. Recreation features of a pathway, seating areas, interpretive signs and lighting will be incorporated along the inland edge of the habitat restoration.

Alternative 5, Maximized Riparian with Limited Aquatic A: favors maximized riparian habitat like the shoreline stabilization and plantings of Alternative 1, while providing a low level of aquatic habitat benefits. Emergent wetland and shallow water aquatic habitat would only be provided in the notch. Recreation features of a pathway, seating areas, interpretive signs, and lighting will be incorporated along the inland edge of the habitat restoration.

Alternative 7, Limited Riparian with Limited Aquatic Habitat: would create an emergent wetland in the "notch" as under Alternative 1, and would provide multi-storied riparian plants on slopes at all areas, except adjacent to one business. It provides no preferable shallow aquatic habitat restoration. Recreation features of a pathway, seating areas, interpretive signs, and lighting will be incorporated along the inland edge of the habitat restoration.

Preferred Alternative: Alternative 1 was identified as the recommended plan/preferred alternative as it effectively and efficiently meets the identified project purpose and need while maximizing ecosystem restoration benefits.

4. ENVIRONMENTAL EFFECTS

The following environmental resources were identified as being relevant to the project – climate change; land use; geology; hydrology/hydraulics, and geomorphology; water quality; air quality; noise; visual/aesthetics; riparian vegetation; riparian wildlife; fish communities; protected species; cultural resources; socioeconomics and environmental justice; and recreation.

Environmental analysis and consequences of the "no action" and three (3) action alternatives are detailed in the project Feasibility Report/ Environmental Assessment (EA). The EA analysis concludes there would be no significant impacts to the environment resulting from implementation of the preferred alternative.

Currently, the Clover Island Ecosystem Restoration work is being consulted upon with the National Marine Fisheries Service and Fish and Wildlife Service for the preferred Clover Island riparian restoration alternative.

The Corps undertook a cultural resources review and assessment of the project area and proposed project activities and made a "No Adverse Effect" determination. The Corps completed consultation with the Washington State Historic Preservation Office (SHPO), Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Nez Perce Tribe, Confederated Tribes and Bands of the Yakama Nation, and the Confederated Tribes of the Colville Reservation. The Washington SHPO concurred with the Corps determination. No tribal comments were received during the cultural resources review.

5. ENVIRONMENTAL STIPULATIONS

The Corps would adhere to the following environmental stipulations as part of the proposed action in order to ensure that impacts and effects that may result from the action are minimized or eliminated.

- Erosion control measures shall be properly installed and provide adequate coverage for disturbed areas or associated areas subject to runoff as a result of the proposed action.

- Timing of project shall not be adjusted beyond the proposed dates more than two weeks without further environmental compliance review.

- Fish exclusion measures shall be taken to remove fish from the in-water work area.

- Spreading of excess materials shall be conducted in a manner to eliminate the potential for any of the material to be become airborne and enter any fish-bearing water body, or enter any fish-bearing water body by any other means, to include, but not limited to, runoff.

- Disturbed areas shall be reseeded or replanted with native materials and seed to minimize the establishment of invasive noxious weed species, and subsequent use of pesticides, as well as the potential for runoff.

6. PUBLIC COMMENT/INVOLVEMENT

The project has been coordinated with both the appropriate U.S. and state (Washington) congressional delegates (i.e. senators and representatives); NMFS; USFWS; Environmental Protection Agency; Washington Department of Fish and Wildlife; Washington Department of Ecology; CTUIR; Confederated Tribes and Bands of the Yakama Nation; Nez Perce Tribe; Washington Department of Archaeology and Historic Preservation; and the City of Kennewick.

The draft FONSI and FR/EA were made available to individuals, businesses, organizations and agencies for a 30-day review and comment period from June 6, 2017 to July 6, 2017.

7. COMPLIANCE WITH OTHER LAWS AND REGULATIONS

The FR/EA provides a detailed discussion of compliance with other laws and regulations. The proposed action complies with other applicable Federal laws and regulations.

8. FINDING and RECOMMENDATION

Having reviewed the FR/EA, I find the document provides sufficient discussions on the purpose and need for the proposed action, alternatives, the environmental effects of the proposed action and alternatives, and a listing of agencies and persons consulted. I have taken into consideration the technical aspects of the project, best scientific information available and public comments received. These documents provide sufficient evidence and analysis to meet the District's requirements pursuant to the National Environmental Policy Act.

Based on this information, I have determined that the preferred alternative would not significantly affect the quality of the human environment, and an Environmental Impact Statement is not required.

I have also considered all significant aspects of the problems and opportunities as they relate to the Clover Island ecosystem restoration project. Those aspects include environmental, social, and economic effects, as well as engineering feasibility.

I support the implementation of Alternative 1, Maximized Habitat Restoration A, which consists of aquatic and riparian restoration across the entire north side of the island with recreation features. The recommended plan has a total project cost, without recreation, of approximately $3,960,046. This plan provides a combined net benefit of 59.1 habitat units over 50 years. All costs associated with the restoration of Clover Island have been considered.

_____ _____

Damon A. Delarosa Date
Lieutenant Colonel, Corps of Engineers
District Commander

US Army Corps
of Engineers®
Walla Walla District

Clover Island Section 1135 Ecosystem Restoration Kennewick, Washington

Clover Island Feasibility Report and Environmental Assessment

May 2017

EXECUTIVE SUMMARY

This study was conducted under the Continuing Authorities Program (CAP) and in accordance with Section 1135 of the Water Resources Development Act (WRDA) of 1986 [Public Law (PL) 99-662], as amended by WRDA 1996, Section 204 (PL 104-303, and codified at 33 USC § 2309) for *Project Modifications for Improvement of Environment*, with the purpose to contribute to the restoration of habitat degraded by the construction or operation of a Federal project. This authority requires a non-Federal Sponsor to partner with the U.S. Army Corps of Engineers (Corps) to cost-share in the planning, design, and construction of the project; to provide all necessary lands; and to conduct long-term project operations and maintenance. The Port of Kennewick (Port), Benton County, Washington, is the non-Federal Sponsor of this project to restore the ecosystem on Port-owned land at Clover Island in the middle reach of the Columbia River, in Kennewick, Washington.

Impoundment of the McNary pool (Lake Wallula) in the 1950s flooded shallow benches along much of the reservoir shoreline. The construction of the Tri-Cities Levees eliminated natural shallow water aquatic habitat and removed riparian vegetation. Both of these actions resulted in an overall degradation of riparian and aquatic habitat throughout the entire reservoir, including Clover Island. An estimated 82% of riparian and shallow water habitat that formerly provided critical rearing sites for juvenile salmonids, birds, wildlife, and other aquatic species listed under the Endangered Species Act (ESA) was lost following the construction of McNary Dam and the Tri-Cities Levees and the filling of Lake Wallula. Loss of habitat has been identified as one of the contributing factors leading to the decline of salmonid species.

The purpose of this project is to restore ecosystem structure, function, and processes necessary for fish (particularly juvenile salmonids) that was degraded or lost following the construction and continuous operation of McNary Lock and Dam and the Tri-Cities Levees. The project goal is to restore riparian and aquatic habitat and ecosystem functions for the benefit of ESA-listed salmonids, other fish, birds, and wildlife in the study area at Clover Island and, where possible, provide education and recreation access.

Restoration alternative plans were developed to meet the project purpose and address the need while limiting impacts to navigation, safety, and the quality of the human environment. In addition, alternatives could not violate any project-specific constraints. The Corps' planning process was used to develop an initial array of eleven alternatives, in addition to the No Action Alternative required by the National Environmental Policy Act (NEPA).

For each restoration alternative, benefits for aquatic and riparian habitats were estimated using the Habitat Suitability Indices (HSI) developed by the US Fish and Wildlife Service (USFWS). Juvenile Chinook salmon and yellow warbler were used as the indicator species during modeling efforts. The HSI resulted in a score of habitat suitability that was compared to existing and future without project conditions. A net benefit was estimated in habitat units (HUs), and was converted to environmental outputs as average annual habitat units (AAHUs).

Cost estimates for each alternative were developed as an average annual cost, and included amortized initial construction costs over a 50-year project life, plus annual maintenance costs from the base year (2017). Costs for each measure were annualized using the Corps' IWR-PLAN decision support software, and cost effective and incremental cost analyses were conducted.

Four alternatives (including the No Action Alternative) were identified as *best buys* with the most cost-effective solutions. The remainder were shown to be non-cost effective and were removed from further consideration. The reasonable array of four alternatives is as follows:

- **The No Action Alternative** would not provide improvement over the current condition of the aquatic or riparian habitat.
- **Alternative 7, *Limited Riparian with Limited Aquatic Habitat*,** would provide emergent wetland in the notch and multi-storied riparian shrub and tree habitat on a stabilized slope along the north shore of the island in all areas except along the bank near a hotel.
- **Alternative 5, *Maximized Riparian with Limited Aquatic A*,** would provide emergent wetland in the notch and multi-storied riparian shrub and tree habitat on a stabilized slope along the entire north shore.
- **Alternative 1, *Maximized Habitat Restoration A***, would provide a submerged bench with aquatic habitat along the north shore, emergent wetland in the notch, and a multi-storied riparian shrub and tree habitat on a stabilized slope along the entire north shore.

Each alternative was evaluated and compared, based on their ability to address the planning criteria of acceptability (environmental effects), completeness, effectiveness (biological benefits) and efficiency (cost benefits). This process identified the national environmental restoration plan that reasonably maximized ecosystem restoration benefits compared to costs, and in consideration with other qualitative information.

Implementation of Alternatives 1, 5, or 7 would restore ecological habitat function for juvenile ESA-listed salmonids, with additional benefits to migratory songbirds. Any of these alternatives would greatly improve shallow water habitat through improved ecosystem function for use by all species and life stages of rearing and migrating salmonids, as well as non-salmonid and resident fishes.

Although Alternative 5 provided the highest incremental benefit per unit cost among the best buy alternatives, Alternative 1 provided the maximum HU benefit for riparian and aquatic species. The aquatic habitat suitability for Alternative 1 was expected to be optimal for rearing ESA-listed juvenile salmonids, largely due to creation of the submerged aquatic bench. Although costs were considered, qualitative benefits that could not be captured by the habitat models alone were also used in the selection of the recommended plan. Qualitative benefits considered were:

- Rarity of location to restore fully-functional aquatic habitat within Lake Wallula because of levees and infrastructure limitations;

- Regional benefits provided by increased habitat connectivity in highly-fragmented environmental conditions between the Yakima River Delta and the McNary National Wildlife Refuge; and
- Reduced predation risk on juvenile salmon by the elimination of predatory habitat.

Under Alternative 1, the construction of a submerged aquatic bench would unquestionably restore aquatic habitat, making it fully functional, eliminating existing predator habitat, and implementing a complete habitat restoration in a reach of the Columbia River where little aquatic and riparian habitat suitable for ESA-listed juvenile salmonids exists and where there are limited locations for restoration.

The recommended plan/preferred alternative was identified as Alternative 1. This plan would create 1.28 acres of shallow aquatic habitat and 1.67 acres of riparian habitat, and provide the combined improved habitat benefit of 1.21 for the 50-year annualized cost of $73,437. A shallow water bench would be designed to meet the needs of ESA-listed juvenile salmonids, would allow for the effective use of bank cover and organic and forage materials produced by the riparian habitat without increased risk from aquatic predators.

Through the restoration of the habitat, an opportunity would be created to allow for education and recreation benefits (authorized under the Federal Water Project Recreation Act of 1965, Policy Guidance Letter No. 59, June 1998; and ER 1105-2-100). Therefore, recreation features developed as a sub-set of those proposed in the Clover Island Master Plan were incorporated into the recommended plan. Proposed recreation features included access (pathways and trails), safety facilities (lighting and railings), seating areas (benches, shade shelters, trash receptacles), signs and interpretive media (education and information), and associated utilities (water/electric). The addition of recreation would create a connection from the Sacagawea Heritage Trail system to the constructed riparian habitat, access to local services on Clover Island, and education and recreation access for the local community and visitors.

Total project cost for the design and implementation of the recommended habitat restoration was estimated to be $3,958,840. The Port is responsible for 25% of the total project cost. Costs for recreation features were based on the total project costs, and would not increase the Federal cost-share for the restoration by more than 10%. This resulted in an estimated Federal cost of $296,913 for recreation features for which the Port would match; resulting in a total recreation cost of $593,826. The following table shows the cost-share without land values ($49,881) and without monitoring and adaptive management costs ($16,750 annual).

Shared Costs	Project Costs (Without Recreation)	Recreation Costs	Project Costs (With Recreation)
Federal Cost Share	$2,970,035	$296,913	$3,266,043
NFS Cost Share	$989,710	$296,913	$1,286,623
Total Shared Costs	$3,958,840	$593,826	$4,552,666

Clover Island Section 1135 Ecosystem Restoration
Kennewick, Washington
Clover Island Feasibility Report and
Environmental Assessment

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Note to the reader: Sections of the report required for compliance with the National Environmental Policy Act of 1969 (NEPA) are marked by an asterisk (*) in the table of contents and have been integrated into the feasibility report for this project, in accordance with NEPA and Engineering Regulation 1105-2-100.

ACRONYMS

AAHU	Average Annual Habitat Units
BA	Biological Assessment
BO	Biological Opinion
CAA	Clean Air Act
CAP	Continuing Authorities Program
CE/ICA	Cost Effectiveness/Incremental Cost Analysis
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	Carbon Dioxide
Corps	US Army Corps of Engineers
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CWA	Clean Water Act
ECO-PCX	Ecosystem Restoration Planning Center of Expertise
EIS	Environmental Impact Statement
EO	Executive Order
EPA	US Environmental Protection Agency
ER	Engineer Regulation
ESA	Endangered Species Act
FCRPS	Federal Columbia River Power System
FONSI	Finding of No Significant Impact
FR/EA	Feasibility Report/Environmental Assessment
FWCA	Fish and Wildlife Coordination Act
GHG	Greenhouse Gases
HSI	Habitat Suitability Index
HTRW	Hazardous, Toxic, and Radioactive Waste
HU	Habitat Unit
IDC	Interest During Construction
ICA	Incremental Cost Analysis
IWR	Institute for Water Resources (US Army Corps of Engineers)
IWR-Plan	Institute for Water Resources Planning Suite
LERRD	Lands, Easements, Rights-of-Way, Relocations, and Disposals
mgd	Million Gallons per Day
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NFS	Non-Federal Sponsor
NHPA	National Historic Preservation Act
NOAA Fisheries	National Oceanic and Atmospheric Administration, National Marine Fisheries Service

NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
OHWM	Ordinary High Water Mark
O&M	Operation & Maintenance
OMRR&R	Operation, Maintenance, Repair, Replacement, & Rehabilitation
PL	Public Law
Port	Port of Kennewick
PPA	Project Partnership Agreement
Project	Clover Island
PRP	Preliminary Restoration Plan
PUD	Public Utility District
RM	River Mile
SHPO	State Historic Preservation Office
SMA	Shoreline Management Act
SMP	Shoreline Management Plan
TMDL	Total Maximum Daily Load
TRIDEC	Tri-City Development Council
USC	US Code
USFWS	US Fish and Wildlife Service
WDOE	Washington State Department of Ecology
WRDA	Water Resources Development Act
WQI	Water Quality Improvement

CHAPTER 1 – INTRODUCTION

1.1 Purpose of Report

This report presents the results of a collaborative ecosystem restoration feasibility study and environmental assessment (EA) conducted by the US Army Corps of Engineers (Corps), Walla Walla District, and the Port of Kennewick (Port), located in Washington State (Figure 1). The report identifies and evaluates alternatives for restoring riparian and aquatic habitat and ecosystem functionality on the shores of Clover Island in Kennewick, Washington, as well as any potential effects. A preferred alternative is also identified..

Figure 1. Clover Island Location

1.2 Scope of the Report

This integrated Feasibility Report and Environmental Assessment (FR/EA) incorporates the Corps planning process found in Engineering Regulation (ER) 1110-2-100 with the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended, 42 United States Code (USC) §§ 4321-4370f, and its implementing regulations, 40 Code of Federal Regulations (CFR) §§ 1500-1508 and 33 CFR Part 230. This report recommends a plan and documents whether actions proposed by the Corps constitute a "…major federal action significantly affecting the quality of the human environment…" [NEPA, Section 102(c)] and whether an environmental impact statement (EIS) is required.

1.3 Study Authority

This study was conducted under authority of the Water Resources Development Act (WRDA) of 1986 [Public Law (PL)] 99-662], Section 1135, as amended by WRDA 1996, Section 204 (PL 104-303, and codified at 33 USC § 2309) for *Project Modifications for Improvement of Environment*. This authority states:

> "(c) Restoration of Environmental Quality
>
> (1) In general, if the Secretary determines that construction of a water resources project by the Secretary or operation of a water resources project constructed by the Secretary has contributed to the degradation of the quality of the environment, the Secretary may undertake measures for restoration of environmental quality and measures for enhancement of environmental quality that are associated with the restoration, through modifications either at the project site or at other locations that have been affected by the construction or operation of the project, if such measures do not conflict with the authorized project purposes."

1.4 Study Sponsor

This study was done as part of the Continuing Authorities Program (CAP), requires a non-Federal sponsor (NFS) to bear responsibility for 50% of the study costs and up to 35% of the design and construction project cost, depending on the specific CAP authority and in accordance with Section 103 of WRDA 1986. The NFS is also responsible for the cost of all land acquisitions and easements, as well as the cost of project operations and maintenance (O&M). The NFS for this project is the Port of Kennewick, Benton County, Washington.

1.5 *Project Purpose and Need

At the Port's request, the Corps proposes entering into partnership with the Port to undertake a Section 1135 ecosystem restoration project under CAP on Port-owned land at Clover Island in Kennewick, Washington. The project purpose is to restore ecosystem function and native riparian habitat for fish, primarily juvenile salmonids, protected under the Endangered Species Act (ESA). This project will restore aquatic and riparian ecosystem structure, function, and dynamic processes degraded or lost following the construction and operation of the McNary Lock and Dam to a less degraded and more natural, better functioning condition.

Impoundment of the McNary pool (Lake Wallula) in the 1950s flooded shallow benches along much of the reservoir shoreline, resulting in the overall degradation of riparian and aquatic

habitat throughout the entire reservoir, including Clover Island. In addition, construction of the Tri-Cities Levees eliminated natural shallow water aquatic habitat and removed riparian vegetation. Since McNary Dam was completed, steep, riprapped embankments and deep water are commonplace along much of the shoreline. Clover Island lies within a reach of the Columbia River where the shoreline has been damaged by the operation of McNary Dam and the associated fluctuations of Lake Wallula. Only an estimated 18% of the riparian and shallow aquatic habitat suitable for juvenile salmonids remains in this reach. Habitat loss on the Columbia River has been identified as one factor contributing to the decline of ESA-listed salmonids in this reach of the Columbia River. The proposed project would restore ecosystem function to riparian and shallow aquatic habitat for ESA-listed species along the northern shore of Clover Island.

As juvenile salmonids outmigrate, they seek shallow water habitat to rest and feed. Riparian and shallow water habitat provides critical rearing sites for these ESA-listed juvenile salmonids, birds, wildlife, and other aquatic species. Riparian vegetation also improves the aquatic habitat by providing shade, organic material, and macro-invertebrates, making the habitat function more effectively.

Restoration alternative plans were developed to meet the project purpose and address the need while limiting impacts to navigation, safety, and the quality of the human environment and not violating project-specific constraints. The Corps' planning process was used to develop a reasonable array of alternatives that addressed the National Environmental Restoration Objective to maximum environmental outputs. To accomplish this, planning objectives were developed from an analysis of the problems and opportunities in the project area and measures were then developed to address these objectives while avoiding study-specific constraints. Measures that could not meet a planning objective or violated a study constraint were considered to be infeasible and were eliminated from further consideration. The remaining measures were used to formulate alternative plans that addressed all or some part of the planning objectives and did not collectively violate a study constraint. The resulting reasonable array of alternatives were evaluated and compared on their ability to address the planning criteria of acceptability (environmental effects), completeness, effectiveness (biological benefits) and efficiency (cost benefits). This process identified the national environmental restoration plan that reasonably maximized ecosystem restoration benefits compared to costs, and considered other qualitative information.

1.6 Project Area

The Clover Island Ecosystem Restoration Project (Project) study area is located on the north shore of Clover Island (Figure 2) in the city of Kennewick, Benton County, Washington. It is located within the middle reach of the Columbia River, at River Mile (RM) 329 within the Federal Columbia River Power System (FCRPS), the system of Federal hydropower locks and dams on the

Columbia and Snake Rivers. This reach of the Columbia River is heavily influenced by operational fluctuations within Lake Wallula, the reservoir impounded by McNary Dam. McNary Dam is the first dam downstream of Clover Island.

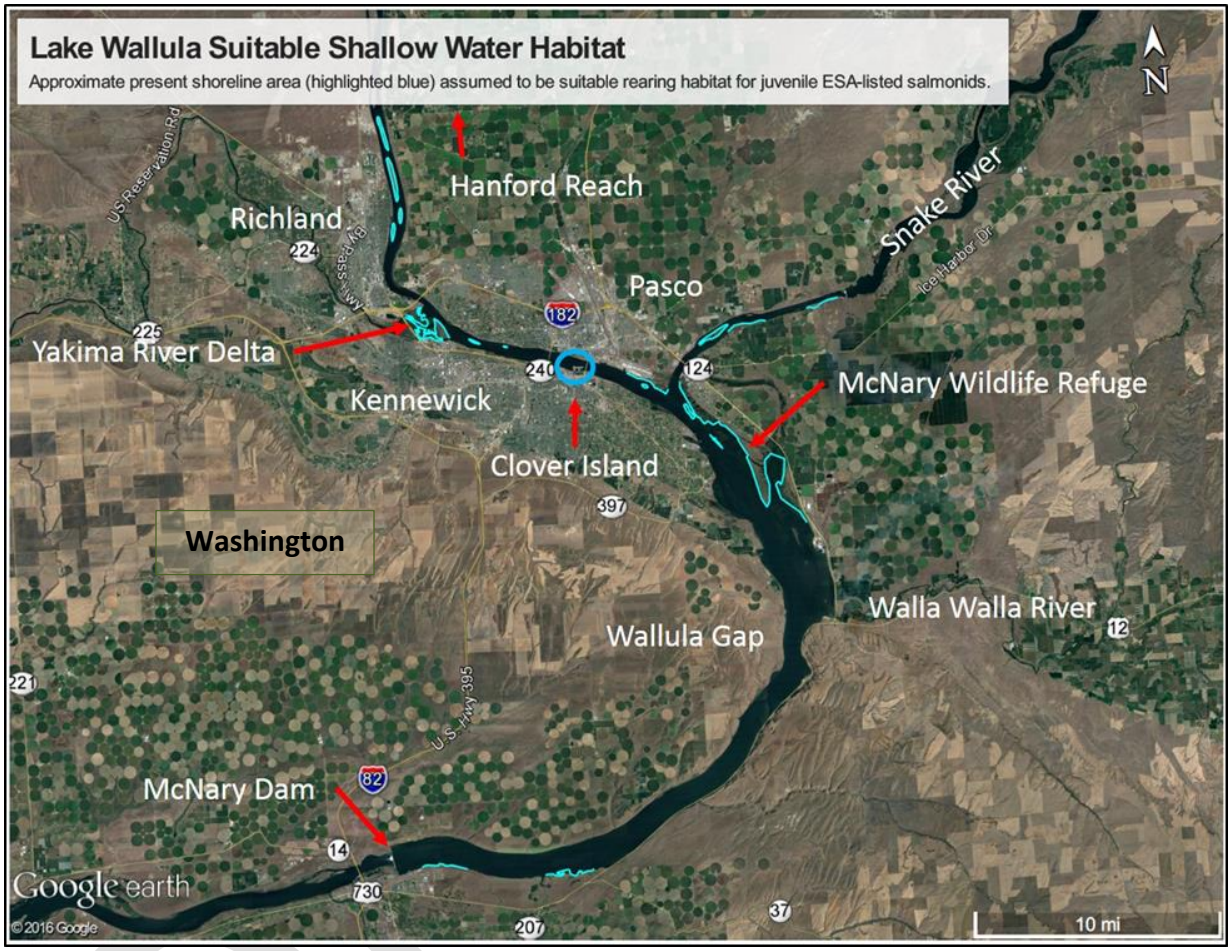

Figure 2. Clover Island Project Location and Lake Wallula Suitable Shallow Water Habitat

The island is also located between the confluences of two major salmon-bearing tributaries of the Columbia River, the Yakima River (upstream) and the Snake River (downstream). Several ESA-listed salmonid species are found within the Columbia, Snake, and Yakima Rivers.

Clover Island is a 16-acre island connected to the mainland by a 650-foot causeway on the south side of the island. The proposed study area extends along the north shoreline, from the northwest corner to the southeast corner of the island (Figure 3).

Figure 3. Clover Island Project Area

1.7 Background

Since the construction of McNary Dam, four salmonid species (Upper Columbia River spring Chinook salmon, Upper Columbia River steelhead, and Middle Columbia River steelhead and bull trout) have declined, and are now protected under the ESA. Shallow water habitat in the Columbia River, including the shores of Clover Island, has been designated as critical habitat for these species. Loss of habitat has been identified as one factor contributing to the decline and ESA-listing of these salmonids.

As juvenile salmonids outmigrate (migrate from inland freshwater rivers to the Pacific Ocean), they seek shallow water habitat to rest and feed (rearing). Riparian and shallow water habitats provide critical rearing sites for these ESA-listed juvenile salmonids, as well as for birds, wildlife, and other aquatic species. Riparian vegetation provides terrestrial food sources (e.g., insects) for fishes, and promotes aquatic insect food sources in the form of organic debris. Riparian vegetation also provides shoreline cover (refugia) for juvenile salmonids to escape avian predators, and shade to locally reduce higher water temperatures.

Prior to the construction of McNary Dam, Clover Island was a naturally-formed bar island (Figure 4), owned and operated by the Port. Valuable shallow water aquatic and riparian habitat was available around the island. The middle reach of the Columbia River and shores of Clover Island were used by six species of juvenile salmonids as both a migration corridor and for rearing and overwintering. This habitat also supported Tribal fisheries and harvests of native riparian plants.

In 1953, the Corps allowed the Port to move material from the lower areas of the original island bar to a higher elevation on the island, thus creating the current configuration of Clover Island (Figures 4 through 7). Figure 4 shows the island prior to inundation of Lake Wallula, while Figure 5 overlays the present configuration onto the original Clover Island. This figure clearly shows the relative reduction in size and loss of available shoreline for aquatic and riparian habitat.

Figure 4. Clover Island prior to the impoundment of the McNary pool

Figure 5. Current Clover Island configuration superimposed over Clover Island prior to the construction of McNary Lock and Dam

The creation of Lake Wallula affected 242 miles of shoreline along the Columbia River and its tributaries. The effects of the reservoir environment extend about 64 miles up the Columbia River from McNary Dam, 9 miles up the Walla Walla River, 9.7 miles up the Snake River (to Ice Harbor Dam), and 6 miles up the Yakima River. Additionally, in order to protect the Tri-Cities (Kennewick, Richland, and Pasco) from flooding when the lake was impounded, the Corps constructed levees throughout this reach of the Columbia River. As a result, even more natural shallow water aquatic and riparian habitat was reduced. It was often replaced with steep, riprapped embankments and deep water along the leveed shoreline. It is estimated that only 18% of the shallow water habitat presently available to outmigrating juvenile salmonids is suitable for rearing (Figure 2).

The configuration of the island from construction (Figure 6) to the present day (Figure 7) has not changed substantially over the last 60 years. Following formation of the current Clover Island, the shoreline was periodically reinforced with concrete rubble, debris, and poured concrete waste. The shoreline is now characterized by steep slopes, with little or no native riparian plant communities. Because there is virtually no shallow water and riparian habitat, operational fluctuations in the McNary pool continue to undermine soils and undercut concrete material previously used to stabilize the shoreline.

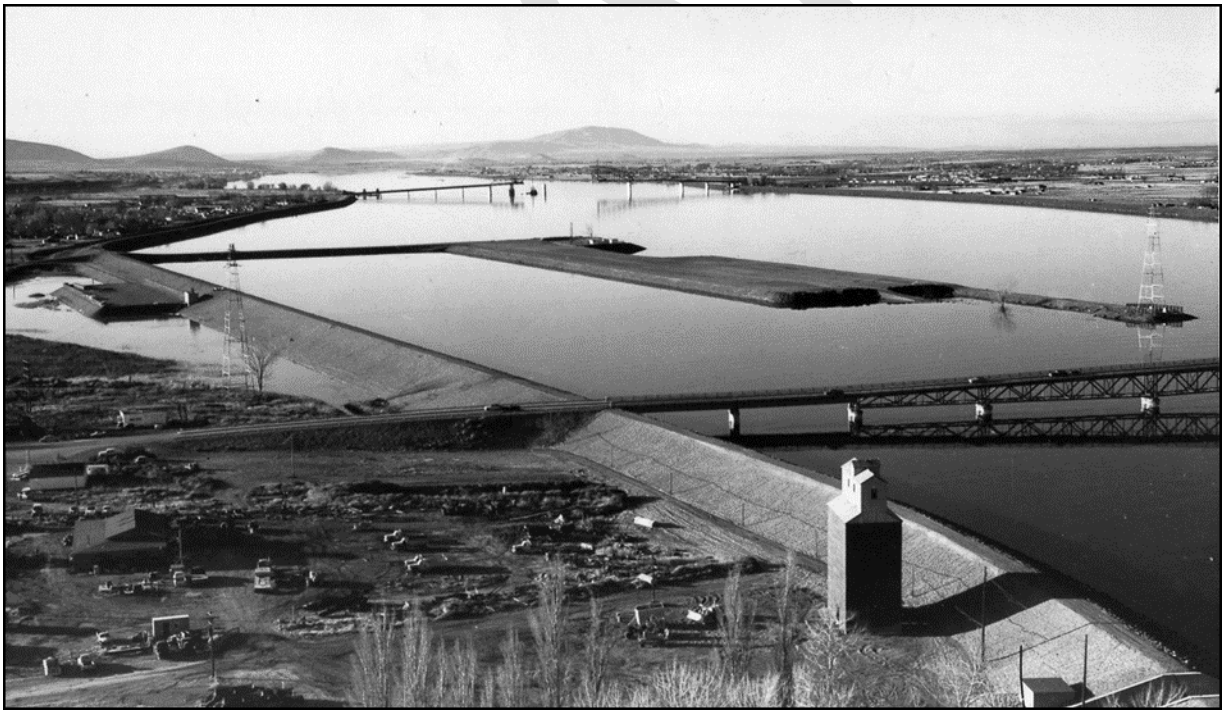

Photo courtesy of Port of Kennewick

Figure 6. The newly constructed Clover Island Circa 1957

Figure 7. Present Clover Island

Clover Island also lies about 15 miles downstream from the Hanford Reach of the Columbia River. The Hanford Reach is the last free-flowing stretch of the Columbia River above Bonneville Dam and, as such, is a critical spawning area for ESA-listed salmonid species. McNary National Wildlife Refuge, the Yakima River delta, and several small islands scattered between the Hanford Reach and the mouth of the Walla Walla River currently provide the only shallow aquatic and riparian habitat. Because of its location, Clover Island has the potential to increase connectivity between the rare upstream and downstream resting and foraging habitat for these ESA-listed salmonids during their juvenile outmigration.

At present, Clover Island has no suitable riparian habitat available to provide shade or forage for migrating juvenile salmonids, and the existing aquatic habitat currently promotes the increase of warmwater predator fish [e.g., smallmouth bass (*Micropterus dolomieu*) and northern pikeminnow (*Ptychocheilus oregonensis*)]. In addition to impacts caused by shoreline erosion on local water quality and riparian vegetation, erosion has also created overhanging cover and deep holes near the shoreline where warmwater predator fish lie in wait to ambush juvenile salmonids.

As a result of the construction of McNary Dam, impoundment of Lake Wallula, and construction of the Tri-Cities levees, an estimated 82% of shallow aquatic and riparian habitat suitable for juvenile salmonid rearing has been lost in the middle reach of the Columbia River, including Clover Island. It has been determined that this area is eligible for a CAP Section 1135 project, and opportunities exist to restore the environment.

1.8 Resource Significance

Clover Island is located on the middle reach of the Columbia River, an area estimated to have lost more than 80% of aquatic and riparian habitat available prior to the construction of McNary Lock and Dam, impoundment of Lake Wallula, and construction of the Tri-Cities Levees. The significance of the environmental resources lost in this reach of the Columbia River, including Clover Island, have been considered relative to Institutional, Public, and Technical Recognition. Each of these sources of recognition are analyzed below for ESA-listed salmon, steelhead, and bull trout, and their critical habitats.

1.8.1 Institutional Recognition

The significance of the Columbia River aquatic and riparian habitat is acknowledged in general environmental laws, specific biological opinions and plans, as well as policies of public agencies, tribes, or private groups working to protect species, characteristics, and functions of the environment. These concerns focus on protected aquatic species. The Port is willing to cost share this project in order to restore critical habitat and improve aesthetic and recreational value to the Clover Island shoreline. The following laws, regulations, and policies specifically protect aquatic species and habitats applicable to the Clover Island shoreline restoration:

- **The ESA of 1973.** All Federal departments and agencies must seek to conserve endangered and threatened species. The purpose of the Act is to provide a means whereby ecosystems upon which endangered and threatened species depend may be conserved, and to provide a program for the conservation of such endangered and threatened species. The proposed project will develop and enhance shallow water habitat critical for ESA-listed juvenile salmonid species.

  Specifically, the shores of Lake Wallula, including the shoreline of Clover Island, have been designated by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) as critical habitat for upper Columbia River spring Chinook salmon (*Oncorhynchus tshawytscha*), middle and upper Columbia River steelhead (*O. mykiss)*, and Columbia River bull trout (*Salvelinus confluentus*). Final rules for the salmon and steelhead species were filed by NOAA Fisheries August 12, 2005. The final designation for bull trout was issued by US Fish and Wildlife Service (USFWS) September 30, 2010.

- **The Magnuson-Stevens Fishery Conservation and Management Act (MSA)**. The MSA was first passed in 1976, and was reauthorized in 2006. It calls for defining and protecting Essential Fish Habitat (EFH) for marine fisheries to foster the sustainability of United States Fisheries. The Columbia River, including Lake Wallula, is designated EFH for Chinook salmon. Federal agencies are required to consult with NOAA Fisheries on effects actions may have on EFH, and NOAA Fisheries may provide

conservation recommendations to minimize impacts to EFH. The proposed ecosystem restoration would ultimately restore EFH for juvenile Chinook salmon on the north shore of Clover Island.

1.8.2 Public Recognition

Environmental enhancement at Clover Island, through aquatic and riparian habitat restoration, has received public support for many years. In 1997, a draft EIS was prepared for the Clover Island Redevelopment Plan that included, as a critical component, environmental enhancement. The plan received support from the cities of Richland, Kennewick, and Pasco; Franklin and Benton Counties; the Ports of Kennewick, Benton, and Pasco; and the Tri-City Development Council (TRIDEC). For a variety of reasons, however, a final EIS was never prepared and the proposed action was terminated. During 2008 and 2009, the current Clover Island shoreline improvement proposal was developed. Like the earlier 1997 project, this proposal also has extensive support from a wide range of interested parties: the City of Kennewick; the Confederated Tribes of the Umatilla Indian Reservation (CTUIR); 8th Legislative District State Representative Brad Kippert; the Kennewick Arts Commission; the Young Professionals of the Tri-Cities; the Tri-City Regional Chamber of Commerce; the Tri-Cities Visitor and Convention Bureau; and the Historic Downtown Kennewick Partnership.

With continued population growth and development in the Tri-Cities area, strong interest and support continues within the community for the restoration of natural areas and riverfront and shoreline access. The Port is still involved in the long-term goal of developing Clover Island into a quality waterfront environment for the Tri-Cities area. To this end, the Port has undertaken a number of projects focused on enhancing Clover Island's appeal to both local residents and visitors to the area. The Port is willing to cost share this project to restore critical habitat, as well as aesthetic and recreational value, to the Clover Island shoreline.

1.8.3 Technical Recognition

The technical significance of aquatic and riparian habitat in the Columbia River has been recognized in multiple recovery plans created for ESA-listed species in the middle and upper Columbia River, including one for bull trout (USFWS, undated), middle Columbia River steelhead (NOAA Fisheries, 2009), and upper Columbia Spring Chinook salmon and steelhead (Upper Columbia Salmon Recovery Board, 2007). The technical significance of the aquatic and riparian habitat is described in the following concepts:

- **Scarcity** is defined as the measure of a resource's relative abundance within a specified geographic range. Generally, a habitat or ecosystem is considered rare if it occupies a narrow geographic range (e.g., limited to a few locations) or occurs in small groupings. Unique resources, unlike any others found within a specified range, may also be considered significant, as may resources threatened by interference from both human and natural causes.

Historically, the Columbia River shoreline was characterized by a low-lying floodplain where side channels and seasonally-inundated pools provided optimal rearing habitat for outmigrating juvenile salmonids. As spring flows increased, these floodplain habitats became available for occupation by rearing juvenile salmonids. Long stretches of free-flowing, naturally-functioning reaches are now rare within the Columbia River because the FCRPS dams regulate flow. Clover Island lies approximately 15 miles downstream of the Hanford Reach of the mid-Columbia River, a free-flowing reach with natural riparian habitat. It is estimated that approximately 18% or less of the available habitat in Lake Wallula is suitable for ESA-listed juvenile salmonid rearing, much less naturally-functioning, due to permanent inundation. Juvenile salmonids have little refuge in the reservoir. The existing shoreline of the Tri-Cities is a constructed levee system paralleled by highways and railroads, which offer little or no habitat preferred by juvenile salmonids.

The remaining 18% of suitable salmonid rearing habitat in Lake Wallula exists along islands, at the mouth of the Yakima River, downstream of Clover Island at Sacajawea State Park, Two Rivers Park, McNary National Wildlife Refuge, and Hat Rock State Park. However, there are few trees for shade and cover at these locations, and the small amount of riparian cover available is often occupied by avian predators. The proposed project will provide important native riparian habitat with little impact from avian predators.

- **Representation** is defined as the ability of a resource to exemplify natural habitat or ecosystems within a specified range. The presence of a large number and percentage of native species, the absence of exotic species, and the presence of undisturbed habitat implies representation.

  While a number of exotic species can be found in the Columbia River, native fishes are struggling but extant, including several ESA-listed salmonid species and bull trout. Improving riparian habitat within a relatively small area (e.g., Clover Island) will provide benefits to native fishes and wildlife, and is expected to provide benefits similar to undisturbed habitat. Furthermore, Clover Island is the only available offshore habitat within the Tri-Cities reach where riparian and shallow water habitat may be restored to a fully-functional condition.

- **Status and Trends.** Biochemical processes are marginally functional within the Columbia River. They have been degraded through the alteration of hydraulic conditions. Riverine systems (erosion, transportation, deposition) have been altered through dam construction, channelization, and inundation of natural floodplains. Aquatic and riparian habitat restoration will improve physical habitat parameters, as well as local water quality, to juvenile salmonids. Over time, a restored riparian habitat will greatly reduce runoff, and flow and wind-driven erosion along Clover

Island's fragile shoreline. Juvenile salmonids require cold, well-oxygenated water for survival. Poor water quality with excess nutrients, contaminants, and high temperatures can invoke physiological stress, making salmonids more vulnerable to predation and disease. Juvenile salmonids outmigrating during the high flow season will benefit from reduced turbidity along the island's restored shoreline habitat.

The present riparian processes are not fully functional and, due to the lack of vegetation, are barely functioning along much of Lake Wallula. The inundation of historic riparian habitat and loss of connectivity between the river and the floodplain have significantly altered habitats for many terrestrial species [e.g., the western yellow-billed cuckoo (*Coccyzus americanus*), an inhabitant of riparian woodlands characterized by stands of cottonwood, thought to have gone extinct in the State of Washington]. With the current levee, railroad, and road system along Lake Wallula, a relatively stable trend in riparian acreage and condition is expected. Without intervening restoration actions, riparian processes will not improve.

- **Habitat.** Limited habitat exists within the Columbia River Basin. Juvenile anadromous salmonids (fish spawned in freshwater that outmigrate to the ocean, where they live for varying lengths of time and then return to their natal streams to spawn and, in most cases, die) require proper rearing habitat as they outmigrate. There is a lack of proper rearing habitat when compared to a naturally-flowing system. Appropriate depth, substrates, and cover are largely unavailable for resting and refuge, where historic floodplain habitats once provided optimal conditions. The limited availability of connected and suitable rearing habitat reduces juvenile salmonid survival through Lake Wallula.

  Habitat loss has been identified as one limiting factor for ESA-listed salmonids, and is specifically called out in the *Middle Columbia River Distinct Population Segment ESA Recovery Plan* (NOAA Fisheries, 2009) and the *Yakima Steelhead Recovery Plan* (Yakima Basin Fish and Wildlife Recovery Board, 2009). Short and long-term habitat objectives were identified in the *Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan* (Upper Columbia Salmon Recovery Board, 2007). Habitat restoration is prioritized in each of these recovery plans, including the following specific objectives identified by the Upper Columbia Salmon Recovery Board (2007).

  - Protect and restore riparian habitat along spawning and rearing streams and identify long-term opportunities for riparian habitat enhancement.

  - Maintain connectivity through the range of listed species where feasible and practical.

- **Biodiversity** can be defined in terms of a variety of organisms within an ecosystem. The riparian area was historically confined to a narrow band lining the river corridor. However, a variety of native species occurred in their respective zones of occupation, extending from the shoreline into the uplands [e.g., willow (*Salix spp.*), black cottonwood (*Populus trichocarpa*), blue elderberry (*Sambucus nigra*), redosier dogwood (*Cornus sericea*), Woods rose (*Rosa woodsii*), white alder (Alnus rhombifolia), and rush species in the riparian or hydrophytic zone; western chokecherry (*Prunus virginiana*), golden currant (*Ribes aureum*), mockorange (*Philadelphus lewisii*), Saskatoon serviceberry (*Amelanchier alnifolia*), and smooth sumac (*Rhus glabra*) in the mesic zone; and sagebrush, rocky mountain juniper (*Juniperus scopulorum*), and antelope bitterbrush (*Prushia tridentate*) in the upland or xeric zone]. Presently, only a few tree species can be found along the Clover Island shoreline, and these are primarily undesirable exotics [e.g., Russian olive (*Elaeagnus angustifolia*)]. These conditions are assumed to be similar along the levees within the Tri-Cities area. Improved native plant biodiversity will bolster wildlife biodiversity on Clover Island by providing feeding, nesting, and breeding habitat for migratory bird species and other wildlife. Greater plant biodiversity is also expected to encourage insect biodiversity, and this will provide a more robust food source for rearing juvenile salmonids and encourage other native fishes to occupy Clover Island aquatic habitat.

1.9 Past Studies and Reports

The Corps, in conjunction with the Port of Kennewick, various local municipalities, and stakeholders has conducted multiple reconnaissance studies and feasibility assessments aimed at restoring or enhancing desirable habitat functions between the levees in the Tri-Cities area. Several plans have been implemented towards this goal. Key aspects of these prior studies are described in the following paragraphs:

- *Tri-Cities Levees, Washington, Reconnaissance Report.* This report (Corps, 1992) describes the need to restore riparian and aquatic ecosystems in the Tri-Cities area, noting that local interests would like to modify the levees by lowering the height, covering the riprap, creating riparian zones along the riverside of the levees, enhancing drainage ditches, and creating wildlife riparian zones on the landward side of the levees. Such restoration projects would provide a transition from the free-flowing section of the Columbia River upstream of the project area through the urbanized Tri-Cities reach. Proposed modifications to the levees were considered consistent with the project purposes of navigation and hydropower, while potentially providing considerable environmental benefits.

- *Tri-Cities Levees Section 1135 Preliminary Restoration Plan.* This report (Corps, 1997) describes local interest in sponsoring Section 1135 restoration projects. Local

interests, such as Benton County, have a vested interest in shoreline protection, fish and wildlife enhancement, and improving recreational opportunities (e.g., boating, fishing, and wildlife watching). The Hanford Reach, now called the Hanford Reach National Monument, retains some of the most valuable and naturally-functioning riverine, wetland, and shoreline habitats on the mainstem Columbia and Snake Rivers. Many local sponsors would like to enhance or recreate similar habitat types closer to the urban centers of Kennewick, Pasco, and Richland. In addition to fish and wildlife benefits, numerous socioeconomic benefits exist with these types of mainstem Columbia River projects.

Tri-Cities Shoreline Restoration Project, Tri-Cities, Washington, Section 905(b) (WRDA 86) Analysis Reconnaissance Study. This restoration project report (Corps, 1999) determined Federal interest in existing ecosystem restoration problems and opportunities associated with the levees and the Columbia River shoreline in the vicinity of the Tri-Cities (Benton and Franklin Counties, Washington). The study evaluated the potential for lowering levee height and reducing side slopes, developing wetlands and riparian habitat areas, and joining the upriver toe of Clover Island to the nearby levee. The study evaluated combinations of these alternatives on ten jurisdictional regions within the project area.

- *Clover Island Shoreline Enhancement, 2010*. With grant money from the Washington State Recreation and Conservation Office's Aquatic Lands Enhancement Account, the Port developed a shoreline enhancement plan that incorporated habitat, aesthetic and recreation improvements. As a result, the island's western causeway was restored to provide a more environmentally complex shoreline, shallow water habitat, large woody debris, and vegetation. Approximately 1,000 linear feet of shoreline was improved during this effort.

Several related reports were done by groups other than the Corps, including the following:

- *Clover Island Shoreline Stabilization,* JF Engineering, August 2012
- *Biological Evaluation for Fish and Wildlife Species at the Port of Kennewick Clover Island Shoreline Enhancement Project, Columbia River, Benton County, WA*, the Watershed Company, April 2009
- *Clover Island Improvements*, HDJ Design Group, January 2008
- *Geotechnical Investigation Report for Conceptual Design, Clover Island Shoreline Improvements Kennewick, WA*, PBS Engineering + Environmental, October 2007

CHAPTER 2 – *INVENTORY AND FORECAST/AFFECTED ENVIRONMENT

2.1 Existing Conditions

This chapter provides the inventory of general conditions that could be influenced by ecosystem restoration at Clover Island.

2.1.1 Physical Resources

Climate. Clover Island lies within the semiarid shrub-steppe zone of the Columbia River Basin in southeastern Washington State. Regional temperatures, precipitation, and winds are greatly influenced by the presence of mountain barriers. The Cascade Range, west of Yakima, influences the climate in the area by its rain shadow effect. The Rocky Mountains and ranges in southern British Columbia protect the inland basin from the more severe polar masses moving across Canada and the winter storms associated with them (Hoitink et al., 2005). The study area receives an average annual rainfall of 7 to 8 inches, and a yearly snowfall average of 7 inches. Winds periodically exceed 30 miles per hour, and blowing dust is a common occurrence.

Land Use. Prior to the arrival of Euro-Americans, the original Clover Island was occupied by Native American people. The two archaeological sites identified in the 1947 Columbia Basin Project (part of the Smithsonian Institute's River Basin Survey Program; Simonds, 1998) clearly illustrate the presence of Native Americans. After Euro-American settlement of the area, residents used Clover Island as a recreation site, accessing it from both land and water. The Port purchased Clover Island in the 1940s for use as an industrial site (primarily barge construction). Prior to the completion of McNary Dam and the impoundment of Lake Wallula, the Corps allowed the Port to remove fill material obtained from lower areas of the island to a higher area on the eastern end of the original island, thereby creating the current island configuration. Clover Island is now primarily a business/commercial area, with a marina, motel, restaurant, and office buildings. Some growth potential still exists, although the small size of the island is limiting.

Geology. The study area is within the Columbia River Basalt Group, a thick layer of flood basalt that covered the Pacific Northwest between 17 and 6 million years ago. Clover Island has an approximate surface elevation of 352 feet mean sea level. Bedrock geology is mostly basaltic lavas (Corps, 2001). Glacial alluvial deposits eroded and, over time, deposited coarse- and fine-grained sediments into the Columbia River and river valleys throughout the region.

The original Clover Island was composed of recent (post-Pleistocene) soil deposited by the Columbia River. The soil below the current island, created by fill, is composed of silty sand deposited under low river-velocity conditions (PBS Engineering + Environmental, 2007).

Hydrology, Hydraulics, and Fluvial Geomorphology. Clover Island is located within the impoundment behind McNary Dam, Lake Wallula. In general, the impoundment has increased channel depths and reduced flow velocities relative to free-flowing river reaches. Both the FCRPS and the dams on the middle Columbia River affect the natural hydrograph by decreasing spring and summer flows and increasing fall and winter flows (The Watershed Company, 2009). Changes in peak/base flows are artificially controlled, primarily by Grand Coulee Dam, which releases drafts of water from August through December according to a variety of rule curves determined on an annual basis. From January through mid-April, Grand Coulee drafts for energy production and flood control based on runoff volume forecasts. From mid-April through June, Lake Roosevelt (the Grand Coulee reservoir) is refilled with spring runoff. During this time, water is released to assist the downstream migration of juvenile salmonids [Chelan County Public Utility District (PUD) No. 1, 1999]. Since 1992, flows have been augmented from June through August to assist downstream juvenile salmonid migration. This reduces flows from January through April in the mid-Columbia as water is conserved for upcoming fish flow augmentation in June (Chelan PUD No. 1, 1999).

Water Quality. Clover Island is located in a segment of the Columbia River the Washington State Department of Ecology currently categorizes as polluted in three of four assessment parameters (e.g., temperature, total dissolved gas, and dioxins). Temperature for the Columbia River is listed as Category 5, which places it on the Clean Water Act Section 303(d) State list of impaired waters. This indicates polluted waters requiring a Total Maximum Daily Load (TMDL) limit or other water quality improvement (WQI) project. For both total dissolved gas and dioxins, the Columbia River has a listing of Category 4A, which indicates polluted waters with an approved and actively implemented TMDL.

Air Quality. The study site is located in an area currently meeting Washington State ambient air quality standards and is, therefore, considered to be in attainment.

Noise. Currently, Clover Island neither receives nor generates a large amount of noise. It is a relatively quiet area due to its distance from the existing mainland, busy streets, business areas, or industries. Because of its location, small size, and limited traffic, Clover Island is not subject to the congestion and noise that often accompany crowds and traffic.

Visual/Aesthetics. Clover Island is an artificially-created, 16-acre island connected to the mainland by a causeway approximately 650 feet long. The top of the island is flat;

and contains buildings, roads, parking lots, and several large gravel and/or dirt areas. Along the south shoreline, two large covered boat moorage facilities coexist. Although limited, vegetation (trees, shrubs, and a few small patches of grass) is scattered across the island. Other than an occasional tree or shrub, most of the island shoreline is bare or, in some places, covered with waste concrete.

2.1.2 Ecological Resources

Riparian Vegetation. Little native riparian or wetland vegetation (e.g., cottonwoods, willows, sedges, rushes, cattails) grow on Clover Island. Much of the current vegetation is non-native and considered invasive. Little or no effort has been made since the island's formation to try and establish a riparian/wetland vegetation presence. The focus for many years has been bank protection and stabilization. This has resulted in large amounts of concrete dumped over bank along numerous segments of the island perimeter.

Riparian Wildlife. As a result of the limited amount of suitable riparian habitat, few wildlife species are present on Clover Island. Mink (*Mustela vison*), mallard duck (*Anas platyrhynchos*), and California gull (*Lanus californicus*) were observed during a site visit in July 2014. Several migratory songbird species were also observed, but not identified. Common bird species expected in riparian habitat along the Columbia River are the American robin (*Turdus migratorius*), red-winged blackbird (*Agelaius phoeniceus*), white-crowned sparrow (*Zonotrichia leucophrys*), and yellow warbler (*Dendroica petechial*).

Fish Communities. The Columbia River is home to many species of anadromous fish, consisting of salmonids (salmon and steelhead) and non-salmonids (lamprey and shad). Anadromous salmonids include Chinook, coho (*O. kisutch*), and sockeye (*O. nerka*) salmon, and steelhead (*O. mykiss*). Many of these species are ESA-listed. Anadromous fish outmigrate as juveniles from tributaries or lakes (sockeye), where they hatch and rear, to the ocean, where they mature. During their outmigration, juvenile salmonids seek shallow water habitat to rest and feed. Conversely, returning adults generally only require a suitable migration corridor. Once sexually mature (typically 1-3 years), the adults return (immigrate) to their natal waters to spawn. It should be noted that no natural origin coho salmon stocks are presently known to return to the mid-Columbia or Snake Rivers.

Among the salmonids, various "runs" occur (Figure 8), characterized by adult returns. Chinook salmon exhibit spring and fall runs, where a large portion of fish immigrate in spring to spawn in the earlier part of the summer (April through June). Another large migration occurs in late summer and early fall (approximately July through September) to spawn. Steelhead are on the other end of the adult immigration spectrum. These fish may enter the river system year-round, but Snake and Upper Columbia River fish

generally enter in September through October, and are referred to as summer fish. The juvenile outmigration timing generally overlaps the adult immigration with some exceptions, as seen with coho salmon and steelhead (Figure 9).

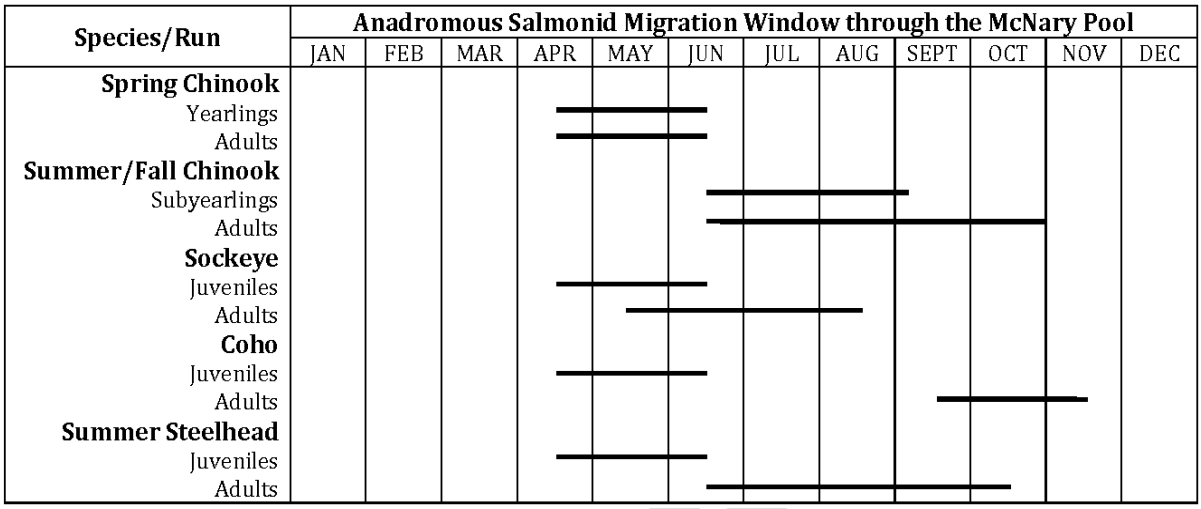

Figure 9. Approximate Adult and Juvenile Salmonid Run Timing through McNary Pool

Juvenile salmonid runs vary in size from year to year, and are greatly influenced by hatchery supplementation. The average sizes of the ESA-listed juvenile salmonid outmigration estimated for the years 2010, 2011, 2012, and 2015 were 1.8 million upper Columbia River Chinook salmon yearlings, 1.1 million upper Columbia River steelhead, and 1.4 million middle Columbia River steelhead. On average, approximately 4.3 million ESA-listed juvenile salmonids may outmigrate from the middle and upper Columbia River in any given year. Although these stocks will experience mortality from dam passage, predation, and other environmental factors, it is safe to assume that at least 1 million juveniles will survive to pass near Clover Island during their outmigration.

Non-salmonid anadromous fish are also found in the Columbia River. Pacific lamprey (*Entosphenus tridentatus*) are a parasitic fish with a life history similar to salmonids, although lamprey have not historically been found around Clover Island. Adults immigrate in the spring and summer, and spawn in freshwater tributaries. Differences in life history include a lower fidelity to natal tributaries for spawning, and juvenile lamprey rear in sandy or silty substrates for as long as 7 years before outmigrating. Pacific lamprey are a species of concern for most Northwest states and Native American Tribes, but are not listed under the ESA. They are not known to spawn or rear around Clover Island.

American shad (*Alosa sapidissima*), a non-salmonid anadromous fish introduced to the Columbia River in 1876, may be found near Clover Island. However, these species prefer flowing, open waters; and not expected to use near shore shallow water habitat.

Bull trout, an ESA-listed species, are a native salmonid exhibiting a fluvial life history. The majority of these individuals may be residents in high mountain tributaries, but some individuals migrate to the mainstem Columbia River to overwinter and feed, returning the following summer to spawn.

White sturgeon (*Acipenser transmontanus*) are native resident fish that inhabit the larger rivers in the Columbia River Basin. They are large, long-lived fish that feed on the riverbed with a vacuum-like, inferior mouth. White sturgeon are generally anadromous, but have become reach-locked within the hydropower system in the Columbia River (McCabe and Tracy 1994). These species are not expected to be found in shallow water habitat near Clover Island.

The resident fish community sample conducted around Clover Island in 1995 (HDR, 1997) produced a list of both native and non-native species likely and assumed to occur presently in the vicinity of Clover Island. Those native species are rainbow trout (*O. mykiss*), mountain whitefish (*Prosopium williamsoni*), northern pikeminnow (*Ptychocheilus oregonensis*), largescale sucker (*Catostomus macrocheilus*), three-spined stickleback (*Gasterosteus aculeatus*), sand roller (*Percopsis transmontana*), chiselmouth (*Acrocheilus alutaceus*), and unidentified sculpin (*Cottus spp.*). Non-native species found in the area are pumpkinseed (*Lepomis gubbosusi*), bluegill (*L. macrochirus*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*M. salmoides*), black crappie (*Pomoxis nigromaculatus*), yellow perch (*Perca flavescens*), walleye (*Sander vitreus*), common carp (*Cyprinius carpio*), brown bullhead (*Ameiurus nebulosus*), and tench (*Tinka tinka*). Of these species, smallmouth bass, largescale sucker, and sculpin are the most common.

Threatened and Endangered Species. The Corps reviewed the threatened and endangered species lists compiled by NOAA Fisheries and USFWS for Franklin and Benton Counties, Washington, on June 15, 2016. Identified species are listed in Table 1. This list was again reviewed in March 2017.

Table 1. Threatened and Endangered Species in the Project Area

Species	Scientific Name	Status	Critical Habitat
NOAA Fisheries Listed Species			
Upper Columbia River Spring Chinook Salmon	*Oncorhynchus tshawytscha*	Endangered	Yes
Upper Columbia River Steelhead	*Oncorhynchus mykiss*	Threatened	Yes
Middle Columbia River Steelhead	*Oncorhynchus mykiss*	Threatened	Yes
USFWS Listed Species			
Bull Trout	*Salvelinus confluentus*	Threatened	Yes
Yellow-Billed Cuckoo	*Coccyzus americanus*	Threatened	Proposed

Clover Island may be used by ESA-listed juvenile salmonids for rearing and as a migration corridor for Upper Columbia River spring Chinook salmon, upper Columbia River steelhead, and middle Columbia River steelhead adults. It may also be used as migratory and overwintering habitat for ESA-listed bull trout. Therefore, much of the Columbia River, including Clover Island shallow water habitat, is designated critical habitat for ESA-listed species of salmon, steelhead, and bull trout. Yellow-billed cuckoo have not been recently documented in the Clover Island project area, and are thought to be extirpated from the state of Washington.

Prior ESA consultation with USFWS and NOAA Fisheries with the Port occurred for the Clover Island Shoreline Enhancement Project (The Watershed Company, 2009), which included shoreline restoration and planting actions similar to the ecosystem restoration alternatives proposed in this report.

The previous consultation resulted in a letter of concurrence from the USFWS (29 September 2009) on an affect determination of "may affect, not likely to adversely affect" ESA-listed bull trout or their critical habitat. A biological opinion (2 July 2010) from NOAA Fisheries concurred that the project "is not likely to adversely affect" ESA-listed upper Columbia River spring Chinook salmon or their critical habitat. The NOAA Fisheries biological opinion (BO) also provided a "No Jeopardy" opinion, with incidental take statement, on a "likely to adversely affect" determination for ESA-listed Middle and Upper Columbia River steelhead with "no adverse modification to critical habitat."

Ongoing Consultation with USFWS and NOAA Fisheries for restoration alternatives proposed in this report are described in Section 6.2.

2.1.3 Social Resources

Cultural Resources – Archaeological and Historical Properties. In 1947, an archaeological survey was conducted within the proposed McNary reservoir area by the Columbia Basin Project of the Smithsonian Institution's River Basin Survey Program. The survey identified two archaeological sites on Clover Island. One site, located on the eastern end of the island, was documented as a village site with burials that contained animal bone, artifacts, shells, and human bones. The second site was located on the island's south side. This was listed as a campsite, and included mussel shells and broken stones. It is assumed both sites were most likely disturbed due to island development and/or reservoir operations. Although neither site received detailed testing or examination, both were included in the Tri-Cities Archaeological District, which is listed on the National Register of Historic Places.

Socioeconomic Setting. Clover Island is located within the City of Kennewick, Benton County, Washington. Kennewick is the most populous (2015 estimate was 78,816) of the three cities that make up the Tri-Cities area (*www.census.gov/quickfacts/table/*

PST045215/5335275, accessed 13 October 2016). It has a predominately Caucasian population, with Hispanic/Latino making up the next largest ethnic group. The median household income was $51,739 (2010-2014) and the median house value was $168,200 (2010-2014).

Recreation. Some recreation is available on Clover Island. The primary activity is boating, facilitated by the Clover Island Marina located on the south end of the island. The marina offers easy access to the Columbia, Snake, and Yakima Rivers, and can provide moorage for over 150 vessels, with overnight stays of up to 14 days. The Clover Island Riverwalk trail along the causeway provides visitors with the opportunity to explore the causeway waterfront on foot and offers limited wildlife and scenic viewing. Currently, no similar recreation opportunity exists on Clover Island, due to a lack of aquatic and riparian habitat and associated trail/paths.

2.2 Hazardous, Toxic, and Radioactive Waste (HTRW) Analysis

An investigation of existing environmental data (Washington Department of Ecology's *Underground Storage Tank/Leading Underground Storage Tank* database), maps, and site conditions determined no underground fuel or oil storage tanks are present on the island.

The Corps Seattle District completed the project *Environmental Condition of Property Report* of September of 2015 for the proposed action and notes:

> "In a Geotechnical Investigation Report for Conceptual Design of Clover Island Shoreline Improvements, (PBS 2007), five test pits were dug in order to characterize subsurface soils. The locations of these test pits are shown in Figure 5-1. In test pit TP-3, pieces of broken concrete pipe were found. The concrete pipe was sampled and analyzed for asbestos content. It was found to contain approximately 25 percent asbestos. Asbestos content at this level requires handling in accordance with 29 CFR 1926.1101. This is a recognized environmental condition that only impacts the Clover Island Ecological Restoration Project if additional concrete pipe is uncovered during construction."

Test Pit TP-3 is far removed from the proposed action (at a point proximate to the causeway, not the north shoreline) but identifies a potential risk that would be addressed with monitoring during limited site excavation. The report recommends "The ecological restoration contractor should be advised of this potential and operate in accordance with 29 CFR 1926.1101." The *Environmental Condition of Property Report* is included in Appendix G, E*nvironmental Compliance*.

CHAPTER 3 – *FORMULATION OF ALTERNATIVES

The following section identifies problems, opportunities, planning objectives, and study constraints, based on an assessment of existing and expected future without-project conditions in the project area. It discusses the process used to develop and screen project measures and formulate alternatives; and contains a description of each alternative, an environmental benefits evaluation, a comparison of alternatives using cost-effectiveness and incremental cost analyses, and identifies the national environmental restoration (NER) plan that reasonably maximizes ecosystem restoration benefits compared to costs and a trade-off analysis considering information that cannot be easily quantified.

3.1 Existing Conditions/Future Without-Project Condition/No Action Alternative

As discussed in the previous chapter, riparian and shallow aquatic habitat at Clover Island decreased in quality and quantity with the inundation of the McNary reservoir. Shallow aquatic habitat provides for foraging, resting, and rearing of these juvenile salmonids. Riparian vegetation provides both a food source (e.g., insects) and shade to cool water temperatures along the shoreline where juvenile salmonids rest and feed as they outmigrate from the spawing habitat to the ocean.

Without aquatic and riparian habitat restoration, Clover Island would remain similar to the current condition, with minor changes caused by erosion expected in the future without-project condition. There would continue to be little aquatic habitat for juvenile salmonid rearing and outmigration and no riparian habitat for resting and foraging of birds and wildlife, with little organic material input to the aquatic environment. The lack of riparian habitat would continue to provide no shade and have no potential to reduce local water temperatures. The limited juvenile salmonid habitat presently available will continue to be focused on the downstream (eastern) end of the island. Over the long-term, gradual erosion along portions of the island would impact volunteer riparian plant establishment and succession. Based on current site conditions, any eroded cobble or sediment would likely flow toward the eastern end of the island prior to settling, adding little benefit to shallow aquatic habitat in terms of substrate or depth. Additional predator habitat would increase as erosion continued to undercut the shoreline.

Following the loss of an estimated 82% of the shallow juvenile salmon rearing habitat in the Middle Columbia River, the river continues to be a patchy environment with limited habitat between the Yakima River Delta, upstream, and the McNary National Wildlife Refuge, downstream of Clover Island. Without habitat restoration at Clover Island, the connectivity between the higher functioning upstream and downstream shallow-water habitat for juvenile salmon would not improve.

3.1.1 Problems

For planning purposes, a problem is an undesirable condition that currently exists or will exist in the future. An opportunity is a chance to create a more desirable condition for the future, and to increase the benefits or value of the project.

The loss of shallow aquatic habitat and riparian habitat throughout the Middle Columbia River, including the shores of Clover Island, caused by the construction of McNary Dam has directly affected salmon, steelhead, bull trout, birds, and wildlife species. Based on an evaluation of existing and historic conditions within the project area, the following are specific habitat problems identified along the north shore of Clover Island:

- Lack of a diverse, multi-layer riparian habitat limits nesting, resting, and foraging habitat for birds and wildlife. The availability of organic material and macroinvertebrates as forage for aquatic species is also reduced by the lack of a diverse riparian habitat. Poor existing soil conditions and physical barriers hinder the establishment of riparian habitat.

- Shallow aquatic habitat of appropriate depth and substrates to support foraging and resting opportunities for ESA-listed juvenile salmonids during their outmigration is limited along the north shore. Establishment of healthy aquatic habitat in the notch is hindered by low velocities and circulation caused by the island's shoreline configuration.

3.1.2 Opportunities

In addition to the north shore of Clover Island being one of the few locations in the mid-Columbia River where there is the opportunity to restore habitat, there are other benefits that may be incorporated into the restoration project. The following opportunities exist for Clover Island:

- Where possible, create less desirable habitat for aquatic habitat predators. During the development of aquatic and riparian habitat, opportunity exists to eliminate undercuts in the shoreline material, vertical drop-offs, and deep holes along the north shore. This will remove ambush sites used by warmwater predator fish (e.g., smallmouth bass and northern pikeminnow) that prey on salmonid species.

- Where possible, provide educational opportunities for the public to learn about habitat functions and benefits to fish and wildlife. If the riparian habitat is restored, Clover Island would provide a rare location in which the public could learn about the riparian habitat in an island environment located close to the Tri-Cities area.

- Where possible, expand recreational opportunities for public access to riparian habitat. Clover Island could offer a unique opportunity to expand access from the regional Sacagawea Heritage Trail to restored riparian habitat.

3.2 Project Goals, Planning Objectives, and Constraints

Specific project goals and planning study objectives are developed to support the Federal Objectives and subordinate National Economic Development (NED) or NER objectives, degraded as a result of construction and/or operation of a water resources development project. The Federal objective of water and related land resources planning is to contribute to NED or NER in accordance with national environmental statutes, applicable Executive Orders (EOs), and other Federal planning requirements and policies. Contributions to national improvements are increases in the net value of the national output of goods, services, and ecosystem integrity. Contributions to the Federal objective include increases in the net value of those goods, services, and ecosystems that are or are not marketable.

The use of the term "Federal objective" is distinguished from planning/study objectives. Study objectives are more specific in terms of expected or desired outputs, whereas the Federal objective is considered a national goal. Water and related land resources project plans are formulated to alleviate problems and take advantage of opportunities in ways that contribute to study and Federal objectives.

Restoration of the Nation's environment is achieved when damage to the environment is eliminated and important cultural and natural aspects of the nation's heritage are preserved. Various environmental statutes and EOs assist in ensuring water resource planning is consistent with restoration. The objectives and requirements of applicable laws and EOs are considered throughout the planning process to meet the Federal objective.

This project and the planning study objectives fall under the NER objective. Specific guidance on Federal objectives and NER may be found in ER 1165-2-501, Civil Works Ecosystem Restoration Policy, 1999, and ER 1105-2-100, Planning Guidance Notebook, 2000.

3.2.1 Project Goal

The goal of this Section 1135 project is to restore long-term habitat and ecosystem functions directly related to NER objectives. This project will restore degraded aquatic and riparian ecosystem structure, function, and dynamic processes to a less degraded and more natural condition. Specifically, the goal of the project is to restore riparian and aquatic habitat and ecosystem functions for the benefit of ESA-listed salmonids, other fish, birds, and wildlife in the study area at Clover Island and, where possible, provide for education and recreation access to riparian habitat.

3.2.2 Planning Objectives

Planning study objectives represent desired positive changes intended to meet study goals. They are generated to describe how problems could be addressed by taking advantage of identified opportunities. Within the framework and constraints of the Section 1135 Program, and relative to a "No Action Alternative" over a 50-year horizon, the following objectives were developed to address habitat problems in the study area at Clover Island:

- Restore shallow aquatic habitat for foraging and resting ESA-listed juvenile salmonids
- Restore native riparian habitat with ecosystem functions that provide support to the aquatic habitat

The opportunities identified for this project may be incorporated into the restoration planning objectives. Therefore, separate objectives were not developed. Aquatic predator habitat could be reduced during design and construction of shallow aquatic juvenile salmon habitat by filling holes and removing overhanging rocks and undercut banks. Opportunities to incorporate education and recreation access to riparian habitat could be addressed under the planning objective for restoration of riparian habitat, and will be addressed in accordance with ER-1105-2-100, as discussed in Section 3.2.4. Table 2 shows problems, opportunities, and planning objectives presented for this study.

Table 2. Project Problems, Opportunities and Planning Objectives

Problems and Opportunities in the Clover Island Study Area	Planning Objectives	
	Restore shallow aquatic habit for foraging and resting ESA-listed juvenile salmonids	Restore native riparian habitat with ecosystem function to support aquatic habitat
Lack of multi-layer riparian canopy reduces resting and foraging habitat for birds and wildlife		X
Lack of a diverse riparian habitat reduces the availability of organic material and macroinvertebrates as forage material for aquatic species	X	X
Lack of shallow aquatic habitat of appropriate depth and substrates suitable for juvenile salmon	X	
Where possible create less desirable habitat for aquatic habitat predators*	X*	
Where possible provide educational opportunities about habitat functions and benefits*		X*
Where possible expand recreational opportunities for public access to riparian habitat *		X*

* Opportunities are addressed under the habitat restoration planning objectives.

3.2.3 Constraints

Universal constraints are resource, legal, or policy considerations that limit the range or type of actions that could be implemented to meet study objectives. All Corps projects must comply with Federal and applicable state and local laws, regulations, and policies. In addition, projects authorized under Section 1135 of WRDA 1986 must promote self-sustaining solutions without exceeding the Federal funding limit for a CAP project ($10 million).

Project actions are further restricted by existing features and uses in the study area on and near Clover Island. Four project-specific study constraints were identified for this study:

- Actions may not encroach on open navigation and boater safety
- Actions may not change or reduce the effectiveness or safety of existing structures and services provided at Clover Island
- Actions may not create aquatic predator habitat
- Education and recreation features must be consistent with the Clover Island Master Plan

3.2.4 Education and Recreation Opportunities

In accordance with the Federal Water Project Recreation Act of 1965, Policy Guidance Letter No. 59, June 1998; and ER 1105-2-100, a CAP Section 1135 project allows recreation facilities to be added to take advantage of education and recreation potential of an ecosystem restoration project, but the project may not be specifically formulated for recreation. For the purposes of this study, features for education and recreation features will not be formulated into measures and alternatives.

In 2003, the Port started a collaborative process with the community, stakeholders, and local and State agencies, to develop a common vision for Clover Island that prioritized the "enhancement of the environment, aesthetics, and recreation." This public process resulted in the Clover Island Master Plan, 2004 (updates through the Comprehensive Scheme for Harbor Improvements, 2016). The Master Plan included recreation concepts, some of which are being considered and will be incorporated into the recommended restoration alternative identified by this study. This meets the requirement identified as a planning study-specific constraint that education and recreation features must be consistent with the Clover Island Master Plan.

The primary intent of the proposed recreation would be to connect the existing regional Sacagawea Heritage Trail (trail) system on the nearby Tri-Cities Levees and causeway to restored riparian habitat on the north shore of Clover Island. The Corps may participation in recreation features as long as they do not adversely impact the ecosystem restoration purpose. The Corps is also limited to the type of features allowed (ER 1105-2-100). Generally, allowable features at a day use site are for access (pathways and trails), safety facilities (lighting and railings), seating areas (benches, shade shelters, trash receptacles), signs and interpretive media (education and

information), and associated utilities (water/electric). A description of the proposed recreation features can be found in Section 5.3.2.

Justified recreation and allowable recreation features included as part of this CAP, Section 1135 project are all cost-shared facilities, as listed in ER 1165-2-400. Appendix C, *Recreation Benefits Analysis,* describes the analysis of the recreation value and the allowable costs. The Corps costs for projects that include recreation may not exceed the Federal portion of the total project costs by more than ten percent. The NFS is required to acquire all necessary lands and to cost share 50 % of the costs for the recreation features. Costs above the allowed Federal costs are entirely the responsibility of the NFS.

3.3 Measure and Alternative Criteria

This section summarizes planning criteria and considerations used to formulate and evaluate restoration measures (e.g., a specific action or feature to address a problem) and alternatives (one or more measures combined). The planning criteria (acceptability, completeness, effectiveness, and efficiency) and the following considerations were used to formulate and evaluate measures and alternatives. They were also used to remove measures from further evaluation, or were used as a basis for combining measures into alternatives.

- Measures must meet at least one planning objective and avoid all study constraints
- Alternatives must meet all or part of each planning objective and avoid all study constraints
- Alternatives must meet the planning criteria of acceptability, completeness, effectiveness, and efficiency
- The Recommended Plan must be acceptable to the NFS.

3.3.1 Planning Criteria

Acceptability, completeness, effectiveness, and efficiency are four evaluation criteria used by the Corps to develop and screen alternative plans.

- **Acceptability.** An ecosystem restoration plan should be acceptable to Tribal, State and Federal resource agencies, as well as local governments. This includes consideration of the environmental effects of the alternatives in determining what is acceptable. Broad-based public consensus and support for the plan should be evident. A recommended plan must also be acceptable to the NFS, but the recommended plan is not necessarily the locally preferred plan.

- **Completeness.** A recommended plan must provide and account for all necessary investments or other actions needed to ensure the realization of the planned restoration outputs. This may require relating the plan to other types of public or private plans if these plans are crucial to the outcome of the restoration objective.

Real estate, operations and maintenance, monitoring, and sponsorship factors must be considered.

- **Effectiveness.** An ecosystem restoration plan must make a significant contribution to addressing specified restoration problems or opportunities (e.g., restore important ecosystem structure or function to some meaningful degree).

- **Efficiency.** An ecosystem restoration plan must represent a cost-effective way of addressing a restoration problem or opportunity. It must be determined that the plan's restoration outputs cannot be produced more cost efficiently by another agency or institution.

3.4 Formulation of Measures

A measure is an action or feature that can be implemented at a specific geographic site to address one or more planning objectives. Alternative plans are combinations of one or more of these measures. Through a series of charrettes with the NFS and using information provided to the NFS from resource agencies, the Tribes, and the public; 25 concepts were identified and refined. The result of these charrettes were nine restoration measures for consideration in the project.

Project Areas. To facilitate the charette discussion on the various problems and unique site conditions along the shoreline, Clover Island was divided into five distinct areas (Figure 10) that are referenced throughout this document (see Appendix D, *Geotechnical Evaluations* for additional information).

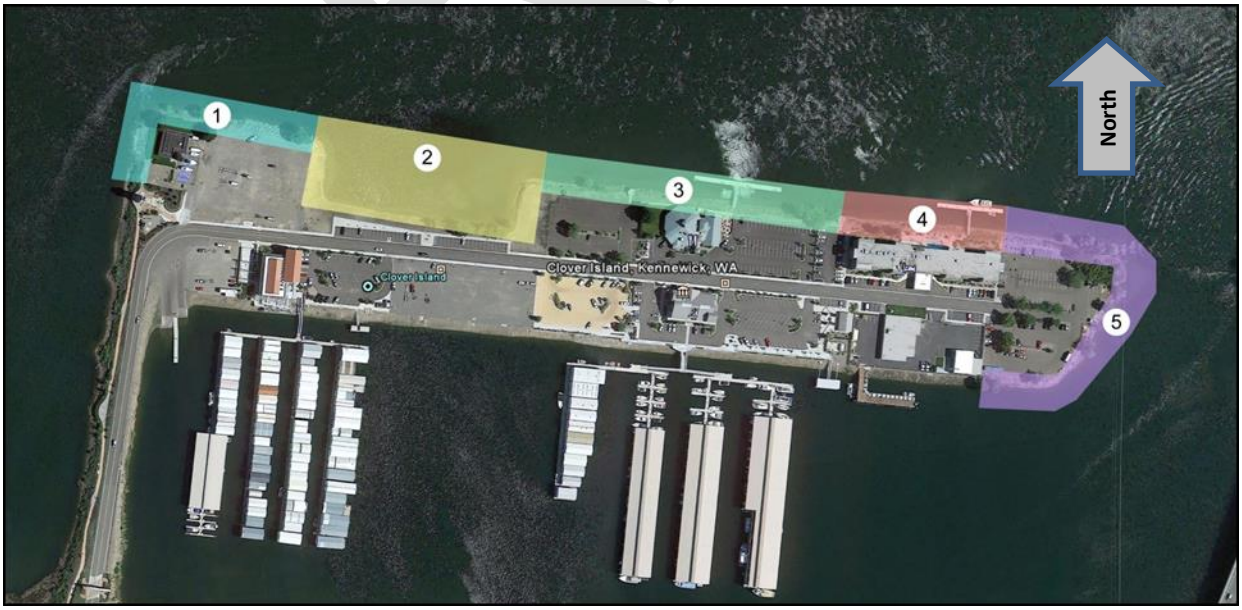

Figure 10. Clover Island Restoration Project Proposed Measure Areas

- **Area 1**. Located at the northwest corner, along the north shore to the upstream edge of the notch is area 1 (Figure 11). This area is characterized by higher water velocities, submerged holes along the shoreline with concrete encased banks, imbedded concrete rubble, and undercut debris.

Figure 11. Area 1, with examples of Concrete Waste and Undercut Debris

- **Area 2.** The notch, or cover, is located immediately downstream of area 1. It is characterized by lower velocity flows and average water depths of less than 6 feet (Figure 12). Sediments are composed of silt, sands and gravel that gradually incline to sloping banks.

Figure 12. Area 2 and Area 3 of Clover Island.

- **Area 3.** Immediately downstream of the notch is area 3, which has steep banks imbedded with concrete rubble and undercut by flows (Figure 12).

- **Area 4.** Located immediately downstream of area 3, with many of the same characteristics (e.g., steep banks, concrete rubble and debris), is area 4 (Figure 13). Area 4 is adjacent to infrastructure, and access to the site is limited.

Figure 13. Area 4 and Area 5 of Clover Island

- **Area 5.** Stretching from the northeast corner to the southeast corner, area 5 is characterized by lower flows, aggregation of gravels, an eroding bank slope aggravated by boat-generated wave action, and erodible soils (Figure 13).

3.4.1 Description of Initial Measures

Nine measures resulted from the charette. A brief description of each measure is contained in the following paragraphs:

- **Aquatic Habitat along Shoreline Fringe (sheet pile at the toe).** Aquatic habitat along the shoreline fringe would be characterized by shallow water habitat suitable for juvenile salmonids. A shoreline fringe of hydrophytic shrubs (e.g., coyote willow) would be planted along the water's edge. Depth and substrate would be suitable along a narrow area nearshore, with adequate bank cover for rearing provided by the willows. This habitat would be created by installing a sheet pile toe below the ordinary high water mark (OHWM) and filling to create a 3-foot horizontal to 1-foot vertical (3:1) bank slope. This measure would apply to areas 1 through 5.

- **Large Woody Debris.** Large woody debris is generally characterized by the accumulation of logs, trees, and root structures that form complex wood configurations suitable for use by juvenile salmonids as cover and forage. In a natural riverine system, large wood accumulates on the inside of river bends and pools, and is deposited along the shoreline when high flows recede. Large woody debris can create undulating shoreline features that encourage deposition, scour, and pool formation over time; and provide important velocity breaks in long riffle-run reaches. Habitat may be improved by providing a variety of food sources (e.g., macroinvertebrate communities) and refugia. This measure would apply to all areas (1 through 5).

- **Aquatic Habitat on a Submerged Bench.** This measure would entail creation of a long, shallow slope from the shoreline out to deeper water. This submerged bench would provide ideal depth and substrate close enough to shore to incorporate

additional food sources and cover provided by the riparian area. Mixed substrate, dominated by gravel and cobble, would provide rearing and feeding areas. A few boulders would be added to provide velocity breaks and pockets for the deposition of finer substrate particles and food items. The bench would be created by placing a choked boulder toe within approximately 60 feet of the shoreline, with backfill material added to create a 3:1 slope up to dry land. The slope would require appropriate fill material to provide suitable shallow water depth and substrate for rearing ESA-listed juvenile salmonids. This measure would be applied to areas 1 through 5.

To implement this measure, a trench would be dug below the OHWM, riprap would be installed within the trench, and the riprap would be choked with finer cobble and gravel in order to create a stabilizing toe for shoreline sloping. Fill material would then be moved in and placed on the shoreline to create a 3:1 slope that extends below the OHWM until meeting the choked riprap toe. In order to create the slope, fill material could extend from 20 feet to 60 feet into the river, depending on bathymetry.

- **Emergent Wetland Habitat in the Notch.** Emergent wetlands are characterized by shallow depths with vegetation such as Northwest Territory sedge association (*Carex utriculata*), other sedges (*Carex spp.*), common spikerush (*Eleocharis palustris*), and hydrophytic shrubs [e.g., redosier dogwood (*Comus sericea*), and willows (*Salix spp.*)]. Soil and substrate gradually become wetter as elevation decrease forms transitions in vegetation types. Shrubs will persist in higher elevations, but plant composition changes closer to open water, primarily to sedges. Wherever water depth is adequate, juvenile salmonids may enter the emergent vegetation to seek refuge and feed on macroinvertebrates. This measure would apply only to area 2.

  To create emergent wetland at Clover Island, the shoreline would be filled to create a gradual slope into the notch from dry land, and appropriate species would be planted, based on elevation. Ecosystem function would be provided as the wetland matured. The wetland would provide shallow water fish habitat with suitable depth and substrate, and could also provide some bank cover in the form of complex root structures. Terrestrial energy inputs and food sources (terrestrial and aquatic invertebrates) for salmonids and other resident and native fishes could increase. In addition, emergent vegetation would create nesting and foraging habitat for nesting and neotropical songbirds [e.g., redwing blackbird (*Agelaius phoeniceus*)] utilizing the Columbia River corridor.

- **Multi-Storied Riparian Shrub/Tree Species on a Stabilized Slope.** A multi-storied riparian habitat is characterized by a variety of plant types and species that create a layered forest effect. Beginning at ground level, understory plants (grasses, forbs, and wildflowers) provide cover and browse for small mammals and herbivores. Mid-story plants [e.g., elderberry (*Sambucus nigra*) and serviceberry (*Amelanchier*

alnifolia)] provide ground floor canopy and herbivore browse, but are also covered by the canopy trees that provide shelter for migratory birds nesting and feeding in the shrubs. Finally, a canopy comprised of large trees [e.g., willows (*Salix spp.*), cottonwood (*Populus spp.*), chokecherry (*Prunus spp*.), and alder (*Alnus spp.*)] provides shade, cover, food sources, and nesting and resting habitat for a variety of birds and mammals. Leaf litter from deciduous trees provides energy inputs for macroinvertebrate communities and potential bank cover for juvenile salmonid refugia (e.g., complex root structures). The riparian area would be planted with appropriate species on a stabilized 3:1 shoreline slope to provide a functional multi-storied riparian ecosystem at project maturity. This measure would apply to all areas (1 through 5).

Implementation of this measure would include the installation of a choked riprap toe along the entire identified island shoreline area below the OHWM, as described above in the *Aquatic Habitat on a Submerged Bench* measure. Fill material would be placed to create a 3:1 slope tied into the riprap toe. Fill material would also tie into the existing slope near the top of the shore, creating a terrace. Coir fiber logs would be placed along the riprap toe and upslope to stabilize the material. Willow whips would be planted around the shoreline, and other native species suitable for upland habitats would be planted through the coir fiber matting to provide appropriate shoreline habitat for both salmonids and riparian obligate wildlife (e.g., yellow warblers). This would also stabilize the toe and other new fill material.

- **Multi-Storied Riparian Shrub/Tree Species on a Stabilized Slope, Excluding Area 4.** This measure is exactly the same as the measure described above, except that no work would be completed at area 4, which would remain in the existing condition. Area 4 was excluded from this measure because the close proximity of a building to the restoration sites limits the types of equipment that can access the shoreline. This measure would apply to areas 1 through 3 and area 5.

- **Stabilized Bank with Retaining Wall and Riparian Shrub Species at Area 4.** A limited riparian shrub habitat, comprised of hydrophytic shrubs, would be planted along the shoreline at area 4. Due to the close proximity of the building to the shoreline, a retaining wall would be required to stabilize the shoreline. A retaining wall would limit the amount and type of vegetation that could be planted at area 4. A few willows would be located in area 4. Other plant species that could endure dryer conditions are woods rose (*Rosa woodsia*) and smooth sumac (*Rhus glabra*). Even this limited planting would still provide food, and nesting and resting habitat for migratory songbirds. This measure would apply only to area 4.

  A retaining wall would be constructed along the shoreline in area 4 to prevent shoreline erosion and stabilize a riparian planting above the wall. Hydrophytic shrubs and trees (e.g., willows) would be planted along the shoreline. Riparian plant species variety would be reduced to reflect a narrow planting zone, and hydrophytic

shrubs and larger trees (e.g., cottonwood, chokecherry, alder) would likely be eliminated from plantings near the retaining wall. This would protect the integrity of the wall from roots as the plantings mature.

- **Flow Deflectors at Areas 1 through 4, of Varying Lengths (three separate measures).** Flow deflectors, ranging in length from 100 feet to 135 feet, would be placed along the shoreline to divert erosive energy away from the bank line and proposed riparian plantings, and redirect it toward the main river channel. The localized disruption of stream energy would also introduce more aquatic heterogeneity into the shallower channel edge and provide habitat benefits. These deflectors would create discontinuities in flowlines near the banks, and introduce nearby scour and deposition zones. Potential benefits include the creation of depositional areas on the upstream side of the deflectors, creation of coarser substrate by flushing finer sediments downstream of the deflectors, creation of areas of varying velocity near the shoreline, redirection of flow into the "notch" to increase the circulation of fresh water, and a shift of the most undermining scour forces away from the shoreline. This measure would apply to areas 1 through 4.

- **Flow Deflectors at Areas 1 through 4, 40-foot-length.** This measure is similar to the flow deflectors at varying lengths measure, except that all flow deflectors would project 40 feet from the shoreline. This measure would apply to areas 1 through 4. The reduction in allowable dimensions of these flow deflectors would also reduce the deflectors' influence on streamlines and energies.

3.4.2 Screening of Initial Measures

The nine measures initially identified for the project were screened against the planning objectives and constraints in additional analysis. A general overview of the measures is provided below. Table 3 indicates whether these measures were retained or dismissed, and provides rationale for those outcomes.

3.4.3 Measures Eliminated from Further Consideration

After the initial screening of measures against planning objectives and constraints, the following measures were eliminated from further consideration:

- **Aquatic Habitat along Shoreline Fringe (with sheet pile at the toe).** This measure was removed from further analysis for two reasons. First, sheet pile installation may destabilize the near-shore portion of the island and damage nearby structures. This violates the planning constraint that "actions may not impact existing structures or services" and is infeasible due to engineering and safety concerns. Second, sheet pile (rather than a choked riprap toe) increases the predation risk for juvenile salmonids by creating an abrupt edge underwater. Ambush predators (e.g., smallmouth bass) may use this edge along the sheet pile as an ambush point to feed

on juvenile salmonids as they forage in shallow water habitat above the sheet pile. This violates the planning constraint that "actions may not create aquatic predator habitat." Therefore, this measure was removed from further analysis.

- **Large Woody Debris.** This measure involves installing large woody debris as bank cover for juvenile salmonids. Artificially installing woody debris may be accomplished through various methods, but can be difficult to avoid creating aquatic predator habitat in some cases. Excavating and placing woody debris may change hydraulic conditions, or the debris may interact inappropriately with flows, particularly along an engineered landform like the north shore of Clover Island, creating atypical scour and potential ambush points for aquatic predators. This measure was removed from further analysis for violating the "actions may not create predator habitat" planning constraint.

- **Flow Deflectors at Areas 1 through 4, Varying Lengths (three separate measures).** Initially, the longer flow deflectors were proposed to angle downstream and direct flow toward the shoreline. This configuration would have likely resulted in variable substrates and debris collection locations, thereby providing aquatic habitat benefits. After consultation with the US Coast Guard, it was determined that the long flow deflectors could create risks for navigation and recreational boaters. The US Coast Guard recommended that the flow deflectors not project any further than 40 feet from the shoreline. As a result of this consultation, the originally conceived long deflector measures were eliminated from consideration because they violated the planning constraint, "actions may not encroach on navigation and boater safety," and are infeasible

- **Flow Deflectors at Areas 1 through 4, 40-foot-length.** This measure projected flow deflectors 40 feet from the shoreline. While the longer flow deflectors would provide some benefit, after examination of the lo(w magnitude of hydraulic effects possible with the reduced-length (40 feet) deflectors, it was determined there were no habitat benefits to merit further consideration and, in one case, a negative impact would be derived from these structures. Therefore, the 40-foot flow deflector measures were considered infeasible due to little (or a negative) effect on benefits, and they were removed from further evaluation. (See Appendix B, *Hydrology and Hydraulic Analysis,* for the flow deflector evaluation.)

Table 3. Measures Retained and Dismissed from Further Consideration

Conceptual Measure	Planning Objectives		Planning Constraints			Future Consideration
	Restore shallow aquatic habitat for forage and resting juvenile salmonids	Restore native riparian habitat with ecosystem function to support aquatic habitat	Actions may not encroach on open navigation and boater safety	Actions may not impact existing structures or services	Actions may not create aquatic predator habitat	Retained/ Dismissed
Aquatic Habitat on Submerged Bench	Yes	Minimal	No	No	No	Retained
Aquatic Habitat only on Shoreline Fringe, with Sheet Piling	Minimal	Yes	No	Potential	Yes	Dismissed
Emergent Wetland in Notch	Minimal	Yes	No	No	No	Retained
Multi-Storied Riparian Shrub/Tree Species on Shoreline and Stabilized Slope	Minimal	Yes	No	No	No	Retained
Stabilized Bank with Retaining Wall and Riparian Shrub Species	Minimal	Yes	No	No	No	Retained
Large Woody Debris	Yes	NA	No	No	Yes	Dismissed
135-foot Flow Vane at Notch	Yes	NA	Yes	No	No	Revised, reanalyzed, and dismissed
100-foot Flow Vane on Northwest Point	Yes	NA	Yes	No	No	Revised, reanalyzed, and dismissed
Series of Parallel 100-foot Flow Deflectors	Yes	NA	Yes	No	No	Revised, reanalyzed, and dismissed
Series of Parallel 40-foot Flow Deflectors	No	NA	No	No	No	Dismissed

3.4.4 Measures Retained for Further Consideration

The five measures retained for further evaluation, along with the planning objectives they meet, are summarized in Table 4.

Table 4. Measures Retained

Measure Designation/ Name	Brief Description	Planning Objectives Potentially Met
A - Aquatic Habitat on Submerged Bench (Areas 1 thru 5)	Create long, shallow slope from the shoreline to deeper water. This submerged bench would provide ideal depth and substrate close enough to shore to incorporate additional food sources and cover provided by the riparian area. The bench would be created by placing a choked boulder toe within approximately 60 feet of the shoreline, with backfill material added to create a 3:1 slope up to dry land.	This submerged bench would create aquatic habitat for ESA-listed juvenile salmonids with ideal depth and substrate close enough to shore to incorporate food sources and cover provided by the riparian area. Mixed substrate, dominated by gravel and cobble, would provide rearing and feeding areas. A few boulders would be added to provide velocity breaks and pockets for the deposition of finer substrate particles and food items.
B - Emergent Wetland in Notch (Area 2)	To create emergent wetland at Clover Island, the shoreline would be filled to create a gradual slope into the notch from dry land, and appropriate species would be planted, based on elevation. Ecosystem function would be provided as the wetland matured.	The wetland would provide shallow aquatic fish habitat with suitable depth and substrate, and bank cover in the form of complex root structures. Terrestrial energy inputs and food sources (terrestrial and aquatic invertebrates) for salmonids and other resident and native fishes would increase. Emergent vegetation would create riparian habitat used for nesting and foraging by neotropical songbirds (e.g., yellow warbler).
C - Multi-Storied Riparian Shrub/Tree Species on Stabilized Slope (Areas 1 thru 5)	The riparian area would be planted with appropriate species on a stabilized shoreline slope to provide a functional multi-storied riparian ecosystem at project maturity. A choked riprap toe would be installed below the OHWM. Fill material would be placed to create a 3:1 slope tied into the toe and the existing slope near the top of the bank, creating a terrace. Coir fiber logs would be placed along the riprap toe and upslope to stabilize the material planting surface for willow whips and other native species suitable for upland habitats.	Riparian habitat would be created that would provide cover and forage, as would shade, cover, food sources, and nesting/resting habitat. Leaf litter would provide energy inputs for macroinvertebrate communities.
D - Multi-Storied Riparian Shrub/Tree Species on Stabilized Slope (Excluding Area 4)	This measure is the same as the measure described above, except that no work would be completed at area 4, which would remain in the existing condition.	Riparian habitat would be created similar to the measure described above, except that no work would be completed at area 4, which would remain in the existing condition.
E - Stabilized Bank with Retaining Wall and Riparian Shrub Species at Area 4	A limited riparian shrub habitat, comprised of hydrophytic shrubs, would be created at area 4. A retaining wall would be constructed to prevent shoreline erosion and stabilize a riparian planting above the wall. A choked riprap toe would be placed at minimum pool, with hydrophytic shrubs and trees (e.g., willows).	Limited riparian habitat would provide food, and nesting and resting habitat for migratory songbirds.

3.5 *Alternatives

Alternative plans are developed by combining one or more measures to form a plan that meets all planning objectives and avoids all constraints. The evaluation criteria of acceptability, completeness, effectiveness, and efficiency are considered in the development of the alternatives and confirmed for the recommended plan/preferred alternative. Alternatives are compared and evaluated against the No Action plan, with respect to ecosystem outputs (habitat benefits) and by incremental cost analyses. A No Action plan is required by NEPA and represents Clover Island as it currently is, without this ecosystem restoration project or any other improvements. No local or state agencies or other groups have expressed an interest in pursuing environmental improvements at Clover Island on their own without a Federal partner. Therefore, the "No Federal Action Alternative" was not developed or considered.

The five measures remaining after the initial screening were combined into several alternatives, based on whether or not they were mutually exclusive, combinable, or dependent on other measures. The following criteria exists:

- The No Action alternative cannot be combined with any other measure
- Only Measure B could be considered a standalone alternative
- Measures C and D are mutually exclusive
- Measure E is dependent on Measure D, and can be combined with any other measure except Measure C

Based on these interrelationships, 11 alternative plans, in addition to the No Action Alternative, were compared with respect to habitat benefits and costs estimated to implement, operate, and maintain the project. Table 5 identifies the measures used to develop the alternative plans, and the following list contains a brief description of these alternatives:

Table 5. Composition of Alternative Plans

Alternative Plans			Final Measures				
No.	**Name**	**Benefits**	**A**	**B**	**C**	**D**	**E**
	No Action		-	-	-	-	-
Maximized Aquatic and Riparian Habitat							
1	Maximized Habitat Restoration A	Max Balanced	X	X	X		
2	Maximized Habitat Restoration B		X	X		X	X
Maximized Aquatic Habitat with Limited Riparian Habitat							
3	Maximized Aquatic with Medium Riparian	Max Aquatic	X	X		X	
4	Maximized Aquatic with Limited Riparian		X	X			
Maximized Riparian Habitat with Limited Aquatic Habitat							
5	Maximized Riparian with Limited Aquatic A	Max Riparian		X	X		
6	Maximized Riparian with Limited Aquatic B			X		X	X
Limited Riparian Habitat with Limited Aquatic Habitat							
7	Limited Riparian with Limited Aquatic Habitat	Conservative		X		X	
Medium Level of Aquatic and Riparian Habitat							
8	Medium Level of Riparian/Aquatic Habitat A	Mid Balanced	X			X	
9	Medium Level of Riparian/Aquatic Habitat B		X		X		
10	Medium Level of Riparian/Aquatic Habitat C		X			X	X
Limited Aquatic Habitat with Minimal Riparian Habitat							
11	Limited Riparian with Limited Aquatic Habitat	Conservative		X			

- The No Action Alternative is required by NEPA. If this alternative is selected, no work will be done to restore ecosystem functions at Clover Island. It is the baseline condition against which all other alternatives are compared to determine potential benefits.

- Alternative 1, *Maximized Habitat Restoration A*, is a balanced approach to ecosystem restoration. It combines Measures A, B, and C to provide a submerged bench with aquatic habitat, emergent wetland in the notch, and multi-storied riparian shrub and tree plantings on a stabilized slope.

- Alternative 2, *Maximized Habitat Restoration B*, is an equally balanced approach to ecosystem restoration; and combines Measures A, B, D, and E. It provides the submerged bench and emergent wetland in the notch. Unlike Alternative 2, however, it would create a stabilizing retaining wall with riparian plantings at area 4, and multi-storied riparian plants everywhere else.

- Alternative 3, *Maximized Aquatic with Medium Riparian*, provides maximized aquatic habitat. Measures A, B, and D would combine to provide the submerged bench, emergent wetland in the notch, and multi-storied riparian plantings on stabilized slopes except at area 4.

- Alternative 4, *Maximized Aquatic with Limited Riparian*, also provides maximized aquatic habitat. It is similar to Alternative 1, except that it only includes Measures A and B.

- Alternative 5, *Maximized Riparian with Limited Aquatic A*, favors maximized riparian habitat, while providing a low level of aquatic habitat benefits. Measures B and C would be combined to provide emergent wetland in the notch, and multi-storied riparian shrub and tree plantings on a stabilized slope.

- Alternative 6, *Maximized Riparian with Limited Aquatic B*, also favors maximized riparian habitat, while providing a lower level of aquatic habitat benefit. It combines Measures B, D, and E to create emergent wetland in the notch, multi-storied riparian plantings on slopes at all areas except area 4, and provides a stabilized retaining wall and riparian shrub plantings at area 4.

- Alternative 7, *Limited Riparian with Limited Aquatic Habitat*, is a very conservative approach that combines Measures B and D. It would create an emergent wetland in the notch and provide multi-storied riparian plants on slopes at all areas except area 4.

- Alternative 8, *Medium Level of Riparian/Aquatic Habitat A*, is a mid-balanced alternative combining Measures A and D. This alternative would provide the submerged bench with aquatic habitat, as well as multi-storied riparian plantings on slopes everywhere except area 4.

- Alternative 9, *Medium Level of Riparian/Aquatic Habitat B*, is also a mid-balanced alternative that combines Measures A and C. It would provide the submerged bench with aquatic habitat, and multi-storied riparian plantings on stabilized slopes at all areas.

- Alternative 10, *Medium Level of Riparian/Aquatic Habitat C*, is another mid-balanced alternative combining Measures A, D, and E. It would also provide the submerged bench with aquatic habitat, multi-storied riparian plantings at all areas except area 4, and a stabilizing retaining wall and riparian shrub plants at area 4.

- Alternative 11, *Limited Aquatic with Minimal Riparian Habitat*, is a single measure plan that only includes Measure B. It would create an emergent wetland in the notch, with in-water plantings as part of the wetland features.

3.5.1 Alternative Benefits Approach

Benefits for each alternative were developed using the Habitat Suitability Indices (HSI) developed by USFWS, which represent riparian and aquatic habitat. The HSI resulted in a score of habitat suitability used to compare alternatives to the existing and future without project conditions, and estimates net benefits in habitat units (HUs). The net gain of habitat benefits is the difference between the future without project condition and habitat benefits potentially achieved by the alternatives. Net benefits were input to the Corps' Institute of Water Resources (IWR) Planning Suite (IWR-PLAN) decision support software, which quantified environmental outputs as average annual habitat units (AAHU) for a cost effectiveness and incremental benefit analysis.

A review of models approved by the Corps' Ecosystem Restoration Planning Community of Practice's (ECO-PCX), as well as models previously used in successful ecosystem restoration projects, identified two indicator species representing habitat requirements and associated benefits applicable to species in the study area. The riparian HSI focused on vegetation metrics relative to the preferred habitat of the yellow warbler. The yellow warbler was chosen as a representative migratory bird species for the riparian model, because the habitat this species represents is the type of highly functioning riparian habitat found in the middle reach of the Columbia River. The aquatic HSI focused on riverine physical conditions relative to preferred rearing habitat for ESA-listed juvenile salmonids.

The riparian HSI scores were derived by the arithmetic equation presented in Table 6 (Schroeder, 1982), plus the addition of a fourth variable: overall riparian canopy cover. This model is Corps-approved, with the exception of the fourth variable. The fourth variable was added to ensure conservative habitat estimates for with-project benefits, but also to increase applicability for a broader range of bird species. This equation treats habitat variables as limiting factors, meaning other variables cannot equally compensate for poor or missing habitat variables.

Aquatic HSI scores were derived by taking the mean of habitat values for each variable. Aquatic habitat variables are considered to be compensatory, meaning other variables can equally compensate for poor or missing habitat variables. The juvenile Chinook salmon model was approved by the Corps for implementation on the Willamette River (Tetra Tech, 2014), and is representative of the salmon models presented by Raleigh et al. (1986). The substrate model variable was modified to better represent the preferred habitat defined by Tiffan and Hattan (2012), as well as represent the more readily available substrates around Clover Island. Models representing habitat connectivity and predation were not readily available.

Inclusion and adjustment of model variables for site-specific conditions is recommended by Schroeder (1982) and Raleigh et al. (1986). Model selection, justification, and derivation of HSI scores and habitat units are presented in Appendix A, *Habitat Evaluation Models*).

Table 6. Riparian and Aquatic HSI Model Habitat Factors

Riparian (Yellow Warbler)	Aquatic (Juvenile Chinook Salmon)
1. Percent deciduous shrub cover 2. Percent overall canopy cover 3. Shrub canopy height 4. Percent hydrophytic shrubs	1. Percent bank cover 2. Depth 3. Substrate Type
HSI = (X1*X2*X3*X4) ^ 0.5 = riparian score	HSI = (X1+X2+X3)/3 = aquatic score

Habitat variables were rated on a scale of 0-1, with 1 being prime habitat. The maximum possible HSI score was 1. The HSI scores were used to derive HUs as a standard measure of the existing condition and potential benefits of restoration. The HUs were calculated by multiplying total affected area by the HSI score for aquatic and riparian metrics. Aquatic and riparian HUs were summed to provide an estimate of total HUs for the existing and restored conditions for each alternative. Environmental outputs, quantified as AAHU, were delineated for the project area to document quantity and quality for existing conditions, future without project conditions, and with implementation of restoration measures.

Limitations of the Native Salmonids Mainstem Model are that it does not incorporate the effects of predation or lack of habitat connectivity, which are important characteristics of salmonid habitat in Lake Wallula.

- Predation on juvenile salmonids by birds and other fish is a problem in the Columbia River. For example, large rookeries have imposed a measurable impact on juvenile salmonid survival near the mouth of the Snake and Walla Walla Rivers. Non-native fishes that prey on juvenile salmonids are found in the vicinity of Clover Island. Habitat models does not capture the habitat characteristics that result in reductions of these predators.

- Connectivity of suitable shallow water rearing habitat in Lake Wallula is fragmented, making juvenile ESA-listed salmonids more vulnerable to predation as they migrate to the ocean. The habitat model addresses local habitat characteristics, but does not incorporate the benefit of increased connectivity of the environment.

Restoring riparian and aquatic habitat at Clover Island would reduce avian and piscivore predation and aid in closing the gap in suitable rearing habitat between the Yakima River delta and the McNary National Wildlife Refuge. However, for the purpose of this model, these habitat characteristics were considered qualitative and were not included in the modeling results.

3.5.2 Planning-Level Cost Estimate and Alternative Benefits

Selecting the best alternative required an assessment of the total costs of implementation and O&M for each alternative. Detailed preliminary cost estimates were developed for each alternative, and were based on preliminary design plans, including total construction cost plus a contingency added to construction and design costs. These costs were then annualized over the course of the 50-year period of analysis and reported as average annual costs. The average annual costs for each alternative were used in the incremental cost analysis and compared against the AAHUs to determine the alternative that provided the greatest benefit for the least cost.

The preliminary cost estimates (also referred to as planning-level estimates or first construction costs) for each alternative were calculated based on 2017 prices. They include contingencies, engineering and design, construction, and construction administration. A cost estimate for real estate needs was not included in the planning level cost estimate, because values for the lands and administrative costs were relatively similar for all alternatives. Lands needed for the project are already owned by the Port, and no additional real estate costs are expected during project implementation.

The cost estimate for each alternative was provided as an average annual cost, and includes amortized initial construction costs over a 50-year project life plus annual maintenance costs from the base year (2017). Costs for each measure were annualized using IWR-PLAN. The discount rate of 2.875% was determined by Economic Guidance Memorandum 17-01, *Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2017*.

Planning-level costs for the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) vary from project to project, depending on the recommended alternative. If no annual OMRR&R is recommended, the annual cost is zero. For alternatives requiring vegetation establishment or control, management of native vegetation will also be required. This may include actions such as irrigating, mowing, removing, or controlling invasive species, and reseeding native plant species. The OMRR&R costs are projected to occur after completion of the construction phase; and would continue for the 50-year period of analysis. Costs for any management actions were estimated for each alternative (based on the area affected and frequency of treatment). The annual OMRR&R cost is included in the total annual cost estimate. Table 7 summarizes net total habitat benefits, average annual habitat units, and annual costs for each alternative.

Table 7. Summary of Benefits (AAHUs) and Costs for Each Alternative

Alt	Measures Included	Construction Cost	Construction Contingency Cost	Total Construction Cost	Interest During Construction	Total Investments	Annualized Investment Costs	Annual Average O&M Cost	Total Annual Costs	Annual Average Habitat Units
0	No-Action	$0	$0	$0	$0	$0	$0	$0	$0	0
1	A, B, C	$2,629,876	$1,314,938	$3,944,814	$14,026	$3,958,840	$150,230	$27,605	$177,835	1.21
2	A , B, D, E	$2,724,304	$1,362,152	$4,086,456	$14,530	$4,100,986	$155,625	$27,605	$183,229	1.02
3	A, B, D	$2,496,968	$1,248,484	$3,745,452	$13,317	$3,758,769	$142,638	$26,402	$169,040	1.03
4	A, B	$1,594,737	$797,369	$2,392,106	$8,505	$2,400,611	$91,099	$22,169	$113,267	0.27
5	B, C	$1,614,749	$807,375	$2,422,124	$8,612	$2,430,736	$92,242	$12,156	$104,398	1.04
6	B, D, E	$1,307,524	$653,762	$1,961,286	$6,974	$1,968,260	$74,692	$12,156	$86,848	0.73
7	B, D	$1,080,188	$540,094	$1,620,282	$5,761	$1,626,043	$61,705	$10,953	$72,658	0.75
8	A, D	$2,472,215	$1,236,108	$3,708,323	$13,185	$3,721,508	$141,244	$26,200	$167,444	0.92
9	A, C	$2,605,123	$1,302,562	$3,907,685	$13,894	$3,921,579	$148,816	$27,403	$176,219	1.09
10	A, D, E	$2,699,551	$1,349,776	$4,049,327	$14,398	$4,063,724	$154,211	$27,403	$181,613	0.92
11	B	$177,957	$88,979	$266,936	$949	$267,885	$10,166	$263	$10,429	0.10

Green indicates Cost Effective Alternatives
Blue indicates the Cost Effective and Best Buy Alternatives

3.5.3 Cost Effectiveness and Incremental Cost Analyses

Cost Effectiveness and Incremental Cost Analyses (CE/ICA) are required for ecosystem restoration projects per ER 1105-2-100, *Planning Guidance Notebook*, and IWR Report 95-R-1, *Evaluation of Environmental Investments Procedures Manual, Interim: Cost Effectiveness and Incremental Cost Analyses.* The CE/ICA must show that ecosystem outputs for an alternative cannot be produced more cost effectively by another alternative. The CE/ICA was conducted using IWR-Plan decision support software. Cost effectiveness means that, for a given level of non-monetary output, no other plan costs less and no other plan yields more output at a lower cost. Six alternatives were identified as cost-effective solutions. The remainder were shown to be non-cost effective and were removed from further consideration. Figure 13 provides a summary of the average annual costs, average annual outputs, and cost effectiveness analysis. Alternative 1, *No Action*, was included for comparison ($0 in costs and 0 outputs).

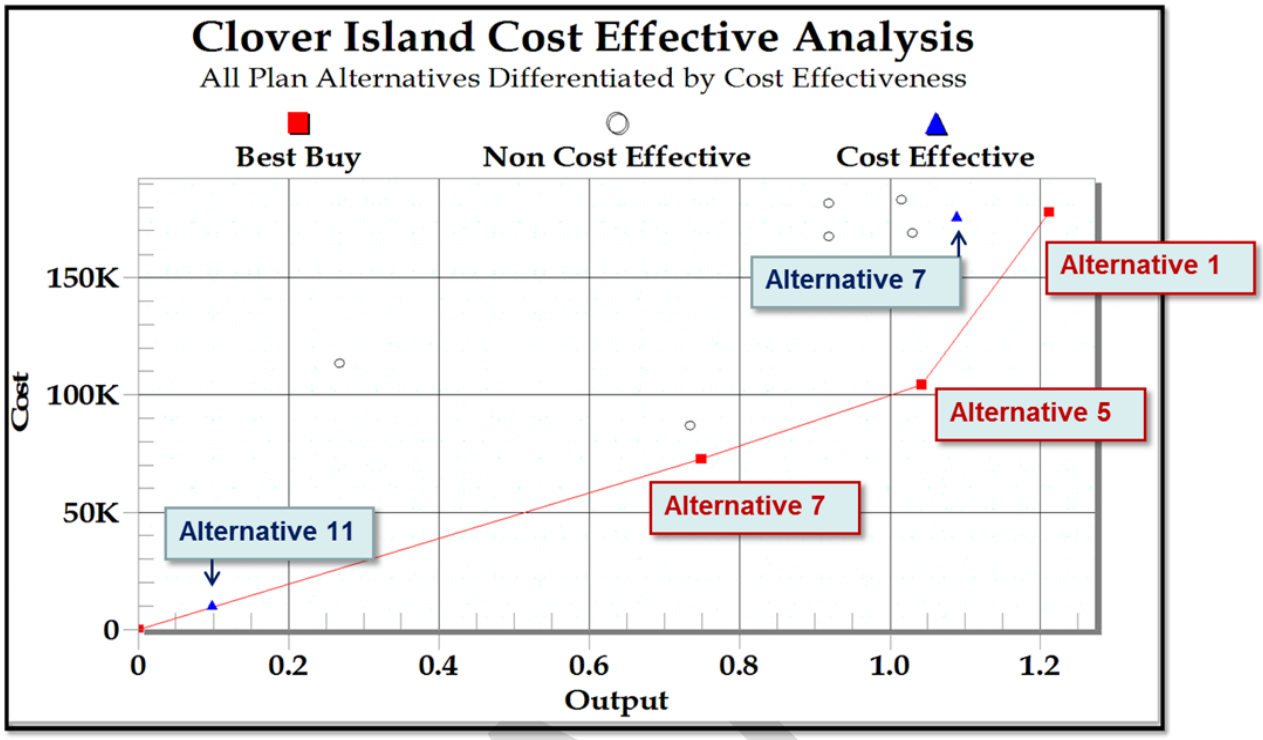

Figure 13. Alternative CE/ICA Distribution

Through ICA, the cost-effective alternatives were examined sequentially (by increasing scale and increment of output) to ascertain those providing the greatest increase in environmental benefits for the smallest cost increases.

Of the cost-effective alternatives identified in Figure 13, four were determined by IWR-Plan to be "best buys" (most cost effective per unit of ecosystem restoration). The best buy plans are shown in Table 8 and Figure 14, and are described in the following section.

Table 8. Best Buy Alternatives

Alt	Measures Included	Total Investment	Annualized Investment Costs	Annual Average O&M Cost	Total Annual Costs	Total Acres	Aquatic Benefits (AAHU)	Riparian Benefits (AAHU)	Net Benefits (AAHUs)
No Action		$0	$0	$0	$0	0	0	0	0
1	A, B, C	$3,958,840	$150,230	$27,605	$177,835	2.95	0.47	0.72	1.21
5	B, C	$2,430,736	$92,242	$12,156	$104,398	1.67	0.30	0.72	1.04
7	B, D	$1,626,043	$61,705	$10,953	$72,658	1.67	0.18	0.55	0.75

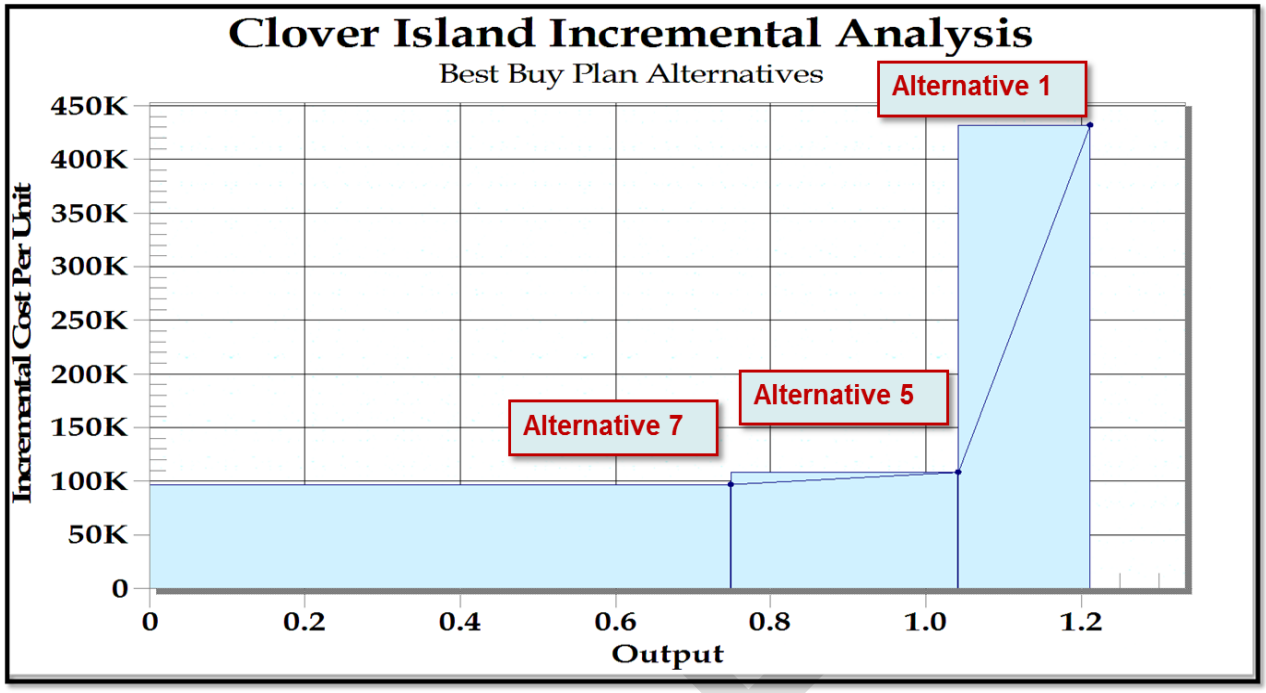

Figure 14. Best Buy ICA Breakdown

It should be noted that the No Action Alternative is always considered to be cost effective and a best buy plan, and it must be considered under NEPA. This alternative would result in no habitat restoration and continued degradation at Clover Island. Although this alternative does not meet the project purpose and need, under guidelines from the Council on Environmental Quality (CEQ), it serves as the project baseline for environmental conditions and, therefore, is carried forward for further analysis.

3.6 Evaluating and Comparing Alternative Plan Benefits and Cost Effectiveness

The next step in the planning process is to evaluate and compare the four best buy alternative plans: The No Action Alternative; Alternative 1, *Maximized Habitat Restoration A*; Alternative 5, *Maximized Riparian with Limited Aquatic A*; and Alternative 7, *Limited Riparian with Limited Aquatic Habitat.*

3.6.1 Evaluation and Comparison

The No Action Alternative would not provide any improvement over the current condition of the aquatic or riparian habitat. Existing riparian habitat features include steep, crumbling, cobble banks with sparse vegetation along the length of the shoreline. Layers of concrete cover the shoreline and extend into the water. The concrete continues along the north shore to the notch. Few trees and shrubs are present here; and substrate in areas without concrete slabs provides marginal aquatic habitat with a mix of gravel, cobble, and boulder substrate.

Alternative 7, *Limited Riparian with Limited Aquatic Habitat*, would provide emergent wetland in the notch and multi-storied riparian shrub and tree planting on a stabilized slope. Area 4 would be excluded in this alternative.

- **Riparian Habitat:** This alternative would create approximately 1.67 acres of fully restored riparian habitat used for nesting, resting, and foraging habitat by neotropical songbirds in all areas except area 4. This alternative would leave a gap in riparian habitat between areas 3 and 5. Riparian habitat would be created in area 5, but would be disconnected from the habitat created in areas 1 through 3. Over 50 years, this alternative would result in a net improvement to riparian habitat of 27.43 cumulative habitat units (0.55 AAHU), when compared with the No Action Alternative.

  A secondary benefit of riparian restoration would be an improvement to aquatic habitat. This would be achieved by creating bank cover to provide food sources for rearing ESA-listed juvenile salmonids, although no submerged bench would be created. The aquatic habitat in the notch would be greatly improved by creation of the wetland. Around the remainder of the island, the riparian contribution to the aquatic habitat would increase aquatic habitat suitability relative to the No Action Alternative, and would result in a net improvement to aquatic habitat of 43.24 cumulative habitat units (0.18 AAHU) over 50 years.

- **Aquatic Habitat:** Under this alternative, the shallow water bench for ESA-listed juvenile salmonids would not be created, submerged predator habitat (holes and overhangs would not be eliminated), and the aquatic habitat would remain in its current condition except for the area in the notch.

- **Costs and Benefits:** The combined average annualized units of aquatic and riparian habitat improvement over 50 years is a net 0.75 AAHU at an annualized cost of $72,658, with incremental costs of $97,071 per unit of habitat benefit.

- **Regional Benefits:** At a regional level, this alternative would reduce the patchiness of riparian habitat where this type of habitat is rare and connectivity is limited. However, it would not reduce the patchiness of the shallow aquatic juvenile salmon habitat or improve regional connectivity of critical habitat for ESA-listed juvenile salmonids in the middle reach of the Columbia River.

- **Risks:** The risk of Alternative 7 is the potential of increased predation on juvenile salmonids. The increase in bank cover, and organic and macroinvertebrate forage material created by restored riparian habitat, is expected to attract juvenile salmonids. Because aquatic predator habitat would not be eliminated under this alternative, juvenile salmonids could be exposed to a higher rate of predation than that occurring with the No Action Alternative.

Alternative 5, *Maximized Riparian with Limited Aquatic A*, would provide emergent wetland in the notch and multi-storied riparian shrub and tree plantings on a stabilized slope. This alternative is similar to Alternative 7, but adds riparian habitat in area 4.

- **Riparian Habitat:** This alternative would result in fully-restored riparian habitat of 1.67 acres to provide nesting, resting, and forage habitat for neotropical songbirds where little or no habitat presently exists. There would be no discontinuation in riparian habitat between areas 3 and 5. The riparian habitat created in Alternative 5 would provide a cumulative of 36.17 habitat units (0.72 AAHU) over 50 years when compared to the No Action Alternative, and an improvement of an additional 8.74 riparian habitat units (increase of 0.17 AAHU) more than those provided by Alternative 7.

  Similar to Alternative 7, riparian restoration would provide benefits to aquatic habitat by creating bank cover and providing food sources for rearing ESA-listed juvenile salmonids, although no submerged bench would be created. The aquatic habitat in the notch would be greatly improved by creation of the wetland. Around the rest of the island, the riparian component of aquatic habitat would substantially increase aquatic habitat suitability relative to the No Action Alternative. This would result in an improvement to the aquatic habitat of 49.20 cumulative habitat units (0.30 AAHU) over 50 years relative to the No Action Alternative, and result in the improvement of an additional 5.36 aquatic habitat units (0.12 AAHU) more than those created by Alternative 7.

- **Aquatic Habitat:** Shallow aquatic habitat for ESA-listed salmonids would not be created in Alternative 5. Existing aquatic habitat would be suboptimal around most of the island and, except for the notch, remain in its current condition.

- **Cost and Benefits:** The combined average annualized units of aquatic and riparian habitat improvement for Alternative 5 over 50 years is a net 1.04 AAHU at an annualized cost of $104,398. Alternative 5, when compared to Alternative 7, provides an additional 0.29 combined habitat benefit at an addition cost of $31,740 (estimated to be $108,143 per habitat benefit). Alternative 5 provides an increase in combined habitat benefit from including area 4 at only a moderate increase in incremental costs ($11,072).

- **Regional Benefits:** Alternative 5 would provide additional improvement to patchiness of the riparian habitat when compared to Alternative 7. Alternative 5 does not reduce the patchiness of shallow aquatic juvenile salmon habitat or improve regional connectivity of critical habitat for ESA-listed juvenile salmonids in the middle reach of the Columbia River.

- **Risks:** The risk of potential predation is similar to that depicted in Alternative 7. This alternative would not eliminate submerged predator habitat (holes and overhangs). The expected increase in the presence of juvenile salmonids along the north shore of the island could increase exposure to ambush predators.

Alternative 1, *Maximized Habitat Restoration A*, would provide a submerged bench with aquatic habitat, emergent wetland in the notch, and multi-storied riparian shrub and tree plantings on a stabilized slope. This alternative would provide optimal riparian and aquatic habitat with the maximum benefits possible at this location when compared to all other alternatives, particularly the No Action Alternative.

- **Riparian Habitat:** Under this alternative, fully restored riparian habitat of 1.67 acres in areas 1 through 5 would provide nesting, resting, and forage habitat for neotropical songbirds where little or no habitat presently exists. This would result in an improvement of the same net benefits of riparian habitat created on Clover Island, as compared to Alternative 5; and provide a cumulative of 36.17 habitat units (0.72 AAHU) over 50 years when compared to the No Action Alternative.

- **Aquatic Habitat:** In this alternative, shallow aquatic habitat for ESA-listed salmonids would be created along the shore of areas 1 through 5. Of importance to ESA-listed salmonids, the aquatic bench would fully restore substrates within the depth range preferred by rearing ESA-listed juvenile salmonids, reduce warmwater predator habitat, and establish bank cover (resulting from riparian restoration) to provide refuge and food sources. Alternative 1 would result in 1.28 acres of aquatic habitat, with an improvement of 57.72 cumulative habitat units (0.47 AAHU) over 50 years, relative to the No Action Alternative; and an increase of 6.52 aquatic habitat units (0.17 AAHU) more than created by Alternative 5.

- **Cost and Benefit:** The combined average annualized units of aquatic and riparian habitat improvement for Alternative 1 over 50 years is a net 1.21 AAHU at an annualized cost of $177,835. Alternative 1, when compared to Alternative 5, provides an additional 0.17 combined habitat benefit, at an addition cost of $73,437 (estimated to be $431,982 per habitat benefit). Alternative 1 provides an increase in combined habitat benefit, from the creation of the shallow aquatic bench for the juvenile salmonid habitat, at an increase in incremental costs of $323,829.

- **Regional Benefit:** At a regional level, Alternative 1 offers the most benefits, with a reduction in the patchiness of both the riparian and shallow aquatic habitat for juvenile salmonids and increased connectivity of riparian and critical habitat for ESA-listed juvenile salmonids in the middle reach of the Columbia River.

- **Risks:** Risk associated with Alternative 1 is lower than the No Action Alternative and Alternatives 5 and 7. When the submerged bench is created, the aquatic predator habitat (holes and overhang areas) would be eliminated, thereby reducing predation risk to juvenile salmonids.

3.6.2 Recreation Features

For each Best Buy alternative, the proposed recreation features are the same, except the No Action Alternative does not include recreation. The primary intent of the recreation features would be to connect the existing regional Sacagawea Heritage Trail system to the restored riparian habitat in project area 1, 2 and 3 on the north shore of Clover Island and to provide pathways, seating areas, education and interpretive signs/kiosks, and safety features for access to the riparian habitat. The recreation features would be constructed outside of the riparian corridor, and are not expected to impact the performance of the ecosystem restoration project. Section 5.3.2 and Appendix C, *Recreation Benefits Analysis,* provides additional information. A summary of the proposed recreation features is as follows:

- **Pathways.** An approximately 1,500-linear-foot, concrete meandering pathway/trail about 5 to 9 feet wide, compliant with the Americans with Disabilities Act (ADA) of 1990, would be constructed along the top of the shoreline. The pathway would follow the shoreline contour in Areas 1, 2 and 3; with connection to existing sidewalks between areas 3 and 4. The pathway in area 3 would extend south an additional 150 feet to connect with an existing sidewalk along Clover Island Drive.

- **Signs and Interpretive Media.** Signs and interpretive media would be placed along the new trail to educate visitors about native plants and birds likely to be seen on the island.

- **Seating Areas and Associated Features.** Seating areas, benches, and trash receptacles would be placed along the trail. Existing benches, parking, and overlooks would be incorporated into the plan.

- **Safety.** Pedestrian safety lighting, bollard lighting, and electrical conduit would be installed along the trails, viewpoints, and benches for public safety and to minimize vandalism. Lights would be selected and positioned to reduce habitat impacts. Handrails would be incorporated, as appropriate, at trails/viewpoints/overlooks for safety purposes.

3.6.3 Conclusions

Alternative 7 creates 1.67 acres of riparian habitat with the combined improved habitat benefit of 0.75 AAHU. This is worth the annualized cost of $72,658 because it produces fully-functioning riparian habitat in 77% of the available area on Clover Island. Although Alternative 7 does not construct the shallow water submerged bank for ESA-listed salmonids, it provides an 18% improvement to the aquatic environment as a result of the constructed riparian habitat. Recreation benefits are the connection of the downstream end of the Sacagawea Heritage Trail system to the constructed riparian habitat, access to local services on Clover Island, and education and recreation access to the local community and visitors.

Alternative 5 similarly creates 1.67 acres of riparian habitat with an increase of 0.29 AAHU. This is worth the annualized incremental cost of $31,740, because it increases fully-functioning riparian habitat to 100% of available area on Clover Island. Like the previous alternative, a shallow water submerged bank is not created, but this alternative results in a 40% increase in aquatic habitat benefit above that provided by the previous alternative, as a result of riparian habitat construction. Recreation benefits are similar to the previous alternative.

Alternative 1, in addition to the riparian habitat created in the previous alternative, also creates 1.28 acres of shallow aquatic habitat, with a combined improved habitat benefit of 0.17 AAHU. This is worth the annualized costs of $73,437, because it produces a shallow water bench designed to meet the needs of ESA-listed juvenile salmonids on 100% of available area at Clover Island. This alternative provides a 36% increase in aquatic habitat benefits above those provided by the previous alternative. It also allows ESA-listed juvenile salmonids to effectively use the bank cover and organic and forage materials produced by the riparian habitat with reduced risk from aquatic predators. Recreation benefits are similar to the previous alternative.

In summary, implementation of Alternatives 1, 5, or 7 would restore ecological habitat function for juvenile ESA-listed salmonids, with additional benefits to migratory songbirds. Any of these alternatives would greatly improve shallow water habitat through improved ecosystem function for use by all species and life stages of rearing and migrating salmonids, as well as non-salmonid and resident fishes.

However, under Alternative 1, the construction of a submerged aquatic bench would unquestionably restore aquatic habitat, making it fully functional, eliminating existing predator habitat, and implementing a complete habitat restoration in a reach of the Columbia River where little aquatic and riparian habitat suitable for ESA-listed juvenile salmonids exists and where there are limited locations for restoration.

CHAPTER 4 – *ENVIRONMENTAL CONSEQUENCES

This section identifies direct, indirect, and cumulative environmental effects to current conditions stemming from implementation of any of the reasonable alternatives identified in Chapter 3. These alternatives are fairly similar in the types of actions included and the general location, therefore effects of the actions are generally similar in nature and typically vary only by degree of effect. As an ecosystem restoration project, long term environmental effects would be positive.

4.1 Alternatives Considered

Alternatives 1, 5 and 7 (habitat restoration) with recreation features are carried forward for detailed analysis as the final array of reasonable alternatives. The No Action Alternative is also carried forward for comparison purposes. Section 3 contains a description of all alternatives.

- No Action
- Alternative 1, *Maximized Habitat Restoration A*
- Alternative 5, *Maximized Riparian with Limited Aquatic A*
- Alternative 7, *Limited Riparian with Limited Aquatic Habitat*

4.2 Physical Resource Impacts

4.2.1 Climate Change

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to climate change, either on the short- or long-term, and therefore no significant effect to climate change as a result of this alternative. Changes to climate in this regional are expected to be more precipitation, as rain instead of snow, more spring run-off and less summer flows with overall higher temperatures. The Climate change effects on the project location could be exacerbated by flashier runoff in the Columbia and Yakima River basins over time, but specific effects are not anticipated to be significant beyond the current relatively minor erosional issues.

Alternative 1: The limited scale and level of work associated with this alternative would not affect local or regional climate either in the short- or long-term. The CEQ, in NEPA guidance for documenting effects of climate change and greenhouse gas (GHG) emissions, uses 25,000 metric tons of carbon dioxide (CO_2) equivalent GHG emissions on an annual basis as threshold guidance. If that amount of CO_2-equivalent GHG emission is reached, agencies should consider it a threshold for providing a quantitative and qualitative assessment to decision makers and the public. Under the alternative, the type and number of vehicles and equipment needed, along with the limited construction time to complete the project, would not generate an annual total of 25,000 metric tons of CO_2-equivalent GHG emissions. Overall, the potential effects of

the constructing or maintaining the alternative would not be great enough to affect weather patterns or result in significant (or measurable) adverse effects to the regional climate. The minimal short-term effects of the construction are far outweighed by the long term benefits of native plant system restoration. This alternative was developed in consideration of the McNary pool fluctuations during low and high flows events, and is expected that the habitat would be resilient to the types of forecasted climate changes. Climate change is not anticipated to have a significant effect on the alternative, but could increase the maintenance needed to address erosion.

Alternative 5: The short-term effects to climate change would be very similar to but less than Alternative 1, and still discountable. The effects of climate change on the project would be the same.

Alternative 7: The short-term effects to climate change would be very similar to but slightly less than Alternative 5. The effects of climate change on the project would be the same.

4.2.2 Land Use.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to land use, either on the short-, long-term, or cumulatively and therefore no significant effect to land use as a result of this alternative.

Alternative 1: Implementing this alternative could have some impact on overall land use at Clover Island. Riparian/wetland plantings would be done along the shoreline and the sloped embankments leading to the shoreline. Presently, this area receives limited use because it has little aesthetic or recreational value. However, when riparian/wetland vegetation is planted and established along with the proposed recreation features, it would provide a "greener" environment along a large portion of what is now barren and uninviting. This could draw more people to Clover Island to enjoy the enhanced "ambience" of the island (e.g., use of existing paths and trails). With greater vegetation growth, more birds and wildlife could also be attracted to the area. If larger numbers of visitors are attracted to the location because of its aesthetic value, it is possible further commercial development could ensue. However, future commercial development on Clover Island would be managed in accordance with the Clover Island Master Plan (and subsequent comprehensive updates). Construction activities would have short-term localized negative impacts, but long-term positive benefits to local and regional land use objectives. The cumulative effect to land use over the long-term is beneficial and therefore not a significant impact to the human environment.

Alternative 5: The short-term effect to land use would be to the same as Alternative 1. Likewise the long-term benefits to land use would be the same.

Alternative 7: The short-term effect to land use would be very similar to, but slightly less than Alternative 5. Likewise the long-term benefits to land use would be less.

4.2.3 Geology.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to geological resources, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: There is no longer any "naturally occurring" geology on Clover Island. The island is an artificial landform built in 1953 by using dredged material from the original island. Imported materials shaped and compacted into its present configuration in the 1960s. Because of its material composition and the manner in which it was formed, constraints exist on how riparian habitat development can occur on Clover Island. A critical factor for habitat development is ensuring stability in areas where planting would be done. This alternative addresses this issue by design and therefore results in short-term impacts during construction but long-term and cumulative benefits to the human environment. Therefore, there is no significant impact to the geologic resources.

Alternative 5: The short-term effect to geology would be very similar to, but slightly less than Alternative 1. Likewise the long-term benefits to land use would be slightly less.

Alternative 7: The short-term effect to geology would be very similar to, but slightly less than Alternative 5. Likewise the long-term benefits to land use would be slightly less.

4.2.4 Hydrology/Hydraulics, and Fluvial Geomorphology.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to hydrologic or hydrogeomorphic resources, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: The changes in the cross-sectional flow area associated with the alternative's bank line regrade are not anticipated to notably affect the river conveyance area or river flood stages. The Columbia River is approximately 2,000 feet wide at Clover Island. For both the short- and long-term effects considerations the amount of fill material added to reshape the banks is not expected to be large, and flow behavior would not increase flood risk. Thus independently and cumulatively there is not a significant effect to the resource area.

Alternative 5: The short-term effect to hydrology and related resources would be very similar to, but slightly less than Alternative 1.

Alternative 7: The short-term effect to hydrology and related resources would be very similar to, but slightly less than Alternative 5.

4.2.5 Water Quality.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to water quality, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: A major feature of the alternative's riparian habitat planting would be the excavation of a toe trench along the shoreline. The toe trench would be located below the OHWM, and is a key feature in stabilizing the riparian planting. A backhoe would likely be used to reach the needed dimensions of the trench (10 feet wide by 2 feet deep). A total of approximately 2,511 linear feet of toe trench would be dug. Given the nature, minor impact and location of the work, the project would fall under Nationwide Permit 27 – *Aquatic Habitat Restoration, Establishment, and Enhancement Activitie*s as reissued and effective on March 19, 2017. The project also meets the conditions of the Washington Department of Ecology Section 401 Water Quality Certification for NWP 27, also effective on March 19, 2017. The analysis employed for establishing Nationwide permits has already identified that actions falling within their parameters, with appropriate stipulations, do not cause significant effects to the human environment, either short-term, long-term, nor cumulatively. Further, this alternative inherently provides important benefits to several wetland/riparian functions and values.

Alternative 5: The short-term effect to water quality would be very similar to, but slightly less than Alternative 1. Likewise the long-term benefits would be less.

Alternative 7: The short-term effect to water quality would be very similar to, but slightly less than Alternative 5. Likewise the long-term benefits would be less.

4.2.6 Air Quality.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to air quality, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: The alternative's vegetation planting and earth moving would require the use of heavy equipment (e.g., barge, trucks, backhoe, excavator, etc.) that would produce emissions. Similar to the effects described above under climate change, because this is a minor action of limited duration, the volume of emissions would not reach a level that exceeds Washington State air quality standards or result in the area being out of attainment in the short-term. In the long-term and cumulatively with other air quality management programs, the project should be beneficial due to the establishment of native wetland/riparian vegetation.

Alternative 5: The short-term effect to air quality would be very similar to, but slightly less than Alternative 1. Likewise the long-term benefits would be less.

Alternative 7: The short-term effect to air quality would be very similar to, but slightly less than Alternative 5. Likewise the long-term benefits would be less.

4.2.7 Noise.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to noise levels, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: Over the short-term, the noise level on Clover Island would increase during bank stabilization work and riparian planting under this alternative. However, noise would not exceed levels or time periods established in the City of Kennewick's municipal code (Kennewick Municipal Code, Title 09, Chapter 9.52). In the long-term and cumulatively, established native vegetation could assist with attenuation of local noise and become beneficial.

Alternative 5: The short-term effect to noise levels would be very similar to, but slightly less than Alternative 1. Likewise the long-term benefits would be slightly less.

Alternative 7: The short-term effect to noise levels would be very similar to, but slightly less than Alternative 5. Likewise the long-term benefits would be slightly less.

4.2.8 Visual/Aesthetics.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to local visual resources, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: During the construction phase (over the short-term) aesthetic resources would be negatively impacted under this alternative. However in the long-term and cumulatively native vegetation grown for riparian habitat restoration would greatly benefit the visual and aesthetic resources of Clover Island. Currently, much of the shoreline is bare of vegetation and desolate in appearance. As this vegetation develops and matures, it would create an environment that would be much more appealing visually and aesthetically. There would therefore be no significant effect to visual/aesthetic resources.

Alternative 5: The short-term effect to aesthetic resources would be very similar to, but slightly less than Alternative 1. Likewise the long-term benefits would be slightly less.

Alternative 7: The short-term effect to aesthetic resources would be very similar to, but slightly less than Alternative 5. Likewise the long-term benefits would be slightly less.

4.3 Ecological Resource Impacts

4.3.1 Riparian Vegetation.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to local riparian vegetation, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: The focus of this alternative is to develop and enhance riparian habitat along the Clover Island shoreline. Implementation would remove invasive species and replace them with healthy stands of native riparian vegetation along the north and east shorelines of the island. Short-term, long-term, and cumulative effects of the alternative are anticipated to be beneficial to regional riparian vegetation communities. Therefore, no significant adverse effects are expected as a result of implementing this alternative.

Alternative 5: The short-term and long-term benefits to riparian vegetation would be similar to, but less than Alternative 1.

Alternative 7: The short-term and long-term benefit to riparian vegetation would be similar to, but less than Alternative 5.

4.3.2 Riparian Wildlife.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to local riparian wildlife, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: At present, limited habitat exists for riparian wildlife species along the Clover Island shoreline. However, implementing this alternative would provide native vegetation and deciduous shrub and tree canopy cover, and make the approximately 1.7-acre riparian area suitable for wildlife occupation. Many migratory bird species that rely on riparian vegetation (within the Columbia River Basin) for feeding, nesting, and breeding would benefit from this project, as would other species (e.g., mink) that may exist on the island. Short-term impacts would be less than significant due to the limited value and extent of extant degraded habitats removed, while the long-term and cumulative effects would be notably beneficial.

Alternative 5: The short-term effects and long-term benefits to riparian wildlife would be similar to, but less than Alternative 1.

Alternative 7: The short-term effects and long-term benefit to riparian wildlife would be similar to, but less than Alternative 5.

4.3.3 Fish Communities.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to fish communities, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: While current substrates are not ideal for juvenile salmonids, gravel and cobble are abundant in many locations along Clover Island, particularly on the north shore within and downstream of the notch. By creating a larger suitable shallow water habitat area, the Recommended Plan will physically improve shoreline aquatic habitat with appropriate depth and substrate. Bank cover may be created by complex root structures. Construction could generate short-term impacts to both ESA and other native species, the alternative would generate notable benefits to native fish communities in the long-term, and thus result in less than a significant impact.

This alternative involves in-water excavation, in-water fill, and re-sloping the shoreline for riparian planting. These actions will create short-term, negative impacts to water quality and habitat, generally caused by increased turbidity. Noise from equipment operation may also deter fish from the immediate area. Sediment containment measures would be in place during construction and the project would result in restored shallow water habitat for juvenile ESA-listed salmonids.

It is reasonable to assume that all fishes, both native and non-native, would suffer the same short-term negative impacts from construction relative to turbidity and physical construction, and all species would benefit from additional food sources provided by the restored riparian habitat; however, non-native, predator fishes such as smallmouth bass would also experience long-term negative effects from a reduction in habitat advantageous to preying upon juvenile salmonids. This negative effect would likely not be significant relative to general habitat conditions in Lake Wallula.

Alternative 5: The short-term effects and long-term benefits to fish would be similar to, but less than Alternative 1.

Alternative 7: The short-term effects and long-term benefit to fish would be similar to, but less than Alternative 5.

4.3.4 Protected Species.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to threatened or endangered species, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: The Corps has determined that the preferred alternative "may affect, but is not likely to adversely affect" Upper Columbia River spring Chinook salmon and bull trout or their critical habitat. The preferred alternative is "likely to adversely affect" Middle and Upper Columbia River steelhead, but the Corps expects no destruction or adverse modification to critical habitat. The Corps has determined there would be no adverse effects from the collective impact of the proposed alternative to Essential Fish Habitat under the Magnuson-Stevens Fishery Conservation and Management Act.

The Corps has also determined there would be "no effect" on yellow-billed cuckoo, as this species has not been documented near the project area and may be extinct within the State of Washington. Furthermore, there would be no take under the Migratory Bird Treaty Act, and no disturbance or take under the Bald and Golden Eagle Protection Act.

Thus, while the alternative would likely have less than significant effects to protected species in the short-term, the long term effects would be notably beneficial and therefore less than significant in impact.

Alternative 5: The short-term and long-term benefits to protected species would be similar to, but less than Alternative 1.

Alternative 7: The short-term and long-term benefit to protected species would be similar to, but less than Alternative 5.

4.4 Social Resources

4.4.1 Cultural Resources – Archaeological and Historical Properties.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to cultural resources, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: The construction of the modern Clover Island in the 1950s destroyed the only two previously recorded archaeological sites to have existed on the original island. Between 5 and 25 feet of soil was removed from the surrounding areas of the original island, and was presumably redeposited in the new location, as suggested by an isolated find in fill. Preparation of the ground surface prior to the placement of fill for construction of the modern island also would have disturbed near-surface deposits. The only ground-disturbing activities proposed as part of the current project are the slope establishment and excavation of a toe for the reworked shoreline of the island, and the placement of stakes to hold coir logs in place. The toe excavations are within previously disturbed areas excavated for fill.

Human remains or other cultural materials, although not in the original context, may possibly persist within the fill used to construct the modern Clover Island. The Corps would ensure an

archaeological monitor be present during any excavation to assess and ensure proper disposition of any cultural remains found during the work.

Therefore the Corps determined that there would be No Adverse Effect to cultural or historic resource with the concurrence of the Washington State Historic Preservation Office (3 September 2015, Appendix G, Environmental Compliance). The alternative would therefore not likely have short-term, long-term, nor cumulatively significant effects to cultural resources.

Alternative 5: The likely effects to cultural resources would be the same as Alternative 1.

Alternative 7: The likely effects to cultural resources would be the same as Alternative 1.

4.4.2 Socioeconomics and Environmental Justice.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to socioeconomics or disadvantaged social groups, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: The proposed project would have a negligible impact on social equity. It is a minor action, with limited scope, and would not require a large crew or an extensive amount of time to complete (6 months or less). If work is done by a contractor outside the Tri-Cities area, the small number of additional individuals and their accompanying spending would have a very minimal effect on social properties identified for this project (e.g., population, income, and ethnicity). The area surrounding the effort is largely commercial or public recreation lands and all users would be equally affected.

Alternative 5: The effects to social equity would be the same as Alternative 1.

Alternative 7: The effects to social equity would be the same as Alternative 1.

4.4.3 Recreation.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts to recreational resources, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: The alternative has the potential to draw more visitors to the island. A vegetated shoreline, consisting of native riparian and wetland plants, would provide a more inviting and attractive landscape than the primarily barren shoreline that currently exists. The vegetation would provide a source of both food and shade for fish and wildlife and these features, coupled with existing and proposed trails and pathways, would offer visitors a pleasant hiking/walking experience. Because of the location and nature of the work, the project would not likely impact boating activities around the island.

Alternative 5: The effects to recreation would be the same or slightly less than Alternative 1, depending upon the recreational values assigned to the habitat by the users.

Alternative 7: The effects to recreation would be the same or slightly less than Alternative 5, depending upon the recreational values assigned to the habitat by the users.

4.5 Hazardous, Toxic, and Radioactive Waste.

No Action: Under the No Action Alternative there would be no Federal action, and therefore no added impacts from hazardous, toxic, or radioactive waste, either on the short-, long-term, or cumulatively, and therefore no significant effect to such resources as a result of this alternative.

Alternative 1: This alternative would not generate nor have any long-term adverse effects stemming from the disturbance of HTRW materials. An investigation of existing environmental data, maps, and site conditions determined no underground fuel or oil storage tanks are present on the island, and HTRW risks associated with the project site are negligible. Further, the Corps Seattle District completed the project *Environmental Condition of Property Report* of September of 2015 for the proposed action and noted asbestos-bearing concrete debris in test pit 3. "This is a recognized environmental condition that only impacts the Clover Island Ecological Restoration Project if additional concrete pipe is uncovered during construction."

Test Pit TP-3 is far removed from the proposed action (at a point proximate to the causeway, not the north shoreline) but identifies a potential risk that would be addressed with monitoring during limited site excavation. The report recommends "The ecological restoration contractor should be advised of this potential and operate in accordance with 29 CFR 1926.1101." The culmination of the review with monitoring considerations ensure HTRW risks associated with the project site are negligible, thus short-term, long-term and cumulative HTRW effects would be less than significant.

Alternative 5: The HTRW risks and potential effects would be the same as for Alternative 1.

Alternative 7: The HTRW risks and potential effects would be the same as for Alternative 1.

4.6 Cumulative Effects

4.6.1 Scope of Cumulative Effects Analysis

CEQ regulations implementing NEPA require Federal agencies to consider the cumulative impacts of their actions. Cumulative effects are defined as "the impact on the environment which results from the incremental impact of an 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. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time"
(40 CFR § 1508.7).

This section evaluates the cumulative effects of actions that could potentially affect the environmental resources discussed in the following section. A resource may be differentially impacted in both time and space. The implication of those impacts depends on the characteristics of the resource, the magnitude and scale of project impacts, and the environmental setting. The scope of this analysis extends beyond the Clover Island project to other areas that also may include the identified resources of concern.

Guidance for setting appropriate boundaries for a cumulative effect analysis is available from the CEQ and the Environmental Protection Agency (EPA). Generally, the scope of a cumulative effects analysis should be broader than the scope of analysis used in assessing direct or indirect effects. The analysis should delineate appropriate geographic areas, including natural ecological boundaries whenever possible, and should evaluate the time period of the project's effects. Discussed below are the past, present, and reasonably foreseeable future actions considered for the cumulative effects analysis, the effects of the actions on the resources assessed, and a summary of the cumulative effects of the Action Alternatives. The geographic boundary for the cumulative effects analysis for riparian vegetation, threatened and endangered fish, and visual/aesthetics includes actions taking place within the Tri-Cities Levee System. Figure 1 delineates the geographic boundaries used in this cumulative effects analysis.

A 67-year timeframe was used, based on when the "new" Clover Island was created (1953) to the present, plus an additional 5 years to include the "reasonably foreseeable future." For an action to be considered "reasonable foreseeable," there must be a strong indication it will occur.

4.6.2 Resources Considered

This report identifies alternatives and addresses the potential effects of those alternatives on a range of resources relevant to the proposed project. However, not all these resources need to, or should be, included in the cumulative effects analysis. Only those resources noted for their importance not only to the immediate action itself, but to larger areas as well, should be included here, based upon the specific resource evaluations above. These important resources are:

- Riparian Vegetation
- Threatened and Endangered Fish Species
- Visual/Aesthetics

The resources assessed have experienced various impacts since the mid-1900s. Construction and operations of the dams and associated levee systems, agricultural development, road

building, city development, and fish harvest have all contributed to the current state of area resources.

The following sections discuss the cumulative effect boundary (geographic and temporal); the past, present, and reasonably foreseeable future actions and their effects on these resources, and the potential effects of the action alternatives on these resources when added to past, present, and future actions. As Alternative 1, 5, and 7 are quite similar and all provide benefits to these resource areas in the long-term, this discussion is generic to all three alternatives, with the understanding that Alternative 1 generates more benefits than Alternative 5, which in turn generates more benefits than Alternative 7.

4.6.3 Past, Present, and Reasonably Foreseeable Future Actions

The following sections present summaries of past, present, and reasonably foreseeable future actions considered in this cumulative effects analysis, and the effects of those actions on the resources considered.

- **Past Actions**

  The construction of McNary Lock and Dam began in 1947. The reservoir behind McNary Dam began filling in December 1953, and electricity was first delivered to Bonneville Power Administration in 1954. The reservoir permanently inundated 13,800 acres of land.

  Coinciding with the building of McNary Dam, 16.8 miles of levees were constructed along the section of the Columbia River that passes through the Tri-Cities. The levees were built after the floods of 1948 inundated large portions of the Tri-Cities. Levee construction filled natural shallow water habitats and removed riparian vegetation. Only steep, riprapped embankments and deep water along the shoreline remained. The levee system also includes 15 pumping plants to pump water that accumulates behind the levees into the Columbia River.

  Pursuant to levee construction the shoreline was developed, and boat docks were constructed, creating habitat for piscivorous fish and birds that prey on ESA-listed juvenile salmonids.

- **Effects of Past Actions on Resources**

  - **Riparian Vegetation**

    Prior to inundation by the McNary pool, the Corps allowed the Port to relocate materials from the lower areas of the original Clover Island to create the above-water portion of the island that exists today. Any vegetation on the island not disturbed by the Port prior to the completion of McNary Dam was subsequently

inundated, as was any other shoreline riparian vegetation not disturbed by the construction of levees within the Tri-Cities. Clover Island remains largely un-vegetated, but riparian vegetation on the western shoreline of the causeway was restored around 2011 to a similar condition to what existed prior to inundation.

- **Threatened and Endangered Fish Species**

  The McNary pool inundated a large portion of shallow water habitat available to salmonids now listed as Threatened or Endangered under the ESA. The development of levees along the shorelines of the Tri-Cities cut the Columbia River off from historic floodplain habitat. These actions reduced the quality and quantity of available rearing and spawning habitat for anadromous salmonids and resident fishes such that, at present, required habitat features for ESA-listed salmonids are not fully functional.

  Introduction of smallmouth bass into the Yakima River in the 1920's for recreation fishing lead to their spread throughout the Columbia River. This non-native species is now a very successful predator on juvenile salmonids. Construction of private boat docks within the Tri-Cities area created conditions which smallmouth bass exploit as ambush points that further exposed juvenile salmonids to higher risk of predation.

- **Visual/Aesthetics**

  Because the "new" Clover Island was created by using both the original island as well as imported sediments, it was devoid of any vegetation when originally completed (Figure 6). The lack of vegetation continued into the 1960s (Figure 16), making Clover Island a barren landscape that offered no visually or aesthetically pleasing aspects.

Photo courtesy of Port of Kennewick

Figure 16. Clover Island Circa 1960s.

- **Present Actions**

  Work was recently done to the Clover Island boat launch area to enhance water access and boating experiences for the public. Activities include the installation of a new public restroom, paved parking, landscaping and public artwork, and in-water ramp replacement. Continued actions within the Tri-Cities area of the Columbia River include levee vegetation maintenance, stormwater management, and new private boat docks. On-water and near shore recreation is popular.

- **Effects of Present Actions on Resources**

  - **Riparian Vegetation**

    Ongoing levee maintenance, including vegetation management, would reduce a small portion of available riparian habitat, and would likely reduce non-native vegetation as well. Permits to construct new private boat docks within the Tri-Cities may be granted at any time, but the McNary Shoreline Plan has identified a cap for the number of docks that may exist on the McNary pool that are suitable to reduce potential effects to shoreline habitats. That cap is nearly met. The construction of new boat docks is not expected to significantly impact riparian vegetation anyway, because these docks generally extend off the levees, and the Shoreline Plan requires mitigation for what impacts do occur.

- **Threatened and Endangered Fish Species**

  Levee maintenance is assumed to be ongoing, and would have little effect on ESA-listed salmonids. In-water work and significant vegetation disturbance are not expected, but small or temporary impacts to riparian vegetation is foreseeable as a result. Furthermore, construction of new private boat docks is not expected to impact ESA-listed salmonids due to the dock design criteria applied in the McNary Shoreline Plan. Dock permit applications must include the dock design for review and approval prior to construction which ensures compliance with these criteria.

- **Visual/Aesthetics**

  Current actions would have no impact on Clover Island's visual/aesthetic setting. There would be no change in either vegetation or structures that could potentially result in a noticeable change in island aesthetics.

- **Foreseeable Future Actions**

  - **New Pasco Water Intake Facility**

    The City of Pasco is planning to construct a new water intake facility located immediately adjacent to the I-182 bridge. It is currently scheduled for completion in 2017. It would initially operate at 12 million gallons per day (mgd) for the first year, but would increase to 18 mgd in 2018 and beyond.

  - **Pasco Shoreline Master Program**

    The Washington State Shoreline Management Act of 1971 (SMA) provides a statewide framework for managing, accessing, and protecting shorelines; and is the fundamental authority for developing, updating, and amending Shoreline Master Programs (SMPs). These SMPs are both planning and regulatory documents, and are designed to carry out the policies of the SMA on local shorelines. The SMA has three broad policies: 1) protect the environmental resources of state shorelines; 2) promote public access and enjoyment opportunities; and 3) give priority to uses that require a shoreline location.

    The City of Pasco underwent an extensive review process that culminated in the adoption of a new master program by the Pasco City council. Pasco's SMP was reviewed by Washington State Department of Ecology (WDOE) and accepted without revision in June 2016. It is expected that Pasco implemented the updated SMP upon WDOE approval.

- **McNary Shoreline Management Plan**

  Under the McNary Shoreline Management Plan, new private boat docks can be built on the McNary reservoir provided all identified compliance requirements are met and permits are acquired from the Corps. The Plan, though consultation with the National Marine Fisheries Service and the Fish and Wildlife Service, has placed a cap on the number of private docks that can be constructed on the McNary shoreline, and that number cannot be exceeded.

- **Richland Stormwater Program**

  In 2015, the City of Richland hired a consultant to assess the stormwater program and make recommendations for future improvements. Considering the consultant's recommendations, Richland updated its Stormwater Management Plan in 2016. Future improvements to the city's stormwater management program may include modifications or additions to infrastructure.

- **Effects of Foreseeable Future Actions on Resources**

  - **Riparian Vegetation**

    Looking beyond ecosystem restoration at Clover Island, no expected foreseeable future actions are pending that may negatively impact Clover Island riparian vegetation. The Port of Kennewick would maintain riparian plantings, replace plants as needed post-restoration, to ensure the restored area remains well vegetated and established. Actions potentially occurring along the levees within the Tri-Cities (e.g., levee and vegetation maintenance and the addition of private boat docks) are not expected to significantly impact riparian habitat along the levees, and will have no impact on the Clover Island riparian area. Natural events (e.g., flooding) may impact riparian vegetation but, because of the way the hydropower system is operated, river volume is generally controlled so water surface elevation within the McNary pool is not likely to rise to an elevation that would severely damage riparian vegetation. In the event of damage or reduction to riparian vegetation in surrounding areas, Clover Island riparian vegetation would provide a future benefit to aquatic and terrestrial species.

  - **Threatened and Endangered Fish Species**

    Given current operations and development within the FCRPS for improved passage and survival of ESA-listed anadromous salmonids, and the regulation on the effects of actions on these species and their critical habitats, the alternatives are not anticipated to generate notable cumulative impacts with the foreseeable future actions. Improvements to upstream stormwater management within the

cities of Richland and Kennewick would improve water quality from stormwater discharges into the Columbia River. Any additional boat docks built along the levees within the Tri-Cities area must meet criteria specified and enforced by the McNary Shoreline Plan, administered by the Corps, and NOAA Fisheries to reduce impacts to ESA-listed salmonids. The Clover Island riparian restoration would provide future benefits for these species during migration periods.

- **Visual/Aesthetics**

  Foreseeable future actions would have no significant cumulative negative impact on either the region's or Clover Island's visual/aesthetic setting. While these actions could potentially have some effect on shoreline areas, they would not affect Clover Island or the proposed riparian habitat restoration work. This is due to both the location and focus of the actions (e.g., the Pasco Shoreline Master Program is limited to the City of Pasco's jurisdiction, while the McNary Shoreline Management Plan is focused on private residences adjacent to the Corps managed lands along the entire pool).

4.6.4 Summary of Cumulative Effects

Potential environmental effects associated with the alternatives considered, when combined with past, present and reasonably foreseeable future actions, is not expected to result in significant effects to the human environment.

- **Riparian Vegetation**

  The proposed action would have some minor, temporary, negative effects from construction activities, as previously described, but result in long-term important cumulative riparian and wetland habitat benefits. The Port would maintain restored riparian habitats along the shoreline embankment.

- **Threatened and Endangered Fish Species**

  Present and future actions (e.g., levee maintenance) may reduce riparian vegetation in localized areas in the region, however, impacts are expected to be minimal. Clover Island shallow water habitat is expected to be fully functional in the future as a result of riparian restoration, and is not expected to be impacted by onsite actions or other actions associated with the Tri-Cities.

  The proposed action would have some minor, temporary, negative effects from construction activities, as previously described, but result in long-term important cumulative aquatic habitat benefits. The Port would maintain restored aquatic habitats at the toe of the shoreline embankment.

- **Visual/Aesthetics**

  The overall visual/aesthetics of the project area would be greatly enhanced with the planting and maturing of riparian vegetation in the proposed locations. Presently, Clover Island has limited vegetation growth. Since its formation in 1953, little has been done to develop "green" areas on the island. In 2010, the Port undertook a project on the west end of the island for flowage, stabilization, and beautification purposes, and it did create a more natural and inviting area. However, most of the island remains sparsely vegetated, resulting in a visually barren landscape with limited color and appeal. The proposed riparian habitat development will provide a dimension to the island that, until now, has been absent. Once established, riparian vegetation will give Clover Island a much more appealing and inviting overall presence. Visually and aesthetically, it will present a much richer and vibrant scene than the drab view currently presented. It could serve as impetus for additional development of green areas along the south shore, as well as on the inland portions of the island.

  Within the cumulative effects geographic boundaries, the project will also provide much needed visual and aesthetic enhancement along a stretch of the Columbia River where substantial portions of the shoreline are devoid of vegetation due to existing levees. It provides a green area on the river for Tri-Cities residents, and is easily accessible.

  The proposed action would have some minor, temporary, negative effects from construction activities, as previously described, but result in long-term important cumulative aesthetic benefits. The Port would maintain restored visual benefits.

CHAPTER 5 – *SELECTING THE RECOMMENDED PLAN/PREFERRED ALTERNATIVE

This section describes the selection of the recommended plan/preferred alternative.

5.1 Selecting the Recommended Plan/Preferred Alternative

The plan that reasonably maximizes net NER ecosystem benefits, consistent with the Federal objective, is identified as the NER Plan. The NER Plan is the Recommended Plan and, therefore, the Preferred Alternative. The process used to identify the NER plan is based on the comparison and evaluation of the four best buy alternatives described in Section 3.6, which uses the CE/ICA, the ability of the plan to maximize environmental benefits, and the qualitative benefits not captured in the habitat modeling. During the evaluation process, consideration was given to the plan's ability to meet planning objectives and constraints, demonstrate the significance of ecosystem outputs, and meet evaluation criteria (acceptability, completeness, efficiency, and effectiveness).

5.1.1 Acceptability, Completeness, Effectiveness, and Efficiency

Acceptability, completeness, effectiveness, and efficiency are four evaluation criteria provided by the Corps to use in the development and screening of alternative plans. These criteria were considered in the developed of the initial alternatives. They were re-affirmed for the best buy alternatives to ensure minimum subjective standards of these criteria were met in order to qualify for further consideration and comparison with other plans.

- **Acceptability.** All of the study alternatives will provide habitat restoration and improve aesthetics and recreation opportunities; the same goals envisioned in the NFS Clover Island Master Plan, 2004 (Plan). During the development of the Plan the NFS vetted these goals with public, Tribal, State and Federal resource agencies, as well as local government. Comments received were overwhelmingly supportive of these types of projects. All alternatives considered in this planning study were similar to those conceptualized in the Plan and are determined acceptable. All best buy alternatives were acceptable to the NFS except for the *No Action Alternative*. Therefore, all alternatives met the acceptability planning criteria.

- **Completeness.** All study alternatives were considered to be complete, and did not rely on actions external to this project to realize biological benefits. The real estate requirements are minimal, as lands are already owned by the NFS. Annual O&M requirements are within the range of costs for similar projects in the region, and are acceptable to the NFS.

- **Effectiveness.** The identified problems addressed under this ecosystem restoration authority were lack of riparian habitat and a lack of juvenile salmonid shallow aquatic habitat along the north shore of Clover Island. The study alternatives provide the opportunity to restore aquatic habitat, as well as restore and stabilize riparian areas to benefit shallow water rearing and resting habitat for ESA-listed migrating juvenile salmonids. All study alternatives address the need to restore habitat and ecosystem function, however, some alternatives address the problems more comprehensively than others.

  Alternative 1 provides the greatest amount of restored aquatic habitat for ESA-listed juvenile salmonids, as well as riparian habitat, throughout the project area. The interconnectivity of these habitats will result in restored ecosystem processes along the entire length of the island, in a reach of the Columbia River where much of this habitat has been lost.

- **Efficiency.** All study alternatives were developed and evaluated to represent a cost-effective approach to restoration. The best buy alternatives were the cost-effective way of addressing restoration problems on Clover Island.

  The restoration outputs of the alternatives considered could not be produced more cost efficiently by another agency or institution. Restoration actions for ESA-listed species in a large river system like the Columbia River are complex, and require engineering and biological expertise to develop cost-effective solutions without increased flood risk and structural instability. Methodologies proposed for restoration activities were developed from successful ongoing Corps restoration projects on the Snake River and lessons learned from the Clover Island causeway restoration constructed in 2010-2011. No other institutions or agencies are pursuing restoration actions on this island or in this reach of the Columbia River. Although the NFS restored the causeway, it is unlikely the NFS could complete any of the alternatives with their own finances and Washington State grants alone.

5.1.2 Risk and Uncertainty

Ecosystem restoration may have relatively low risk, but the associated risk and uncertainty of achieving the proposed level of outputs for the NER plan were considered. The primary risks associated with the Clover Island ecosystem restoration project are the potential for undesirable ecological outcomes, possibly resulting from natural hazards or human actions. Those potential risks include:

- Inadequate riparian vegetation cover and abundance of invasive and non-native species. Competition from invasive species may be mitigated by regular monitoring and maintenance of plantings until they become established and can effectively out-compete weeds.

- Unpredictable changes to the riparian or shallow water habitat could create favorable conditions for predatory species (e.g., smallmouth bass in the aquatic habitat and piscivorous birds in the riparian and upland habitats).

- Establishing riparian plantings is inherently risky because of uncertain soil conditions and competition from invasive species. Risk is low since unfavorable soil conditions can be mitigated by properly characterizing soils, selecting appropriate plants, and watering the plants until they are established (if necessary).

- Data gaps in geotechnical surveys and uncertainty regarding subsurface conditions exist. The subsurface material at Clover Island is unknown, and there is uncertainty how site designs for riparian and aquatic habitat will be affected. To incorporate the uncertainty, assumptions were kept consistent between alternatives, and the costs and benefits of each alternative were related to each other. Therefore, while the results have uncertain accuracy, a sensitivity analysis conducted on the habitat benefits demonstrated that the analysis allowed for comparisons between alternatives. The risk that this limited data would affect the outcome of the study is low, because the level of uncertainty was equivalent and did not affect the overall relative ranking order. During development of plans and specifications, additional surveys and modeling would be completed for the recommended plan to improve certainty and minimize risk.

- Risk of high flow events on the viability of riparian and aquatic habitat were considered during the development of the alternative plans. The size/mass of the materials (rock) planned for the toe stabilization were selected based on the flow velocities estimated from a 1-percent annual change exceedance (100-year) flood event. The proposed riparian habitat would be planted from the shoreline, up the slope, and on top of the bank; a range of about 12 to 15 feet in height above the OHWM. Under current and foreseeable system authorized conditions, the water surface elevation at Clover Island seldom varies more than a couple of feet, and the water surface elevation difference between the 5-percent (20-year) and 1-percent annual chance exceedance (100-year) flood event is only about 2.5 feet. Therefore, only the lower portion of the riparian habitats is expected to be inundated and the plant species selected for this zone would be able to withstand periods of submergence.

5.2 *Recommended Plan/Preferred Alternative

Alternative 1 has been identified as the recommended plan/preferred alternative. Although Alternative 5 provides the highest benefit per unit cost among the best buy alternatives, Alternative 1 provides the maximum HU benefit for riparian and aquatic species. The aquatic habitat suitability for Alternative 1 is expected to be optimal for rearing ESA-listed juvenile salmonids, largely due to creation of the submerged aquatic bench. The creation of the aquatic bench is more costly, as revealed by the inflection point of the curve between Alternatives 5

and 1 in Figure 9. Although costs were considered, qualitative benefits that could not be captured by the habitat models were also used in the selection of Alternative 1 as the recommended plan. Qualitative benefits are as follows:

- **Opportunity**: Clover Island presents a rare opportunity to restore fully-functional aquatic habitat for ESA-listed juvenile salmonids in Lake Wallula. There are few (if any) sites within Lake Wallula suitable for full restoration because of levees and infrastructure that prohibit the riparian vegetation and in-water construction proposed in Alternative 1.

- **Habitat Connectivity**: Suitable aquatic habitat in Lake Wallula is highly fragmented. Of the estimated 18% of suitable aquatic habitat present, large portions are within the Yakima River delta and the McNary National Wildlife Refuge. Restored habitat at Clover Island would provide important, utilized habitat in the 9-mile reach of sparse habitat between the Yakima River delta and the McNary National Wildlife Refuge. Providing connectivity between areas of suitable habitat undoubtedly provides a survival benefit to migrating ESA-listed juvenile salmonids by providing critical rearing habitat with appropriate forage and refuge from predators.

- **Reduced Predation Risk:** Clover Island also provides a rare opportunity to restore riparian habitat without encouraging large rookeries of avian piscivores. Islands with healthy canopy trees (e.g., cottonwoods), such as Crescent Island near Wallula Gap, have been shown to measurably reduce ESA-listed juvenile salmonid survival as they migrate past these islands to the ocean. At Clover Island, the developed nature of the island would deter avian predator colonies while providing adequate riparian bank cover for juvenile salmonids. In addition, creation of a shallow water bench would reduce aquatic predator habitat associated with holes and overhanging rubble. Therefore, it is important to restore both aquatic and riparian habitats to fully functional at Clover Island where ESA-listed juvenile salmonids may experience reduced predator risk relative to other island habitats.

5.3 Plan Components

The NER plan is Alternative 1, *Maximized Habitat Restoration A*, which is also the Recommended Plan and Preferred Alternative. Alternative 1 consists of Measures A, B, and C, and allowable recreation features. The estimated cost for the restoration features is $3,958,840. The implementation of Alternative 1 is also discussed in Section 3 and the technical appendices, and is described in the following sections:

5.3.1 Restoration Features

- **Aquatic Habitat Restoration.** A long, shallow slope, from the shoreline out to deeper water, would be created to provide ideal depth. A trench would be dug below the OHWM. Riprap would be installed within the trench and choked with finer cobble and gravel to create a stabilizing toe for shoreline sloping. Fill material would be placed on the shoreline to create a 3:1 slope that extends below the OHWM until meeting the choked riprap toe (Figure 17). Depending on bathymetry, fill material could extend up to 60 feet into the Columbia River. The bench would require appropriate fill material to provide the appropriate depth and substrate for rearing ESA-listed juvenile salmonids.

- **Emergent Wetland in Notch.** To create emergent wetland at Clover Island, the shoreline slope would be relaxed against a choked boulder toe, as discussed above, and fill would be placed as needed to create a gradual slope into the notch from dry land. Appropriate species would be planted, based on elevation and inundation tolerance. Existing concrete along the shoreline would be demolished and removed preparatory to bank regrading. Once the concrete was removed from the shoreline, Clover Island's steep banks would be regraded and reshaped, as described in the previous paragraph. The regraded areas would be stabilized with geotechnical textiles and fabrics (e.g., coir fiber logs and matting). A component of the regrading and reshaping work would involve the construction of a shoreline toe from a trench. The trench would be filled with riprap choked with cobble and gravel to stabilize the banks of the island and ensure riparian plantings remain in place. Native vegetation would be planted along the island shoreline to help restore biodiversity and improve instream habitat for fish and other aquatic species. New vegetation would be irrigated during the establishment period to reduce plant mortality.

- **Multi-Storied Riparian Shrub/Tree Species on Stabilized Slope.** The riparian area would be planted with appropriate species on a stabilized 3:1 slope to provide functional multi-storied riparian habitat at project maturity. This measure would use the installed choked riprap toe along the entire identified shoreline area below the OHWM to start riparian plantings. Fill material would be placed to create a 3:1 slope tied into the riprap toe (Figure 17). Fill material would also tie into the existing slope near the top of the shore, creating a terrace. Coir fiber logs would be placed along the riprap toe to stabilize the materials. Willow whips would be planted around the shoreline, and other native species suitable for upland habitat would be planted through the coir fiber matting to provide appropriate shoreline habitat for both salmonids and wildlife to help stabilize the toe.

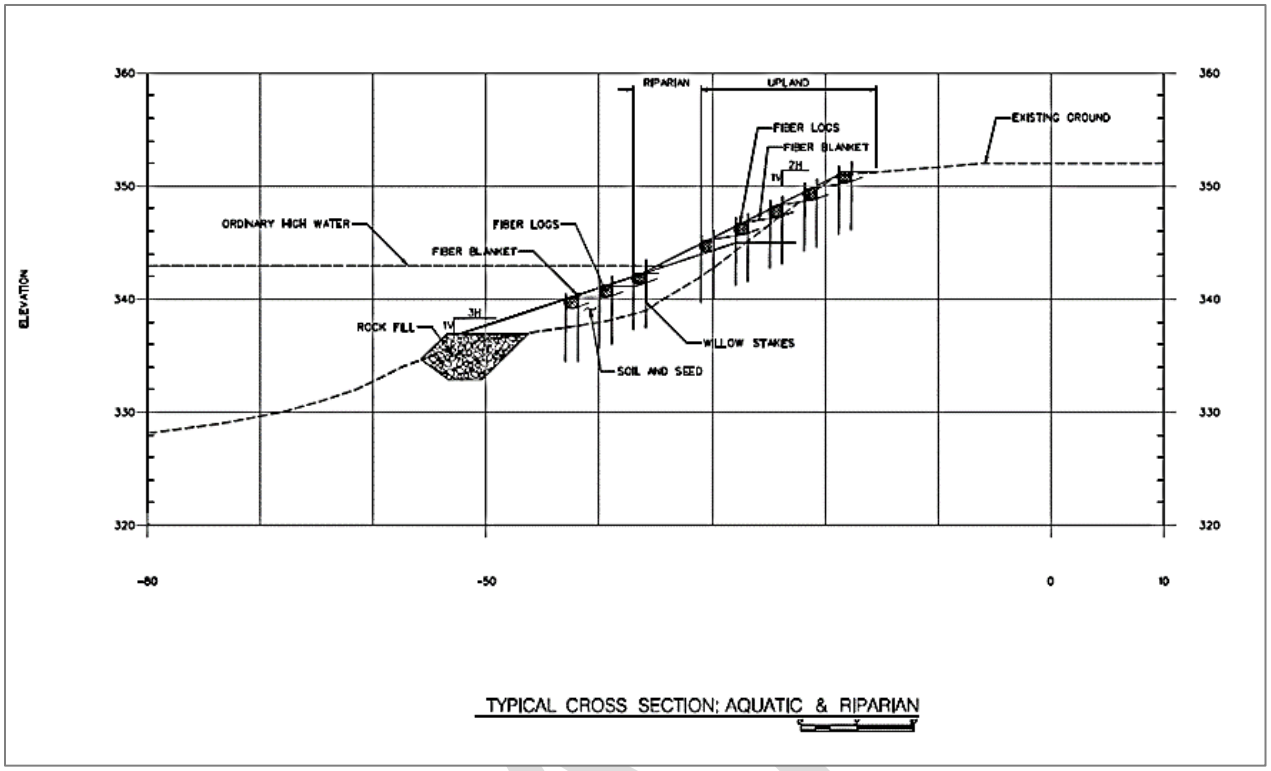

Figure 17. General Profile of Aquatic and Riparian Habitat

5.3.2 Recreation Features

The Section 1135 authority allows recreation features to be included as a cost-shared feature of the project if the recreation features do not negatively affect the restoration features, Federal cost share with recreation does not increase the Federal cost share without recreation by more than 10%, and the cost-shared recreation features are economically justified. The Port would like to incorporate recreation features in the habitat restoration project in accordance with recreation concepts developed in collaboration with the public, stakeholders, and local, State, and Federal agencies for the Clover Island Master Plan (2004).

The primary intent of the recreation features would be to connect the existing regional Sacagawea Heritage trail system (on the nearby Columbia River levees) to the restored riparian habitat on the north shore of Clover Island. The recreation features are planned for project areas 1, 2, and 3; and are not expected to impact the ecosystem restoration project, since they would be constructed outside of the riparian corridor. Figure 18 provides a cross-section of proposed riparian restoration at Clover Island, including the recreation trail. An analysis of recreation benefits is found in Appendix C, *Recreation Benefits Analysis.*

The restoration project has justified recreation costs of up to $714,000 for allowable features. Estimated recreation costs in which the Federal government may cost share, based on 10% of the Federal portion of the costs for the restoration features, is $296,913. The recreation costs must be matched by the Port, resulting in total recreation costs of $593,826. Total costs for

recreation features proposed by the Port are estimated to be $709,014, which exceeds the allowable cost-shared recreation for this project. Additional recreation cost beyond the allowable amount would be the responsibility of the NFS. Table 11 provides cost-share amounts with and without cost-shared recreation features. Implementation of the proposed recreation features would not measurably impact environmental restoration features, and are described as follows:

- **Pathways.** A meandering pathway/trail would be constructed along the top of the shoreline, following the shoreline contour. An approximately 1,500-linear-foot, ADA-compliant trail would be an estimated 5 feet to 9 feet in width (Figure 18). Slight variations would be dictated by the topography and slope of the shoreline. Concrete has been selected as the trail material because it would be easily maintained, is sustainable, and would hold up well in a desert climate. The trail would connect to and extend the causeway tail. It would begin north of the Lighthouse in area 1, travel along the north shoreline to the existing sidewalk at the notch in area 2, and continue from the notch along the north shoreline to area 3 (Appendix C, *Recreation Benefits Analysis*, Figure 18). The trail would connect existing sidewalks between areas 3 and 4. The trail would also extend south an additional 150 feet to connect with an existing sidewalk along Clover Island Drive. Public restrooms already exist at both the east and west ends of the proposed trail.

- **Signs and Interpretive Media.** Signs and interpretive media would be placed along the new trail to educate visitors about native plants and birds likely to be seen on the island. These signs would complement the NFS's actions along the causeway, which include installation of signs about island history, shoreline improvements, and information about the lifecycle of salmon.

- **Seating Areas and Associated Features.** Seating areas, benches, and trash receptacles would be placed along the trail, and existing benches would be incorporated into the plan.

- **Safety.** Pedestrian safety lighting, bollard lighting, and electrical conduit would be installed along the trails, viewpoints, and benches for public safety and to minimize vandalism. Lights would be selected and positioned to reduce habitat impacts. Handrails would be incorporated, as appropriate, at trails/viewpoints/overlooks for safety purposes.

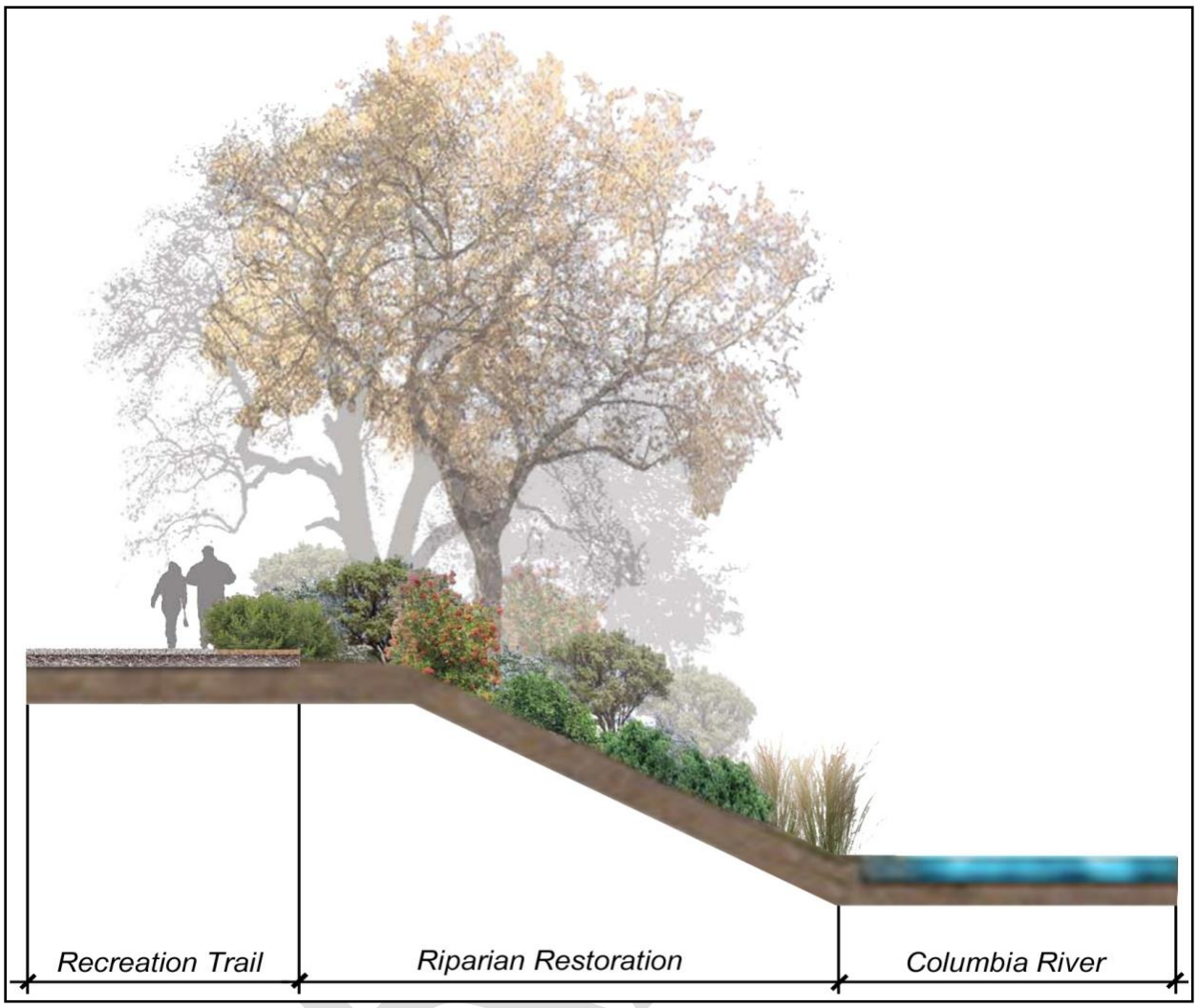

Figure 18. Cross Section View of Riparian Restoration at Clover Island

5.4 Design Considerations

The subsurface material at Clover Island is unknown, and topographic and bathymetric data used in the development of the planning alternatives were from existing sources pre-dating the study phase. To reduce uncertainty and minimize design risks, additional surveys for topography and bathometry would be conducted prior to the start of design.

5.5 Construction Phase

Construction of the project would occur in and adjacent to the Columbia River, at the northwest corner and along the north shore to the southeast corner. Debris, rubble and invasive plant removal would utilize offsite disposal. Excavation of a toe, cut and shaping of the bank, placement of fill material, and planting of native species would likely occur throughout the project area. Bank shaping through cut and fill would be supplemented with riprap, cobbles and gravel from offsite sources. Specific considerations are described as follows:

- **Erosion Control.** Temporary sedimentation could occur during construction, but would not be expected to continue following completion of riparian habitat work. Erosion and sediment control measures (Best Management Practices) such as a floating sediment curtain, hay bales, silt fences, coconut fiber logs, etc., would be implemented to prevent stormwater and sediment from entering adjacent waters. The contractor would be required to obtain a Section 402 permit from the Environmental Protection Agency, and prepare a Storm Water Pollution Prevention Plan prior to the start of construction.

- **Site Safety Preparation.** Clover Island is a public site with services provided to boaters and visitors. Safety fencing, signage, and other safety features would be installed to keep the public away from the site during construction. Staging areas would be marked and adjusted as the project progressed.

- **In-Water Work Window.** Work adjacent to and below the OHWM would be conducted during the annual in-water work window (September 1 to March 1) for Columbia River ESA-listed salmonids. Upland work (e.g., debris removal, removal of invasive species, construction/installation of recreation features) might be conducted prior to or after the in-water work window.

- **Island Services.** Prior to construction activities, scheduling and staging areas would be coordinated with the Port, stakeholders, and others to reduce impacts to services and access. Staging and scheduling during the in-water work window coincides with the seasonal holiday functions on the island, and would require special coordination.

- **Cultural Resources.** Archaeological sites have been documented and Traditional Cultural Properties identified by the Tribes on the original Clover Island. Although uncertain, it is possible excavated material used to increase the elevation of Clover Island may have come from these locations. To ensure minimal impacts to cultural resources potentially contained in the original fill material, an onsite archeologist would monitor excavation activities for the restoration project.

- **Plant Survival and Invasive Species Control.** For one year following planting, the Contractor would be responsible for plant survival, plant replacement, and control of invasive species.

5.6 Lands, Easements, Rights-of Way, Relocations, and Disposal Site Considerations

Appendix F, *Real Estate Plan,* discusses the lands, easements, rights-of-way, relocations, and disposal sites (LERRDS) necessary for project construction. The project site and temporary construction staging areas are owned by the Port. No real estate issues are expected. The estimated value of LERRDS for the proposed project is $49,881.

5.7 Operation and Maintenance Considerations

Following approval of the project, an OMRR&R Plan for the recommended plan would be described in detail in the final design and implementation documents. The Port would be responsible for all OMRR&R costs and actions to ensure project features are maintained.

The Recommended Plan would require minimal ongoing maintenance until vegetation is established. After planting riparian vegetation, some post-construction work could be necessary to remove any invasive species until desired riparian growth is established, potentially requiring several years following initial planting. Estimated annual costs for OMRR&R are $27,605.

The OMRR&R activities are anticipated to be as follows:

- **Plant Replacement.** Wetland emergent and non-woody species survive at a very high rate. The Port's plant replacement maintenance will be focused on riparian plantings, because it takes longer for these species to become established and not all are expected to survive. Plant replacements rates were estimated to be 20% for the first 5 years, followed by a reduction to 10% replacement, and finally to a 2% replacement rate after 10 years.

- **Invasive Species Control.** Invasive species would be managed through portable sprayer applications of herbicide, as well as through manual removal. The Port's maintenance requirements are expected to decrease as riparian plants become established, from three annual applications initially to one application annually after 10 years.

- **Irrigation.** The Port would be responsible for the irrigation of riparian plants. Xeric plants in the upper transition zone, and some hydrophytic plants in the seasonal inundation zone, would only require short-term irrigation before becoming established. The irrigation requirements would likely be reduced by 40% after the first 5 years, followed by additional reduction to less than 20% of the initial irrigation requirement after 10 years.

- **Erosion/Fill Replacement.** Following transfer of the completed project, the Port would be responsible for erosion control and fill replacement. Minimal sediment movement is expected, but erosion from informal public use may occur. As the riparian vegetation becomes established, root systems would likely decrease the potential for erosion and resulting maintenance requirements.

5.8 Monitoring and Adaptive Management Considerations

As authorized under Section 2039 of WRDA 2007, the plan to ensure the success of the Recommend Plan for an ecosystem restoration project is discussed in Appendix E, *Monitoring and Adaptive Management Plan.* The Recommended Plan would require post-construction monitoring of restoration objectives for ten years as vegetation becomes established. If the restoration objectives are not being met in five years, adaptive management actions will be triggered.

The restoration objectives to be monitored and the success criteria after ten years are as follows:

- **Percent Hydrophytic Shrubs.** Success: 50% or greater of the riparian vegetation would likely be composed of hydrophytic shrubs.

- **Percent Deciduous Shrub Canopy Cover.** Greater than 50% of the canopy would be expected to be deciduous shrubs.

- **Deciduous Shrub Canopy Height.** The height of the deciduous shrub canopy would likely be greater than 6.6 ft.

- **Percent Overall Canopy Cover.** Composition of canopy cover provided by *Salix* and *Populus* species would be expected to be 20%.

- **Percent Bank Cover.** Bank cover (e.g., complex root structure) would likely be between 11% and 20%.

- **Percent Non-Native Vegetation.** Percentage of the vegetation composed of non-native species is expected to be less than 5%.

The adaptive management triggers would redirect the restoration effort in the event the system does not function or become established as predicted. Management triggers for each restoration objective would be monitored and evaluated in 5-year increments to identify potential adverse conditions and address issues that impact restoration progress. The estimated average annual cost for monitoring and adaptive management is $16,750, and will be cost shared between the Corps and the Port.

5.9 Total Project Costs Summary

Construction costs and construction contingency costs using MCACES II v4.3 cost estimating software. The fully-funded estimate was prepared to Fiscal Year (FY) 2017 price levels and escalated to account for inflation through the midpoint of construction, the second quarter of FY2018. Risks and uncertainties were identified and addressed through differential contingency

in the Planning, Engineering and Design Phase, Construction, and the Construction Management Phase. The details of the total project cost estimate are provided in Appendix H, *Total Project Costs and Baseline Construction Estimates*. Table 11 shows estimated total project costs with and without the recreation features. These estimates are provided without LERRDS values and costs for 10 years of Monitoring and Adaptive Management.

Table 11. Cost Shared and non-Costs Shared Totals, With and Without Recreation

Shared Costs	Project Costs (Without Recreation)	Recreation Costs	Project Costs (With Recreation)
Federal Cost Share	$2,970,035	$296,913	$3,266,043
NFS Cost Share	$989,710	$296,913	$1,286,623
Total Shared Costs	$3,958,840	$593,826	$4,552,666
Non Shared Costs	**Project Costs***	**Recreation Costs**	**Total Non-Shared Costs**
NFS Cost	$0	$115,188	$115,188

*Excludes average annual OMRR&R costs of $27,605.

5.10 Division of Implementation Responsibilities

This section describes the responsibilities of the NFS and the Federal Government, in implementing the recommended plan. A Project Partnership Agreement (PPA) will be developed using the CAP, Section 1135, model with recreation features, which will outline both the Corps' and Port's responsibilities.

- **Federal Responsibilities.** The Corps will provide 75% of the total project cost of the recommended restoration plan and costs for recreation features that may not exceed 10% of the Federal cost-share responsibility for the restoration project. The Corps would be responsible for project management, coordination with Federal and State agencies, preparation of plans and specifications, completion of NEPA requirements, and execution of a PPA with the Port. In addition, the Corps would advertise and award survey and construction contracts, and perform construction contract supervision and administration.

- **The NFS Responsibilities.** The Port is the NFS, and is responsible for 25% of restoration project costs and they must match Federal costs for allowable recreation features. Additional costs for recreation beyond the allowable amount (Table 11) is the responsibility of the NFS. The costs for LERRDS, as well as in-kind services, could be applied toward the cost-share responsibility of the NFS. In addition to cost share and LERRDS requirements, NFS responsibilities are as follows:

- Assume responsibility for OMRR&R of the project without cost to the Corps, in a manner compatible with the project's authorized purpose and in accordance with applicable Federal and state laws and specific directions prescribed by the Corps in an OMRR&R manual.

- No known hazardous substance has been documented or identified in the work area for the proposed restoration project on Clover Island. However, if necessary for construction of the project, the Port is responsible for performing investigation for hazardous materials that might exist on and under the land, easements, and rights–of-ways.

- Cost share the monitoring and adaptive management to ensure success for restoration objectives.

- Other requirements and responsibilities of the Port will be outlined in the PPA.

The proposed schedule for the Design and Implementation phase is shown in Table 12. The detailed construction is discussed in Appendix H, *Total Project Costs and Baseline Construction Estimates*.

Table 12. Design and Implementation Schedule

Major Activities and Milestones	Schedule
Design and Implementation Phase	
Project Partnership Agreement Executed	August 2017
Conduct Topographic, Bathometric Surveys and Core Samples	August - October 2017
Initiate Design	October 2017
Tactical Acquisition Strategy Board Approval	October 2017
Conduct Design and Specification Review (BCOES Certification)	April 2018
Real Estate and Environmental Compliance and Certification	May 2018
Initiate Advertising	June 2018
Construction Contract Awards	August 2018
Contractor Submittals	September 2018
Construction Deployment	September 2018
Start of in-Water Work Window and Construction	September 2018
In-Water Work Complete	March 1, 2019
Construction Complete	June 2019
Construction Acceptance	August 2020
Physical and Fiscal Closeout	September 2020
Project Transferred to Non-Federal Sponsor	September 2020
Operation and Maintenance Phase	
Non-Federal Sponsor Initiates Annual OMRR&R	September 2020

CHAPTER 6 – *COMPLIANCE WITH OTHER ENVIRONMENTAL REQUIREMENTS

The preferred alternative presented in this integrated documented is in compliance with appropriate statutes, EOs, and memoranda, including the National Historic Preservation Act of 1966, as Amended; the Endangered Species Act of 1973; the Fish and Wildlife Coordination Act; EO 12898, *Environmental Justice*; EO 11988, *Floodplain Management*; EO 11990, *Protection of Wetlands;* and the Rivers and Harbors Act of 1899. The potential project is in compliance with the Clean Air Act (CAA), the CWA, and the NEPA of 1969.

6.1 National Historic Preservation Act of 1966, as Amended.

The National Historic Preservation Act (NHPA) of 1966, as amended, directs Federal agencies to assume responsibility for all cultural resources under their jurisdiction. Section 106 of the NHPA requires agencies to consider the potential effect of their actions on properties listed, or eligible for listing, on the National Register of Historic Places (NRHP). The NHPA implementing regulations, 36 CFR Part 800, require Federal agencies to consult with the State Historic Preservation Officer (SHPO), Tribes, and other interested parties to ensure all historic properties are adequately identified, evaluated, and considered in planning for proposed undertakings.

In 1947, an inventory of the proposed McNary reservoir area recorded two archaeological sites on the original Clover Island, although very little information is available on either one. In all likelihood, the construction of the "new" Clover Island in 1953 destroyed both recorded archaeological sites. The island has also been identified as a Traditional Cultural Property by Tribal groups. It is anticipated that restoring riparian habitat would benefit the traditional cultural values associated with the island and its surrounding area. Therefore, the Corps made a determination of "no adverse effect" for the proposed project, which included the recommendation that a qualified archaeologist be present to monitor project work. The Washington SHPO concurred with the determination, while no comments were received from the Tribes with whom the Corps consulted on this project: the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes and Bands of the Yakama Nation, or the Nez Perce Tribe.

6.2 Endangered Species Act of 1973.

The ESA established a national program for the conservation of threatened and endangered fish, wildlife, and plants, and the habitat upon which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the USFWS and NOAA Fisheries, as appropriate, to ensure their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their critical habitats. Section 7(c) of the ESA and the Federal regulations on endangered species coordination (50 CFR § 402.12) require Federal agencies to prepare a Biological Assessment (BA) to analyze the potential effects of major actions on listed species and critical habitat.

- **Coordination with USFWS.** A BA was supplied to USFWS August 21, 2009, for the Clover Island Shoreline Enhancement Project, which included restoration work on the western shoreline along the causeway. Proposed actions identified in the BA encompass or are identical to those proposed for implementation of the Recommended Plan addressed in this document. Furthermore, the 2009 BA identified the specific action area, including the north and west shorelines, with the exception of the notch. The USFWS responded with a letter of concurrence to the Corps determination of "may affect, not likely to adversely affect" bull trout and their critical habitat.

  A letter was sent to USFWS in November 2014 providing information on the Clover Island ecosystem restoration effort currently in progress. The Corps held a phone conversation with USFWS July 16, 2015, and confirmed that a letter update on the 2009 BA that included the current Recommended Plan implementation actions would satisfy the Corps ESA consultation requirements for bull trout. Email correspondence was sent to USFWS September 15, 2015, that included the 2009 BA, an updated map of the Clover Island restoration, and an explanation of the supplemental information the Corps expects to provide. Ongoing coordination has occurred with USFWS. On April 7, 2016, USFWS advised the Corps to fit this work into a restoration programmatic consultation, if possible.

  An ESA consultation preliminary briefing was held on 7 April, 2017, where restoration Alternative 1 was presented and expected implementation plans discussed. Following this presentation, the USFWS responded in email supporting the restoration. Informal consultation was initiated 21 April, 2017. The BA and communications with the USFWS are included in Appendix G, *Environmental Compliance*.

- **Coordination with NOAA Fisheries.** A BA was supplied to NOAA Fisheries in September 2009 for the Clover Island Shoreline Enhancement Project, including restoration work on the western shoreline along the causeway. Proposed actions identified in the BA encompass, or are similar to, those proposed and addressed in this document for implementation of the Recommended Plan. Furthermore, the 2009 BA identified the specific action area, including the north and west shorelines, with the exception of the notch.

  On July 2, 2010, NOAA Fisheries responded to the BA with a biological opinion (BO) that included a "No Jeopardy" opinion for the determination of "likely to adversely affect" ESA-listed Middle and Upper Columbia River steelhead, and determined "no destruction or adverse modification" to their critical habitat. The BO concurred on the determination of "not likely to adversely affect" Upper Columbia River spring Chinook salmon or their critical habitat. The BO included an incidental take statement, reasonable and prudent measures to minimize incidental take, and one conservation measure to avoid adverse effects to essential fish habitat under the Magnuson-Stevens Fishery Conservation and Management Act for steelhead.

A letter was sent to NOAA Fisheries in November 2014 that provided information on the Clover Island ecosystem restoration effort currently in progress. A call with NOAA Fisheries June 9, 2015, confirmed that a letter update on the 2009 BA, to include the current Recommended Plan implementation actions, would satisfy the Corps ESA consultation requirements for ESA-listed salmon and steelhead. Email correspondence was sent to NOAA Fisheries September 15, 2015, including the 2009 BA, an updated map of the Clover Island restoration, and an explanation of the supplemental information the Corps expects to provide. Ongoing coordination has occurred with NOAA Fisheries. On April 7, 2016, NOAA Fisheries indicated the timeline on the 2010 BO has expired for conducting this work. Therefore, implementation of the Recommended Plan will require either a new BO or a supplement to the 2010 BO.

The Corps has drafted a BA for the Selected Plan/Preferred Alternative (Chapter 5) and is in consultation with the Services, anticipating a BO in 2017. An ESA consultation preliminary briefing was held on 7 April, 2017, where restoration Alternative 1 was presented and expected implementation plans discussed. Following this presentation, a site visit was held with NMFS on 11 April, 2017. The NMFS responded to the site visit in email supporting the restoration. Formal consultation was initiated 21 April, 2017. The BA and communications with the NMFS are included in Appendix G, *Environmental Compliance*.

- **Fish and Wildlife Coordination Act.** The Fish and Wildlife Coordination Act (FWCA) authorizes the USFWS and NMFS to evaluate impacts to fish and wildlife species from proposed Federal water resource development projects that could result in the control or modification of a natural stream or body of water that might have effects on the fish and wildlife resources dependent on that body of water or its associated habitats, and provide recommendations for habitat enhancement. The proposed action does not modify a natural water body and is purely for restoration. Both Services are supportive of this restoration effort and do not require a Coordination Act Report. Correspondence on the FWCA will be included in Appendix G, *Environmental Compliance*.

6.3 Executive Order (EO) 12898, Environmental Justice.

The intent of EO 12898 is to focus Federal attention on the environmental and human health effects of Federal actions on minority and low-income populations, with the goal of achieving environmental protection for all communities. The EO directs Federal agencies to identify and address any disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law.

The proposed action would develop and enhance riparian habitat along identified sections of the Clover Island shoreline, with the intent of providing resting and feeding areas for migrating juvenile salmonids. Project costs would be shared by the Port and the Federal Government. No minority or low-income populations would be adversely affected by the project.

6.4 EO 11990, Protection of Wetlands.

Each agency will provide leadership and take action to minimize the destruction, loss, or degradation of wetlands; and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities. Ecosystem restoration at Clover Island will have no impact on local wetlands, and may ultimately promote the growth of wetland vegetation along the Clover Island shoreline.

6.5 EO 11988 and EO 13690, Floodplain Management.

Each Federal agency has a responsibility to evaluate the potential effects of any actions it may take in a floodplain; to ensure that its planning programs and budget requests reflect consideration of flood hazards and floodplain management; and to prescribe procedures to implement the policies and requirements of this EO.

While the Columbia River within the Tri-Cities area has been excluded from the floodplain because of levees, the Clover Island riparian restoration will restore similar habitat to that historically found within the floodplain in this area without increasing flood risk or hazard.

Procedures under ER 1165-2-26 require a statement of findings, which is as follows: The proposed action is located in the 1% (EO 11988) and 0.2% (EO 13690) flood plain, and would affect the floodplain.

Riparian and aquatic ecosystem restoration projects can only occur in or adjacent to floodplains. The Corps evaluated the restoration potential of the site and determined the location suitable. The shoreline and associated nearshore habitat inherently must be within and part of a floodplain, and therefore conforms to, the State and local flood protection standards.

The dam inherently has negative effects to the natural environment that have been or are being mitigated through numerous complex biological and habitat replacement programs. The planning for and development of the dam was in cooperation with numerous State, interstate, regional resource and management agencies.

No adverse impacts have been identified for the restoration alternatives and beneficial natural and flood plain values would be produced. Practicable natural measures have been identified and included in the preferred alternative to maximize the natural functions. The Corps, the Port, the Services and others have provided input to the project.

6.6 Rivers and Harbors Act of 1899.

Under Section 10 of the Act, it is unlawful to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of, any port, roadstead, haven, harbor, canal, lake, harbor of refuge, or enclosure within the limits of any breakwater, or of the channel of any navigable water of the United States, unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of War prior to beginning work.

Ecosystem restoration at Clover Island would involve excavation and fill within a navigable waterway. Nationwide Permit 27, Aquatic Habitat Restoration, Establishment, and Enhancement Activities would apply.

6.7 Clean Air Act.

The CAA is the comprehensive Federal law regulating air emissions from stationary and mobile sources. This law authorizes the EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and welfare, and to regulate emissions of hazardous air pollutants.

The project area meets Washington State's ambient air quality standards. The development of riparian/wetland habitat would not impact current conditions. The project area would still meet attainment standards.

6.8 Clean Water Act.

The CWA of 1972 establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The CWA, Section 401, requires that any Federal activity that may result in a discharge into waters of the United States must first receive a water quality certification from the state in which the activity will occur. The CWA, Section 404, established a program to regulate the discharge of dredged or fill material into waters of the United States. Section 402 implemented the National Pollutant Discharge Elimination System (NPDES) program, which addresses point-source discharges and stormwater runoff. Under Section 402, preparation of a stormwater pollution prevention plan is required.

The preferred alternative for Clover Island aquatic and riparian habitat restoration work meets the requirements of Nationwide Permit (NWP) 27, Aquatic Habitat Restoration, Establishment, and Enhancement Activities, as reissued and effective on March 19, 2017. The project also meets the conditions of the Washington Department of Ecology Section 401 Water Quality Certification for NWP 27, also effective on March 19, 2017. No additional consultation or coordination required undersection 404 of the CWA.

The preferred alternative would require compliance with Section 402 of the Clean Water Act as more than one acre of ground would be disturbed during construction and there is the possibility of storm water runoff entering the Columbia River. The Corps would require the contractor to obtain a Section 402 permit from the Environmental Protection Agency and prepare a Storm Water Pollution Prevention Plan prior to the start of construction.

6.9 Executive Order 13112, Invasive Species.

Executive order 13211 directs federal agencies to prevent the introduction of invasive species and to provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

The purpose of this project is to restore aquatic and riparian habitat. An element of the proposed project is the control of invasive plant species in the project area to ensure a healthy riparian habitat. Control activities include implementation of Best Management Practices during construction (e.g., requirements for weed free materials), and an invasive species control plan in the project area as part of the OMRR&R. This project complies with the Executive Order.

CHAPTER 7 – *SUMMARY OF COORDINATION, PUBLIC VIEWS AND COMMENTS

Agency coordination during the feasibility study phase incorporated coordination with State, Tribal and Federal Agencies, including NOAA Fisheries, USFWS, the Washington SHPO, and regional Tribes. Table 13 lists coordination with these agencies and the public. Copies of the correspondence are included in Appendix G, *Environmental Compliance*.

Table 13. Coordination with Public, State, Tribal, and Federal Agencies

Agency	Category	Subject	Dates	
			Corps Letter	Response
Public Notification	Project Scoping	Request for Input to Clover Island Restoration project	January 2015	One Comment Feb 2015
Stakeholder Notification	Project Scoping	Requested input from Clover Island Stakeholders on Clover Island	January 2015	No Comments Received
Washington State Historic Properties Office	Section 106 Consultation	Concurrence with Agency decision of "no adverse effect" on archaeological sites and recommendation of an on-site archaeologist during construction.	August 2015	September 2015
Confederated Tribes and Bands of the Yakama Nation	Section 106 Consultation	Request for review and input on Cultural Resources Determination on Proposed Restoration Project	August 2015	No Comments Received
Nez Perce Tribe	Section 106 Consultation	Request for review and input on Cultural Resources Determination on Proposed Restoration Project	August 2015	No Comments Received
Public Notification	Project Scoping	Request for Ideas for Input to Clover Island Restoration project	January 2015	One Comment Feb 2015
Stakeholder Notification	Project Scoping	Requested input from Clover Island Stakeholders on Clover Island	January 2015	No Comments Received
US Fish and Wildlife Service	ESA Consultation	Provided Information on the Proposed Restoration Project	November 2014, September 2015, and April 2017	Pending Final Plan

Agency	Category	Subject	Dates	
			Corps Letter	Response
NOAA Fisheries	ESA Consultation	Provided Information on the Proposed Restoration Project	November 2014, September 2015, and April 2017	Pending Final Plan
Confederated Tribes of the Umatilla Indian Reservation	Project Support	Letter to the Port of Kennewick in support of the Restoration Project	NA	May 2016
Public Review	NEPA	Request for review and comment on the Recommended Plan proposed in the Feasibility Study and Environmental Assessment	Scheduled for June 2017	TBD

The NEPA Public comment period is scheduled to occur for 30 days, beginning in June 2017. Comments, as appropriate, would be incorporated into the decision document.

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