SKOKOMISH RIVER BASIN
MASON COUNTY, WASHINGTON
ECOSYSTEM RESTORATION

DRAFT Integrated Feasibility Report and Environmental Impact Statement

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US Army Corps
of Engineers®
Seattle District

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LIST OF ABBREVIATIONS AND ACRONYMS

AAHU Average Annual Habitat Unit
ACE Annual Chance of Occurrence
ATR Agency Technical Review
BA Biological Assessment
BMP Best Management Practice
CAA Clean Air Act
CE/ICA Cost Effective/Incremental Cost Analysis
CEQ Council for Environmental Quality
CEQA California Environmental Quality Act
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
CFS Cubic feet per second
Corps U.S. Army Corps of Engineers
CSYU Shelton Cooperative Sustained-Yield Unit
CY Cubic yards
CZMA Coastal Zone Management Act
DAHP Department of Archaeology and Historic Preservation
DO Dissolved Oxygen
DPS Distinct Population Segment
DQC District Quality Control
EA Environmental Assessment
EC Engineering Circular
ECO-PCX Ecosystem Planning Center of Expertise
EFH Essential Fish Habitat
EO Ecosystem Outputs
ER Engineer Regulation
ERDC Engineer Research and Development Center
ESA Endangered Species Act
EPA U.S. Environmental Protection Agency
FERC Federal Energy Regulatory Commission
FMP Fishery Management Plan
FPPA Farmland Protection Policy Act
FR/EIS Feasibility Report/Environmental Impact Statement
FONSI Finding of No Significant Impact
FSM Feasibility Scoping Meeting
FWCA Fish and Wildlife Coordination Act
GHG Greenhouse Gas
GI General Investigation
HAPC Habitat Area of Particular Concern
HCCC Hood Canal Coordinating Council
IDC Interest during construction
IEPR Independent External Peer Review
IWR Institute for Water Resources
LWD Large Woody Debris
LOS Level of service
MBTA Migratory Bird Treaty Act
MCACES Micro-Computer Aided Cost Estimating System
MMPA Marine Mammal Protection Act
MSFCMA Magnuson-Stevens Fishery Conservation and Management Act
NAGPRA Native American Graves Protection and Repatriation Act
NEPA National Environmental Policy Act
NER National Ecosystem Restoration
NHPA National Historic Preservation Act
NMFS National Marine Fisheries Service
NOAA National Oceanic and Atmospheric Administration
NOI Notice of Intent
NPDES National Pollutant Discharge Elimination System
NRHP National Register of Historic Places
NWI National Wetlands Inventory
O&M Operations and Maintenance
ONF Olympic National Forest
PDT Project Delivery Team
PPA Project Partnership Agreement
RCO Recreation and Conservation Office
RM River Mile
SHPO State Historic Preservation Officer
SMA Shoreline Management Act
SWAT Skokomish Watershed Action Team
TCP Traditional Cultural Properties
Tribe Skokomish Indian Tribe
TSP Tentatively Selected Plan
U&A Usual and Accustomed
USACE U.S. Army Corps of Engineers
USC United States Code
USFS U.S. Forest Service
USFWS U.S. Fish and Wildlife Service
WDFW Washington State Department of Fish and Wildlife
WDNR Washington State Department of Natural Resources
WDOE Washington Department of Ecology
WRDA Water Resources Development Act
WRIA Water Resource Inventory Area
WQC Water Quality Certification

Executive Summary

This integrated feasibility report and environmental impact statement presents the results of a U.S. Army Corps of Engineers (Corps) Ecosystem Restoration feasibility study undertaken to identify and evaluate alternatives for restoring degraded structures, functions, and processes in the Skokomish River Basin, Washington. The Corps is undertaking this action in partnership with Mason County and the Skokomish Indian Tribe. This report provides documentation of the plan formulation process to select a recommended restoration plan, along with environmental, engineering, and cost details of the tentatively selected plan (TSP), which will allow additional design and construction to proceed following approval of this report.

The Skokomish River Basin is located on the Great Bend of Hood Canal, a natural fjord-like arm of the Puget Sound and water of national significance. The Skokomish River is the largest source of freshwater to Hood Canal and of critical importance to the overall health of Hood Canal. The primary concern to be addressed in this study is ecosystem degradation in the Skokomish River Basin, which includes the Skokomish Indian Reservation. High sediment load, reduced flows, and encroachment on the floodplain by man-made structures are causing continued degradation of natural ecosystem structures, functions, and processes necessary to support critical fish and wildlife habitat throughout the basin. The decline in populations has resulted in the listing of four anadromous fish species under the Endangered Species Act (ESA) (i.e., Chinook salmon, chum salmon, steelhead, and bull trout) that use the river as their primary habitat. The impaired ecosystem has adversely affected riverine, wetland, and estuarine habitats that are critical to these and other important fish and wildlife species such as bears, bald eagles, and river otters to name a few.

As part of the planning process for the study, the Project Delivery Team (PDT), in coordination with interested stakeholders and the public, developed a series of measures and alternatives to be considered as potential elements of the project solution. The array of alternatives was formulated based on preliminary data collection and analysis as well as best professional judgment. The study team identified 60 potential restoration sites and completed multiple rounds of screening to identify which sites meet the priority objectives of the study (increase channel capacity and provide a year-round channel for fish passage). Each alternative was formulated to include a "base" measure that addresses these critical needs of the study area. Incremental measures (e.g., side channel reconnections, levee setbacks, and placement of large woody debris) were added to these base alternatives to capture supplementary benefits associated with restoration of additional habitat features.

The PDT developed preliminary cost estimates for each site and calculated habitat benefits that could accrue from restoration measures. Habitat benefits were calculated using the Skokomish River Ecosystem Benefits Model, a habitat suitability index model accounting for the quality and quantity of available habitat for salmonids (an indicator species for overall ecosystem health in the Pacific Northwest). The preliminary costs and habitat benefits were used in a Cost Effectiveness and Incremental Cost Analysis (CE/ICA) to identify alternatives that provide high levels of habitat benefit relative to the costs. The CE/ICA was a primary element used to select the recommended restoration plan.

A recommended restoration plan was selected that includes a levee removal, three side channel or tributary restorations, placement of large woody debris in the upstream reaches of the river, and construction of two setback levees to improve habitat connectivity in the floodplain. The total area of the proposed sites included in this TSP is approximately 330 acres, the average annual habitat units are estimated at 226, and the total estimated first cost of the TSP is $41 million. The TSP reasonably maximizes environmental benefits considering cost effectiveness and incremental cost analyses, significance of outputs, completeness, efficiency, effectiveness, and acceptability. The alternative referred to as the TSP in this document is the agency preferred alternative as it is called under NEPA.

During construction, there could be temporary adverse effects such as increases in turbidity, temporary clearing of vegetation, and handling of fish for removal from construction areas. These effects would be minimized by providing erosion and pollution control best management practices and conducting all fish salvage and removal activities according to State and Federal requirements. Conservation measures would be implemented during construction to minimize effects to ESA-listed species.

The overall cumulative effects of the TSP would be synergistic benefits to all aquatic species through process-based restoration in the lower Skokomish River. The benefits of increasing the number and size of in-channel pools, placing enough large woody debris (LWD) to mimic quantities in nearby more natural rivers, reconnecting aquatic habitats in the adjacent floodplain, and greatly increasing the acreage of riparian zones along the river is predicted to provide substantial benefits to fish and wildlife habitat, especially for salmon species.

1. Introduction

This report documents the planning process for ecosystem restoration in the Skokomish River Basin, Washington, to demonstrate consistency with U.S. Army Corps of Engineers (Corps) planning policy and to meet the regulations that implement the National Environmental Policy Act (NEPA). The following sections provide background information regarding the basis for this study. The sections that are required for NEPA compliance are denoted with an asterisk (*).

1.1 Study Purpose and Scope

The purpose of the Skokomish River Basin feasibility study is to evaluate significant ecosystem degradation in the Skokomish River Basin; to formulate, evaluate, and screen potential solutions to these problems; and to recommend a series of actions and projects that have a Federal interest and are supported by a local entity willing to provide the necessary items of local cooperation.

The Skokomish River Basin is located on Hood Canal, a natural fjord-like arm of the Puget Sound and water of national significance. The Skokomish River is the largest source of freshwater to Hood Canal as it flows into Annas Bay and of critical importance in the overall health of Hood Canal. Environmental degradation can be seen throughout the Skokomish River Basin including a loss of natural ecosystem structures, functions, and processes necessary to support critical fish and wildlife habitat. Four anadromous fish species (Chinook salmon, chum salmon, steelhead, and bull trout) that use the river as their primary habitat are listed under the Endangered Species Act (ESA) and have experienced population declines. The impaired ecosystem has adversely affected riverine, wetland, and estuarine habitats that are critical to these and other listed species. The underlying need for development of a plan for ecosystem restoration in the Basin has arisen from recognition and analysis of these problems.

Since the completion of the Reconnaissance Phase (USACE 2000), continued flooding of the Skokomish Valley has led to significant interest in pursuing a multi-purpose feasibility study (addressing ecosystem restoration and flood risk management) by the public. Mason County has been proactive in flood mitigation projects collaborating with the Federal Emergency Management Agency, the State of Washington's Emergency Management Division and the Department of Ecology (DOE). Past Corps studies (USACE 1988, 1995) indicate a low benefit-to-cost ratio for flood risk management alternatives. More recent economic analyses indicate very low expected annual flood damages due to the rural nature of the study area and implementation of previous flood risk management projects by Mason County including residential acquisitions (buy-outs), strict development/zoning regulations, implementation of a flood warning system and evacuation plan, and raising of structures in the floodplain. Based on these developments, the non-Federal sponsors and study team have agreed to continue to pursue a single-purpose (ecosystem restoration) feasibility study. Although the study is a single-purpose study focusing on ecosystem restoration, there is a potential for ecosystem projects that secondarily meet flood risk management goals. Additionally, local and State government agencies will continue locally funded flood damage reduction efforts to achieve local flood risk management goals, such as preserving local business, communities, and historic land uses.

1.2 Study Authority*

The Feasibility Study for the Skokomish River Basin is being conducted under the Authority of Section 209 of the River and Harbor Act of 1962, Public Law 87-874 (Puget Sound and Adjacent Waters):

"The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements, and floods aggravated by or due to wind or tidal effects, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the following named localities: Provided, That after the regular or formal reports made on any survey are submitted to Congress, no supplemental or additional report or estimate shall be made unless authorized by law except that the Secretary of the Army may cause a review of any examination or survey to be made and a report thereon submitted to Congress, if such review is required by the national defense or by changed physical or economic conditions: Provided further, That the Government shall not be deemed to have entered upon any project for the improvement of any waterway or harbor mentioned in this title until the project for the proposed work shall have been adopted by law:

Puget Sound, Washington, and adjacent waters, including tributaries, in the interest of flood control, navigation, and other water uses and related land resources."

Seattle District Office of Council has confirmed the appropriateness of this authority with USACE Headquarters Office of Council. The Act's reference to "other water uses and related land resources" provides sufficient authority to study ecosystem restoration opportunities in the Skokomish River Basin.

1.3 Lead Federal Agency and Non-Federal Sponsors*

The study documented herein has been conducted jointly by the Corps (lead Federal agency) and two non-Federal sponsors, Mason County (County) and the Skokomish Indian Tribe (Tribe). As the non-Federal sponsors, the County and Tribe contribute 50 percent of the total feasibility study costs in the form of cash or in-kind contributions; a feasibility cost sharing agreement was signed in 2006.

1.4 Cooperating Agencies*

Prior to the Feasibility Scoping Meeting, the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) expressed willingness to consider a cooperating agency role; although they declined upon formal invitation, both agencies remain actively involved in the study.

1.5 Location of the Study Area*

The Skokomish River Basin is located on the Olympic Peninsula in northwestern Washington (Figure 1-2). The study area is approximately 11 square miles comprised of the lower Skokomish watershed, the Skokomish Valley, and Skokomish River estuary (Figure 1-2). The area is characteristic of the enormous beauty and versatile environment of Hood Canal and Puget Sound.

The Skokomish watershed drains approximately 230 square miles from three major tributary basins, the North Fork (118 square miles), the South Fork (76 square miles) and Vance Creek (29 square miles). The river collects flow from these steep, mountainous basins and drains into a flat, alluvial plain approximately ¾ to 1½ miles wide known as the Skokomish Valley. Richert Springs, Hunter, Weaver, and Purdy Creeks are predominantly spring fed tributaries that flow through agricultural lands in the southern portion of the Skokomish Valley floodplain before entering the mainstem Skokomish River. The Skokomish River mainstem flows through the Skokomish Valley to the Skokomish estuary, consisting of the mouth of the Skokomish River and the delta that is tidally influenced. It is the largest and most complex river estuary in Hood Canal. The Skokomish River empties into Annas Bay at the southern end of Hood Canal, an arm of Puget Sound.

The Skokomish Valley has a population of approximately 730 residents (2011 Census) with an economy dominated by rural agriculture. The lower six miles of the river, including a substantial portion of the estuary, are located on the 4,950-acre Skokomish Indian Reservation. There is one privately owned hydroelectric dam near the project area, Cushman Dam, which impounds flows on the North Fork Skokomish River, which influences flows in the lower reach of the study area.

The Skokomish River Basin is a large and complex watershed. Numerous Federal, State, and local agencies are working within their individual authorities to implement restoration projects throughout the watershed. While existing restoration efforts will have localized benefits, a need for action by the Corps still exists. The Corps has a unique opportunity to address problems in the Lower South Fork, Skokomish River mainstem, and tributaries (Weaver Creek, Vance Creek, and Purdy Creek) where many impacts from the upper watershed are manifested and where a number of significant ecosystem restoration opportunities exist. As a result, the study area for the General Investigation (GI) will focus on the lower 11 miles of the river. Figure 1-1 and Figure 1-2 show the location of the Skokomish River Basin and GI study area.

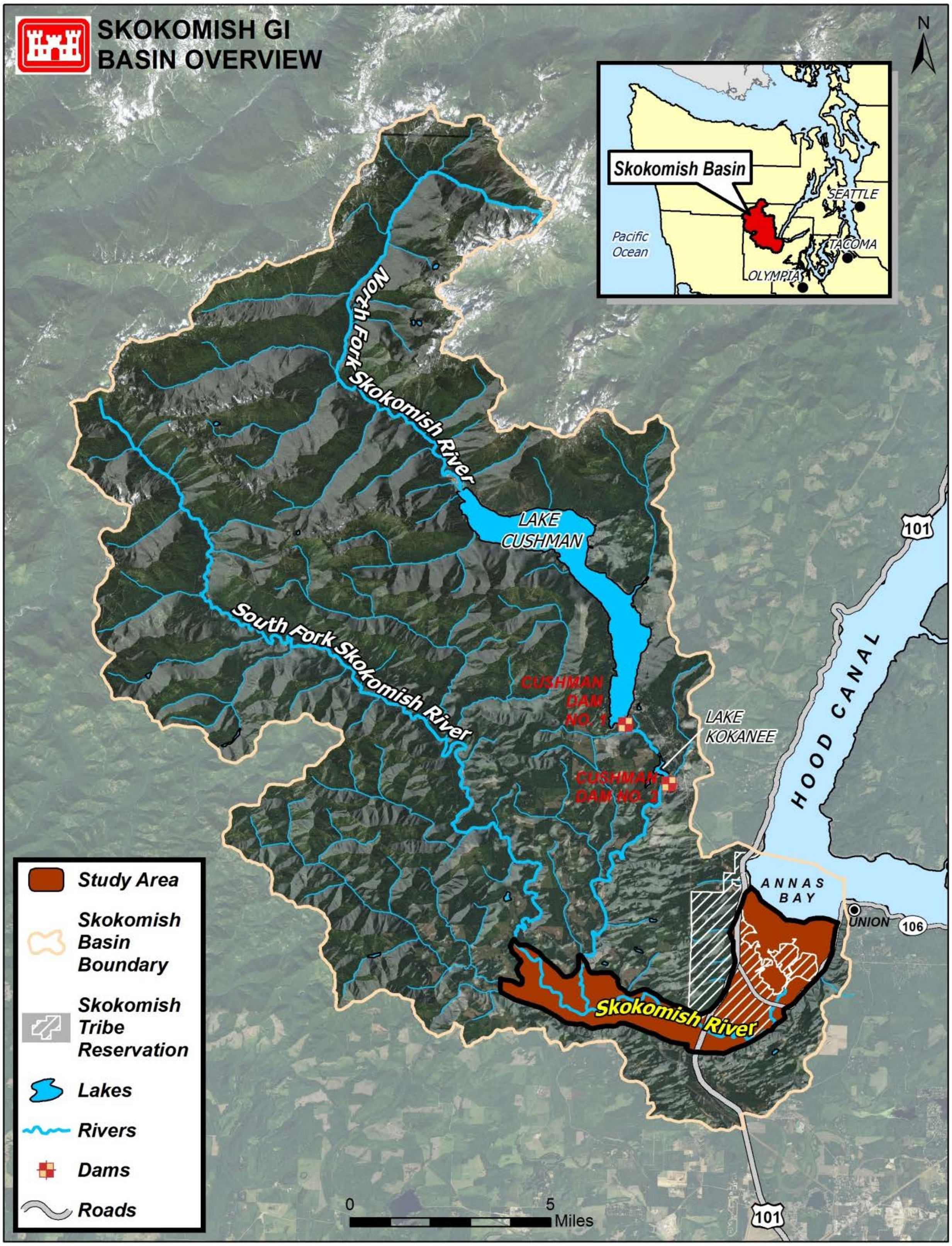


Figure 1-1. Skokomish River Basin Overview

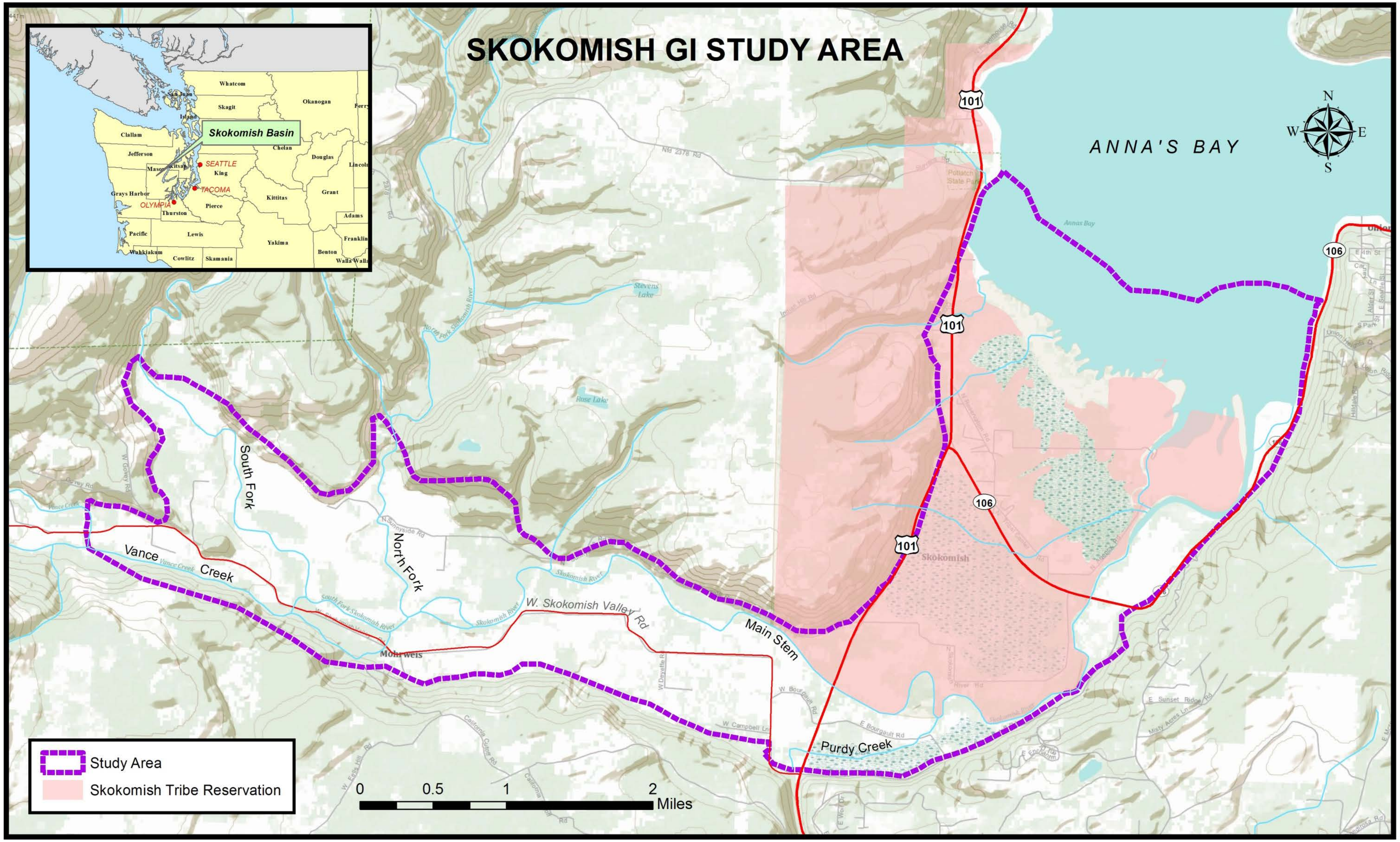


Figure 1-2. Skokomish River Basin GI: Study Area

1.6 Proposal for Federal Action*

The proposal to implement ecosystem restoration in the Skokomish River Basin triggered the National Environmental Policy Act (NEPA) process recorded in this document (40 CFR 1501.2). Based on study results, the Corps is proposing restoration of the Skokomish River in the lower Skokomish Valley. The proposed Federal (Corps) action area is focused on the lower Skokomish Valley because various Federal and State agencies as well as local entities are addressing problems within their individual authorities and in specific areas of the upper watershed as well as the estuary.

1.7 Overview of Integrated FR/EIS

This document is a combined Draft Feasibility Report and Environmental Impact Statement (DFR/EIS). The purpose of the feasibility report is to identify the plan that reasonably maximizes ecosystem restoration benefits, is technically feasible, and preserves environmental and cultural values. The purpose of the EIS portion of the report is to identify and present information about any potentially significant environmental effects of the alternatives and to incorporate environmental concerns into the decision-making process. The six steps of the Corps planning process each align with a NEPA requirement. The planning steps are listed below with the document chapter and NEPA element to which they relate:

Table 1-1. Overview of FR/EIS

Planning Step:	Document Chapter and Analogous NEPA Requirement:
Step One **– Specify Problems and Opportunities**	Appears in Chapter 2, as described in the purpose and need for action.
Step Two **– Inventory and Forecast Conditions**	Appears in Chapter 4, which describes the existing conditions of the study area and compares the action alternatives to the no-action alternative, also known as the future without-project condition.
Step Three **– Formulate Alternative Plans**	Appears in Chapter 3 in the description of the screening process and formulation of alternative plans.
Step Four **– Evaluate Effects of Alternative Plans**	Appears in Chapter 4 with the comparison of how each alternative affects the significant resources identified in Chapter 2.
Step Five **– Compare Alternative Plans**	Begins in Chapter 3 after the description of the alternatives and continues in Chapter 4 with the comparison of how each alternative may affect the significant resources.
Step Six **– Select Recommended Plan**	Appears in Chapter 5 and includes details of the Tentatively Selected Plan (agency preferred alternative).

2. Need for and Objectives of Action

This chapter presents results of the first step of the planning process, the specification of water and related land resources problems and opportunities in the study area. The chapter also establishes the planning objectives and planning constraints, which are the basis for formulation of alternative plans.

2.1 Problems and Opportunities

The primary concern this study addresses is ecosystem degradation in the Skokomish River Basin, which includes public and private lands and the Skokomish Indian Reservation. Alteration of the river environment and encroachment on the floodplain by man-made structures have degraded and continue to affect natural ecosystem structures, functions, and processes necessary to support critical fish and wildlife habitat throughout the basin. The degraded stream, wetland, and riparian habitat cannot support a healthy population of critical fish and wildlife species.

Historically, the Skokomish River system produced the largest runs of salmon and steelhead in Hood Canal (Correa 2003). Since the settlement of the Skokomish Valley in the 1850s by European and American settlers, human activities have altered the Skokomish River's hydraulic and geomorphic processes and reduced the fisheries resource. Specific anthropogenic impacts to the Skokomish River Basin include the following:

- Removal of large woody debris (LWD) simplified the stream habitat by reducing the occurrence of pools, caused loss of nutrients and substrate to support aquatic insects, and removed the complex rootwad structures that allow juvenile fish to hide from predators. Pools are critical habitat as sheltered areas for spawning adults to rest and for juvenile salmon to rear. Aquatic insects are an important component of a healthy aquatic ecosystem and are the primary food source for juvenile salmonids rearing in the river. LWD is essential for supporting these ecosystem components.
- Removal of the riparian forest has reduced the supply of LWD, overhanging vegetation that provides food sources for terrestrial and aquatic insects, and shade cover (approximately 62% of the mainstem is sparsely vegetated). Leaf and litter fall from overhanging vegetation provides food for aquatic insects, and drops terrestrial insects into the river where they become fish food. The loss of shade cover has contributed to high water temperatures during the summer, which causes stress to adults on their spawning migration and reduces growth rate of juveniles rearing in the river and off-channel habitats. The substantial loss of riparian forest has reduced these inputs to the aquatic ecosystem.
- Intensive logging activities that disturbed and destabilized the stream banks reduced streamside vegetation due to erosion. This prevents new vegetation from establishing to provide energy inputs to the river, and the erosion causes sedimentation downstream that can smother salmon eggs or settle at tributary mouths and reduce their accessibility for fish. The accumulation of sediment in the riverbed has resulted in an unfavorable width to depth ratio such that the main channels are too shallow to support good habitat for salmon, and sediment has filled in nearly all the high value pool habitat.

- Protection of agricultural lands from erosion led to construction of bank protection measures. Those measures stopped natural channel migration, which reduces the rate of habitat creation in the river and in the floodplain.
- Logging activities in the South Fork and Vance Creek watersheds may have increased the upper basin sediment supply that is accumulating in the river reaches of the study area. This accumulation of gravel in the riverbed has resulted in cutting off access to aquatic habitats in the floodplain. Such side channel closures eliminated fish access to slack water, an important rearing habitat that supports more juvenile fish than do medium and higher velocities, and important spawning habitat for chum and coho salmon.
- The Cushman Dam Project, channel straightening, and levees have, to varying degrees, reduced ecosystem functions and habitat availability for all riverine fish species and the aquatic-oriented mammals such as beaver, river otter, and mink (construction of Cushman Dam blocked 25% of mainstem habitat and 18% of tributary habitat available to salmon).
- The removal of LWD, disturbance of the stream banks, bank protection, and side-channel closures have all contributed to altering the bedload transport and deposition in the South Fork, Vance Creek, and the mainstem Skokomish River. In addition, flow regulation by the Cushman Project has altered bedload transport and deposition in the mainstem Skokomish River. A significant problem of the sediment accumulation is that the river dries up for a mile for nearly two months each year in the late summer. This poses a total block for upstream and downstream fish migration, and can prevent salmon from reaching their spawning grounds in time to spawn before dying.
- The U.S. Highway 101 and State Route 106 road embankments disrupt overbank flood flows and reduce habitat connectivity. Connections from the mainstem to the aquatic habitats in the adjacent floodplain are highly important for fish to find additional food sources, spawning habitat, and low velocity refuge, as well as pathways back into the mainstem after floodwaters carry them out of the main channel.

The effects outlined above have led to the degradation of ecosystem processes, structures, and functions in the Skokomish Basin. Four ESA-listed salmonid species are represented in six unique populations in the study area; two of these six stocks are already extirpated from the Skokomish River. The major problem affecting salmon survival and migration is extensive aggradation in the South Fork and mainstem riverbeds. One reach of the South Fork Skokomish River near the North Fork confluence started running subsurface in late summer months (Figure 2-1, top row) about 10 years ago. Abundance estimates of coho, chum, Chinook, and steelhead have dropped dramatically since 2004 (Skokomish Tribe 2013). This relatively new blockage problem delays or completely precludes some adult salmon access to upstream habitat and spawning areas preventing successful spawning, and delays juvenile migration downstream to the abundant food sources of the estuary. Additionally, low channel capacity leads to frequent flooding of the river, transporting juvenile and adult salmon out of the river, and stranding them in the floodplain to die during even modest flow events (Figure 2-1, bottom row). Finally, altered bedload deposition causes instability of the gravel bed in the river, the shifting pattern of the riverbed, and riverbed aggradation, ultimately producing annual changes in spawning gravel locations and negatively affecting spawning success for some of the salmon stocks.

Figure 2-1. **Existing Conditions in the Skokomish River. Top Row: Riverbed aggradation blocks fish passage during migration season for some species and limits the availability of high quality pool habitat. Bottom row: Limited channel capacity also leads to frequent flooding of the river, causing fish stranding and mortality.**

Based on the above-mentioned anthropogenic impacts, the study team identified the following problems during the early stage of this study:

1. In the Skokomish Basin, salmon populations have been so greatly impaired by anthropogenic actions that two of the ESA-listed populations have been extirpated from the system. Detrimental actions have included channel alterations, large wood removal, overfishing, and the conversion of forestland to agriculture.
2. Aggradation causes areas of the South Fork Skokomish River to run subsurface during the summer low flow period, which blocks passage for endangered fish species during the migration season.
3. Aggradation in the Skokomish River has reduced channel capacity in the mainstem, which causes frequent overbank flows and stranding fish during even modest flow events.

4. Connections of the Skokomish River main channel to side channels, tributaries, and backwater habitats have been reduced due to numerous anthropogenic impacts and land management activities including dam construction, flow diversion, levee construction, and channelization.
5. The Skokomish River mainstem and tributaries lack high quality and complex habitats including pools, side-channels, hiding places, and floodplain habitats because of levee and dike construction, closure of side channels and sloughs, agricultural development, and the removal of large woody debris and riparian vegetation.

Opportunities to address problems for this study include the following:

1. Restore degraded ecosystem structures, functions, and dynamic processes of the Skokomish River for the benefit of four ESA-listed salmonid species.
2. Restore a continuous low flow channel in the Skokomish River to maintain fish passage during summer low flow periods.
3. Restore channel capacity to rebuild critical habitat for ESA-listed salmonid species.
4. Restore the connection of the Skokomish River mainstem to side channels and tributaries.
5. Return habitat quality, complexity, and functionality of the Skokomish River system to a less degraded, more natural state.
6. There is a potential for ecosystem projects that secondarily contribute to local flood risk management goals.

2.2 Purpose and Need for Action*

The need for the proposed Federal action arises from the significant degradation of natural processes that sustain the ecological functions of the watershed as described in the previous section. The purpose for the proposed Federal action is to work within the defined study area to enact solutions within the Corps' authority to restore ecosystem process, structure, and function in the aquatic environment by addressing the primary problems identified during the feasibility study. Effort toward improving the aquatic ecosystem should include addressing lack of wetland and side-channel connections, increasing channel complexity, increasing large woody debris, increasing pool depth and frequency, restoring degraded riparian conditions, improving conditions in the reach of the river that dries up each summer, and improving channel capacity to the maximum extent practicable. Restoration of ecosystem structures, functions, and processes will benefit nationally significant resources in the study area.

2.3 Resource Significance – Technical, Institutional, Public

The Skokomish River is the largest and most diverse tributary to Hood Canal, a 70-mile-long natural fjord-like arm of Puget Sound that supports vital natural resources. Significant resources in the Skokomish River Basin have declined to a point that the ecosystem may no longer be self-sustaining without immediate intervention to curtail considerable ecological degradation. These resources are technically, institutionally, and publicly significant as described in the following sections.

2.3.1 Technical Significance

The Pacific Northwest ecoregion is home to many species of the Salmonidae family. These fish serve as an indicator of the overall health of not only the aquatic environment where they dwell, but also the connected riparian, wetland, and upland habitats. A comprehensive restoration plan for all species in the Salmonidae family, as keystone species, effectively restores habitat and nutrient input for a broad suite of over 130 other native plant and animal species (Cederholm et al. 2000). Keystone species play a unique and crucial role in the way an ecosystem functions; these fish are extremely sensitive to changes in water quality, trophic webs, and perturbations to the river flow, turbidity, and temperature. Pacific salmon are a food source for a variety of marine, freshwater, and land animals and provide a source of marine-derived nutrients to freshwater environments after spawning (Cederholm et al. 1999). Juvenile salmonids feed on aquatic invertebrates that are indicators of water quality. Additionally, ESA-listed Orca whales, a top predator and iconic species of the Puget Sound region, have been recorded following and feeding on adult Skokomish-bound salmon.

Generally, the more pristine, diverse, and productive the ecosystem is, the healthier the salmon stocks. A decline in the capacity of a watershed to support juvenile salmonids is one indication of declining ecosystem health. Restoration planning centered on habitat for the Salmonidae family reinstitutes dynamic processes that tend to maintain healthy ecosystem characteristics.

Wetlands in the Skokomish watershed provide significant ecological functions including rearing and resting sites for aquatic and land species, natural drainage, storage areas for floodwater, groundwater discharge areas critical to summer low flow, and significant water purification functions through natural filtration. The water quality functions of wetlands associated with the Skokomish River benefit water quality in Hood Canal.

2.3.2 Institutional Significance

Four ESA-listed fish species of the Puget Sound area occur in the Skokomish River. These are represented by six unique populations: Spring and fall Chinook salmon, Hood Canal summer chum salmon, winter and summer steelhead, and bull trout. Two specific runs of salmon, summer chum salmon and spring Chinook, have been extirpated from the Skokomish River. The decline of these particularly sensitive species indicates degradation of environmental health of the Skokomish River and Hood Canal aquatic systems, representing an urgent need to address degradation in the study area.

NMFS designated Essential Fish Habitat (EFH) within the South Fork Skokomish watershed under the Magnuson-Stevens Fishery Conservation and Management Act (NMFS 2002). EFH includes all Chinook, coho, and pink salmon habitat.

Puget Sound is an estuary of national significance identified by the Council for Environmental Quality (CEQ) and encompasses a highly interactive system that depends on the continuing cycle of clean water and nutrients to sustain its biological character. As the largest source of freshwater to Hood Canal, improving the health of the Skokomish River watershed is critical to the overall health of Hood Canal, which forms a significant portion of Puget Sound. Restoration of the Skokomish will contribute to the larger mission of the Puget Sound Partnership, a State agency whose primary goal is to restore Puget Sound by 2020.

The Skokomish Tribal Reservation is located at the mouth of the Skokomish River. The multiple species of fish and shellfish resources in the Skokomish River play an integral part of tribal culture, religion, and physical sustenance. The Skokomish Tribe has treaty-protected harvest rights within their Tribe's usual and accustomed (U&A) harvest area, which reflects the historical region in which finfish, shellfish, and other natural resources were collected. As a Federal agency, the Corps has a Federal trust responsibility to act in the Tribes' best interests, including duties to protect Tribal lands and cultural and natural resources. In addition to supporting the feasibility study as a cost-sharing non-Federal sponsor, the Skokomish Tribe has invested funds in restoration of the Skokomish River estuary though the Estuary Restoration Act and continues to support restoration of the Skokomish River Basin.

2.3.3 Public Significance

Members of the public have recognized the significance of the Skokomish River's resources both formally and informally. Ecosystem restoration was a common theme in comments received during the NEPA scoping period (beginning in September 2010) as well as during public meetings that were held throughout the course of the study. In addition to the numerous comments and letters of concern from members of the public, multiple partnerships have formed to acknowledge and advocate for restoration of the resources of the Skokomish River Basin. Strong, durable partnerships have formed in the Skokomish watershed and beyond that seek to halt worsening conditions and restore the river's ecosystem. The Skokomish Watershed Action Team (SWAT) – a diverse, informal partnership of governments, land managers, the public, and others (including representatives from the Mason County Conservation District, WA Department of Ecology, National Marine Fisheries Service, Green Diamond Resource Company, Olympic Forest Coalition, Hood Canal Coordinating Council, The Wilderness Society, and more) are working collaboratively to restore a healthy Skokomish watershed. This extraordinary collaborative effort and recognition of a need for restoration is indicative of the public significance of the resources of the Skokomish River. Table 2-1 summarizes the technically, institutionally, and publicly valued resources in the study area.

Table 2-1. Technical, Institutional, and Public Significance

<table>
<tr><th>Technical Significance</th><th>Institutional Significance</th><th>Public Significance</th></tr>
<tr><td>Salmon – keystone species; indicators of overall ecosystem health</td><td>Four ESA-listed salmon species represented in six unique populations</td><td>NEPA Scoping – Public concern for ecosystem restoration</td></tr>
<tr><td rowspan="3">Wetlands – improve water quality and support unique flora and fauna</td><td>Puget Sound – estuary of national significance (CEQ)</td><td rowspan="3">Skokomish Watershed Action Team</td></tr>
<tr><td>NMFS Essential Fish Habitat</td></tr>
<tr><td>Tribal Trust Responsibility</td></tr>
</table>

2.4 National Objective

The Federal objective of water and related land resources project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. The objective of ecosystem restoration is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Ecosystem restoration aims to reverse the adverse impacts of human activity and restore ecological resources, including fish and wildlife habitat, to as close to previous levels of productivity as feasible, but not a higher level than would have existed under natural conditions in the absence of human activity.

2.5 Planning Objectives

Based on the problems identified in the study area, planning objectives include the following and consist of an effect, subject, location, and timing per ER 1105-2-100:

- Provide year-round passage for fish species around the confluence of the North Fork and South Fork Skokomish River for the 50-year period of analysis.
- Reconnect and restore the spawning, rearing, and refuge habitats in the study's side channel and tributary networks including Hunter and Weaver Creeks for the 50-year period of analysis.
- Improve the quantity, quality, and complexity of native riparian and floodplain habitats in the study area for the 50-year period of analysis.
- Improve the quantity, quality, and complexity of pools in the Skokomish River to promote spawning and rearing success, as well as reduce stranding of ESA-listed salmonid species for the 50-year period of analysis.

Table 2-2 shows which problem each objective addresses.

Table 2-2. Restoration Objectives and the Problems they Address

	Problems in the Study Area			
Objectives	**Year-round passage is blocked during summer low-flow period**	**Reduced channel capacity causes frequent floods and fish stranding**	**Disconnected and degraded side channel and tributary networks**	**Lack of high quality and complex in-channel and floodplain habitats**
Provide year-round passage near confluence	X			
Restore side channel and tributary network			X	X
Improve riparian and floodplain habitats			X	X
Improve quantity, quality, and complexity of pools	X	X		

2.6 Planning Constraints

Planning constraints are significant barriers or restrictions that limit the extent of the planning process. Study-specific planning constraints are statements of things unique to a specific planning study that alternative plans should avoid. The following constraints (i.e. limitations on the range of measures and alternatives that can be proposed) have been identified for the study:

1. Comply with the Federal Energy Regulatory Commission (FERC) Settlement Agreement related to Cushman Dam (the "Cushman Settlement Agreement"). NMFS, Tacoma Public Utilities, the

Skokomish Indian Tribe, and State and other Federal agencies (excluding USACE) signed a settlement and relicensing agreement for Tacoma Power's Cushman Hydroelectric Project in 2009. The agreement resolved a $5.8 billion damages claim and long-standing disputes over the terms of a long-term license for Cushman Dam. The licensing settlement agreement concludes nearly two years of negotiations and decades of contention between Tacoma Power, the Skokomish Indian Tribe, and the many State and Federal agencies that will oversee implementation of the terms of the agreement. Due to the history and controversy surrounding this settlement agreement, USACE will not propose structural modifications to Cushman Dam, including dam removal, flow modifications, or operation adjustments, due to this history and controversy surrounding the settlement agreement.

2. Mason County Flood Ordinance: Comply with Mason County Flood Damage Prevention Ordinance No. 87-08. A special flood risk zone was established for the Zone A and A2 floodplain of the Skokomish River, Vance Creek, and tributaries, as shown on Flood Insurance Rate Maps; these zones are located in the feasibility study area. The special flood risk zone is designated as a floodway and an avulsion risk area, which imposes restrictions on new structures, existing structures, water flow modification structures, bridges, and roadways.
3. The Skokomish Indian Tribe is a federally recognized tribal nation that has treaty-reserved fishing, hunting, and gathering rights on the Skokomish River and has strong cultural and economic interests in the Basin. Proposed projects will avoid negative effects to tribal interests.

2.7 Public Scoping Comments and Resources of Concern*

Several public concerns have been identified during the course of the study. While many public scoping comments were related to the flooding problems in the study area, the non-Federal sponsors and study team have agreed to continue to pursue a single-purpose study focusing on ecosystem restoration only. More discussion of the study's single-purpose scope is described in Chapter 1.

In addition to the flood risk management concerns raised by the public, scoping comments acknowledged that the problems facing the Skokomish River Basin have had negative effects on aquatic habitat and species including endangered fish species. Comments specifically noted that frequent flooding and sediment buildup contribute to poor water quality which can negatively affect certain fish species. Comments encouraged channel restoration to improve habitat, as well as to alleviate flooding. These concerns were taken into account during the analysis of which resources should be included in the detailed analysis that appears in Chapter 4 of this document. A discussion of public involvement is included in Chapter 7, Public Involvement, Review, and Consultation.

3. Plan Formulation

The guidance for conducting civil works planning studies, Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, requires the systematic formulation of alternative plans that contribute to the Federal objective. To ensure that sound decisions are made with respect to development of alternatives and ultimately with respect to plan selection, the plan formulation process requires a systematic and repeatable approach. This chapter presents the results of the plan formulation process. Alternatives were developed in consideration of study area problems and opportunities as well as study objectives and constraints with respect to the four evaluation criteria described in the Principles and Guidelines (completeness, effectiveness, efficiency, and acceptability). Figure 3-1 presents a summary of the plan formulation process that will be presented throughout this chapter.

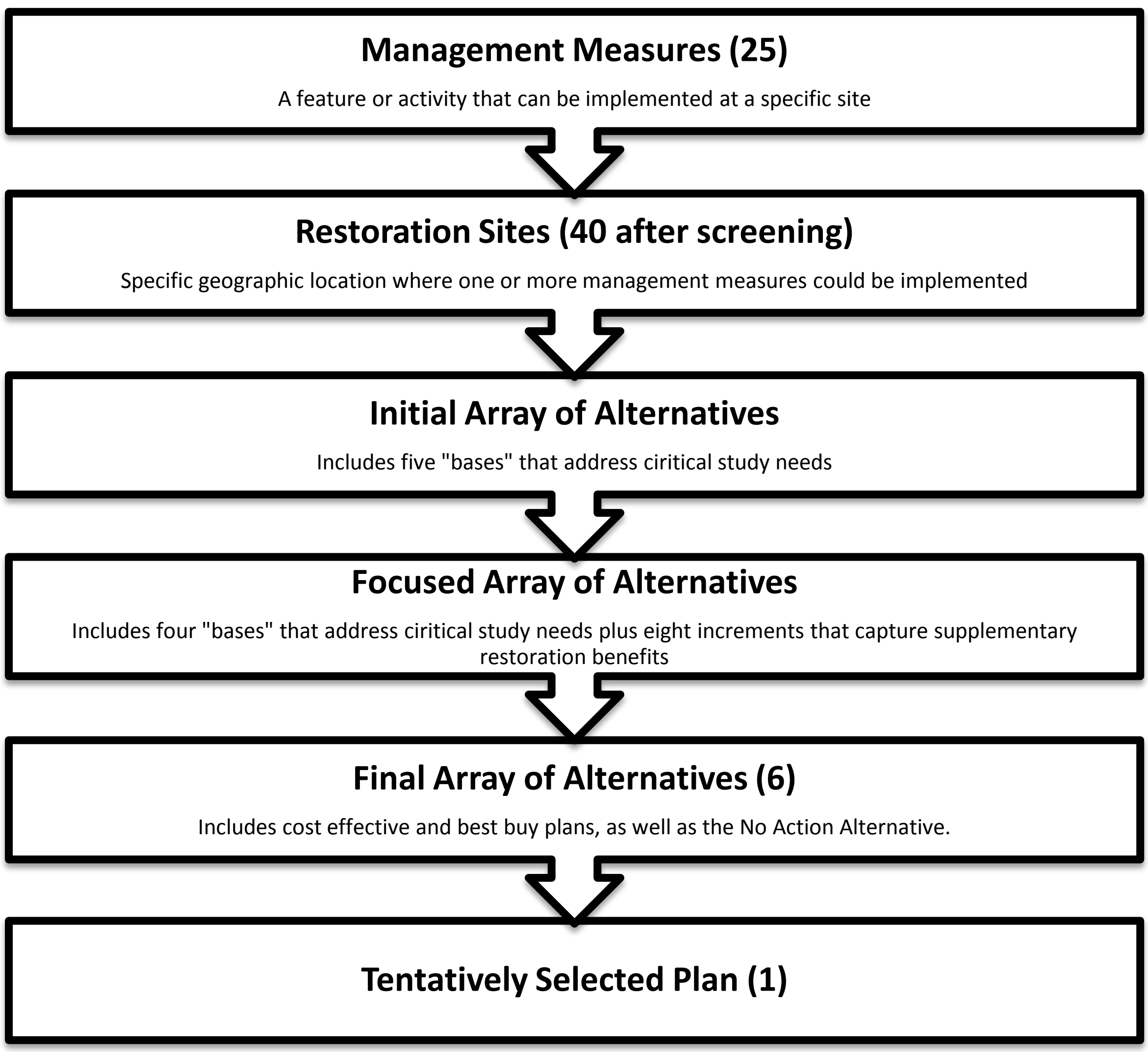


Figure 3-1. Plan Formulation Process

3.1 Management Measures

As part of the planning process for the study, the Project Delivery Team (PDT), in coordination with interested stakeholders and the general public, developed a series of measures to be considered as potential elements of the project solution. A management measure is a feature or activity at a site that addresses one or more of the planning objectives and is a discrete element of a recommended project solution. A total of 25 management measures were identified during preliminary planning stages. Management measures for this study are listed in the table below, along with the related objective(s) that each measure addresses. Measures include both structural and non-structural features.

Table 3-1. Management Measures and Relationship to Planning Objectives

Measure	Objectives			
	Provide Year-Round Passage	Restore Side Channels and Tributaries	Restore Riparian and Floodplain Habitats	Improve Pool Habitats
New channel creation at the historical confluence	X			X
Large-scale sediment removal; environmental dredging	X			X
Spot dredge	X			X
Sediment traps	X			
Selective gravel removal on gravel bars (remove the largest sediment sizes at downstream end of gravel bars) to reduce stream power required to mobilize smaller sediments				X
Remove or breach levees/dikes	X		X	
Construct setback levees/dikes			X	
Create salmonid spawning habitat			X	X
Reconnect wetlands, side channels, backwater areas, and tributaries		X	X	
Place large woody debris			X	X
Install engineered log jams			X	X
Install fish-passable weirs			X	
Install bank armor to stabilize riverbed sediments				
Plant riparian and estuarine vegetation (non-structural measure)		X	X	
Remove or minimize invasive species (non-structural measure)		X	X	
Culverts: add, remove, replace, or upgrade		X	X	X
Road modifications: raise roads, re-route roads, modify bridges or road prisms, decommission or remove roads to improve habitat availability and connectivity			X	
Rehabilitate bank lines: remove riprap, bulkheads, or hardened bank lines			X	
Place hard substrate for oyster attachment				

Install aeration system in Annas Bay				
Reconnect dendritic channels in estuary		X		
Riverbed and wetland vehicle exclusion (fence or barrier installation); non-structural measure				
Reroute power lines in estuary				
Fill estuary farm ditches				
Develop agricultural best management practices (non-structural measure)				

3.2 Screening of Measures

Screening is the ongoing process of eliminating, based on planning criteria, those measures that will not be carried forward for consideration. Criteria are derived for the specific planning study, based on the planning objectives, constraints, and the opportunities and problems of the study/project area. Preliminary criteria used to screen measures at this early stage are presented in the list below:

- Meets at least one planning objective
- Avoids planning constraints
- Access/land ownership considerations
- Size or scale is more conducive for local implementation

Table 3-2. Measures Screened from Further Evaluation

Measure Screened	Reason Screened			
	Does not meet at least one planning objective	**Does not avoid planning constraints**	**Access/land ownership considerations**	**Size or scale is more conducive for local implementation**
Place hard substrate for oyster attachment	X			X
Install aeration system in Annas Bay	X	X	X	
Reconnect dendritic channels in estuary				X
Riverbed and wetland vehicle exclusion	X			X
Reroute power lines in estuary	X		X	X
Fill estuary farm ditches	X			X
Develop agricultural best management practices	X			X

Based on these criteria, seven measures were not carried forward after preliminary screening, leaving 18 measures for further consideration. The seven measures screened are listed in Table 3-2. Nearly all of the measures that were screened from further evaluation at this stage were related to restoration of habitats in the estuary or nearshore of the Skokomish River. The estuary and nearshore were originally included in early plan formulation activities; however, due to successful and ongoing restoration of these areas under the Estuary Restoration Act, these areas were removed from formal consideration within the feasibility study area.

3.3 Siting of Measures

After initial screening of measures was completed, remaining measures were analyzed for additional considerations including: (1) combinability, (2) dependability, (3) mutual exclusion, and (4) site identification for project implementation. The study team, non-Federal sponsors, local and regional stakeholders, and the public identified approximately 60 specific sites within the study area where one or more measures could address specific limiting factors. Sites were selected based on locations of severe degradation, physical features that will provide an opportunity to improve types of degradation, access, and consideration of other complimentary proposed projects outside the range of the feasibility study. Preliminary measures were assigned to sites using best professional judgment of those features that will best function at the site for intended benefits. Qualitative considerations of sustainability, operations and maintenance, costs, real estate, scale, risk and reliability of performance, and type of benefit needed were considered when applying measures to sites.

A second round of preliminary screening occurred prior to combining the potential restoration sites into an initial array of alternatives. The 60 sites were qualitatively screened based on two primary factors: (1) Plans that have already received funding (or have submitted funding requests) to be constructed by Mason County, the Skokomish Tribe, or other local entity prior to completion of the feasibility study; and (2) plans that could be better accomplished by a local entity (due to the size, scale, or nature of the plan), and not through the feasibility study. After this screening, 40 restoration sites remained for consideration. Figure 3-2 shows the potential project sites in the study area after preliminary screening.

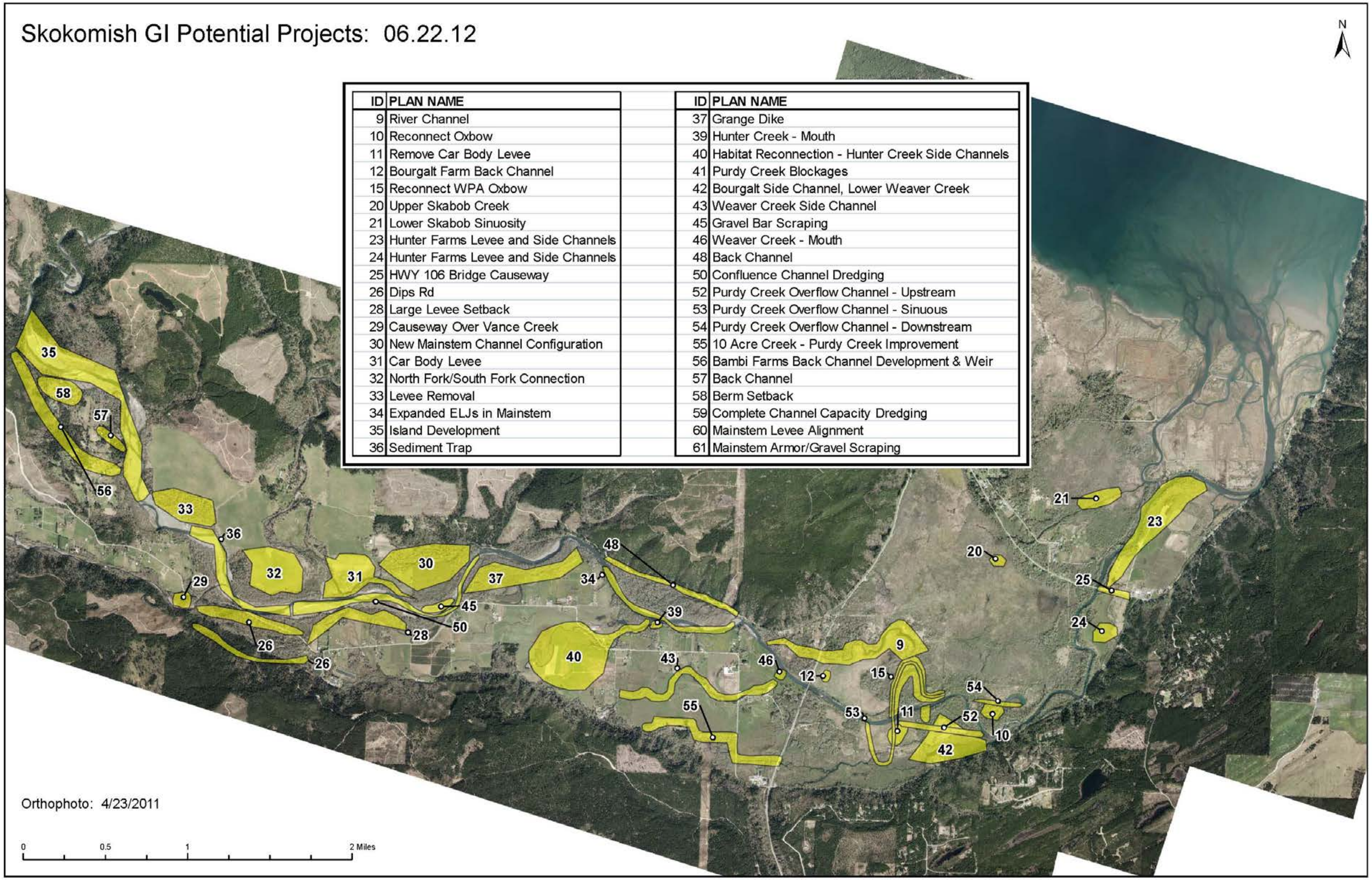


Figure 3-2. **Initial Siting of Measures (40 sites after preliminary screening)**

*Plan ID numbers 59, 60, 61 are located along the entire river (RM 0-9) and are not identified by yellow polygons on this map.

3.4 Initial Array of Alternatives

An initial array of alternatives was formulated based on preliminary data collection and best professional judgment. The study team identified which of the 40 potential restoration sites address the critical needs of the study area. This exercise led to the development of an initial array of alternatives that include a "base" measure. The "bases" are key measures that address the critical needs of the study area (improve the quantity, quality, and complexity of pools and provide year-round fish passage) and meet the purpose and need for action. Developing alternatives around these base measures ensures the critical needs of the study area are addressed. An alternative cannot be considered complete, acceptable, efficient, or effective unless one of these bases is included. Increments will be added to these base alternatives to capture added benefits associated with restoration of additional habitat features. All increments identified in Table 3-5 are dependent on a base; dependencies and combinability relationships are indicated in Table 3-5. The initial array of "bases" includes the following:

Base #1: Riverbed Excavation (River Mile 0-9)

This base includes two primary measures located at site ID #59: large-scale sediment removal and placement of LWD. The goal of this base is to restore mainstem river habitat by removing accumulated sediment and constructing habitat features from RM 0 to RM 9. This base addresses the project objectives of improving the quality, quantity, and complexity of pools and restoring a year-round channel near the confluence to allow for year-round migration. The river channel would be deepened by 8 to 10 feet, which will restore the channel capacity to roughly a two-year return interval probability. The two-year capacity was chosen to mimic typical Puget Sound channels; a two-year capacity will provide similar habitats and biological processes found within less degraded channels in the Puget Sound region.

The increase in channel capacity would allow the placement of additional habitat features (engineered log jams and LWD) while reducing the frequency of overbank flooding and fish stranding. This base would include roughly two LWD jams per mile from RM 0-8, with more placement opportunities at the mouth. Dredging may also require the construction of 6 to 8 larger LWD jams to provide bank protection for high erosion risk sites near RMs 6 and 7. Approximately 40 to 50 single logs per mile could be placed depending on channel conditions.

This base would require the removal of approximately 2.5 million cubic yards from the mainstem channel. The post-construction deposition rate is predicted to be the same as the without-project rate, approximately 35,000 cubic yards (cy) per year. Maintenance at approximately 20-year intervals would be necessary to remove accumulated sediment and maintain channel functions. Dredged material would be placed in the estuary and nearshore zone of Annas Bay which would constitute beneficial reuse of material and would provide suitable hard substrate for shellfish attachment.

Base #2: Confluence Channel Excavation

This base includes two primary measures located at site ID #50: spot-dredging and placement of LWD. The goal of this base is to lower the river thalweg to provide a continuous low flow channel during the late-summer base flow conditions to allow passage of migrating salmon. Fish passage would be restored between RM 7 and RM 9 of the Skokomish River mainstem, which is the reach that experiences subsurface flow during the late-summer/early fall low flow period. This base addresses the project objectives of improving the quality, quantity, and complexity of pools and restoring a year-round channel near the confluence to allow for year-round migration. To re-establish a continuous low flow channel, approximately 150,000 cubic yards of sediment would be removed from the mainstem from RM 7.3 to 8.8. The alignment of the dredged channel would follow the thalweg to minimize disturbance of the channel and the dredging volume. The total length of excavation would be 7,000 feet. This excavation could increase the discharge capacity of the river channel by about 4,000 cubic feet per second (cfs) and lower flood elevations locally by up to one foot. LWD would be placed in this reach to maintain the established channel path within the boundaries of the active river channel. Woody debris would also create deeper pools and hiding places, which are critical needs for fish in the system. This base addresses the project objectives on a much smaller scale than Base #1, focusing on improving channel capacity and habitat in the reach of the river where passage is most often blocked during the late-summer/early fall low flow period. Periodic maintenance may be necessary to remove sediment accumulations. Dredged material would be placed in the estuary and nearshore zone of Annas Bay, which constitutes beneficial reuse of material as it would provide suitable substrate for shellfish.

Base #3: North Fork/South Fork Confluence: Car Body Levee Removal

This base includes two primary measures located at site ID #31: removal of levees and placement of LWD. This base proposes removal of the levee on the north side of the mainstem near the original North Fork confluence. This base primarily addresses the project objective of restoring a continuous low flow channel near the confluence and to a lesser extent the objective of improving the quantity, quality, and complexity of pool habitat in the river. Mainstem flows would be diverted into the North Fork channel and reenter the mainstem at the confluence location. This would bypass the subsurface flow reach and provide improved fish migration. A portion of flood flows would stay in the old channel. Installed LWD would direct flow in the new channel and improve fish habitat. Periodic maintenance may be necessary to remove sediment accumulations from the new channel.

Corps staff conducted a site visit on October 25, 2013 and observed approximately five car bodies at the base of the western section of the levee. No distressed vegetation, stained soils, or odors were noted. The levee is heavily vegetated and access is limited. Based on available information including a Preliminary Phase I Site Assessment, HTRW expert analysis, site visit, and dissipation of pollutants after 80+ years of inundation, there are no HTRW concerns at the car body levee. At this time, the cars are assumed to be solid waste that will be disposed of by the Non-Federal Sponsors at an appropriate disposal site. Additional investigations during feasibility-level design could include clearing vegetation for access on the levee, determining whether engines, batteries, or fuel tanks are present or intact, and possible retrieval of soil samples for chemical analysis if odors, staining, smearing, etc. are discovered during feasibility-level design analysis. If these activities confirm the need for additional analysis, the Corps will conduct additional Phase II Assessment activities to characterize the site conditions.

Base #4: North/South Fork Confluence Channel

This base includes three primary measures located at site ID #30: spot-dredging, construction of a levee, and placement of LWD. The goal of this base is to restore the North Fork/South Fork confluence to its pre-2003 location at RM 8.4. This base addresses the project objective of restoring year-round passage near the confluence by increasing summer low flow. Approximately 50,000 cubic yards of sediment would be removed from the mainstem and North Fork channels. LWD would be placed to maintain channel alignment and facilitate creation of pools and hiding places. Periodic maintenance may be necessary to remove sediment accumulations from the restored confluence. Dredged material would be placed in the estuary and nearshore zone of Annas Bay, which would constitute beneficial reuse of material as it would provide suitable hard substrate for shellfish attachment.

Base #5: Riverbed Excavation (River Mile 3.5-9)

This base includes two primary measures located at site ID #59: large-scale sediment removal and placement of LWD. Dredging for Base #5 would start at RM 3.5 and continue upstream to RM 9. This base addresses the project objectives of improving the quality, quantity, and complexity of pools and restoring a year-round channel near the confluence to allow for year-round migration. The downstream limit was chosen because it will deliver the design discharge and associated bedload to a point where the river has some natural capacity to convey them to the mouth. It will channelize the flows through the reach between RMs 3.5 and 4 where bedload transport is at a minimum under existing conditions. For floods larger than the design discharge, flooding and low bedload transport will still occur between RMs 3.5 and 4. To assure the late summer connection to the South Fork, dredging must continue upstream past the old North Fork confluence to RM 9.

Similar to Base #1, an increase in channel capacity would allow the placement of additional habitat features (engineered logjams and LWD) while reducing the frequency of fish stranding caused by overbank flooding. This base would include roughly two LWD jams per mile from RM 3.5-8, with more placement opportunities at the mouth. Dredging may also require the construction of 6 to 8 larger LWD jams to provide bank protection for high erosion risk sites near RMs 6 and 7. Approximately 40 to 50 single logs per mile could be placed depending on channel conditions.

This base would require removal of approximately 1.9 million cubic yards from the mainstem channel. Periodic maintenance would be required to remove sediment accumulations. Dredged material would be placed in the estuary and nearshore zone of Annas Bay, which would provide suitable hard substrate for shellfish attachment constituting beneficial reuse of material.

Large Woody Debris

As noted in the descriptions above, all bases include placement of LWD. LWD is not a separable element of the bases. While the size, scale, and number of logjams to be installed vary among the bases, this measure was identified to be a critical habitat feature that should be included in any recommended plan in addition to the base. LWD has many benefits for juvenile salmon including increasing habitat complexity and number of pools, providing instream cover and predation refugia, and serves as a substrate for aquatic invertebrates that salmon rely on as a food source (Quinn 2005). Large accumulations of LWD also provide habitat for small mammals that serve as prey for owls and raptors, and perches for aquatic-oriented birds like belted kingfishers and American dippers. The general goal is to achieve approximately 64 logs, two to three feet in diameter and 15 to 30 feet long, per river mile based on recommendations found in Fox and Bolton (2007).

3.5 Evaluation of Initial Array

The initial array of bases was evaluated based on the decision criteria outlined in Table 3-4.

Table 3-3. Criteria for Evaluating the Initial Array of Bases

Evaluation Criteria	Metric / Threshold
Meets planning objectives	Number of objectives met
Avoids planning constraints	Yes / No
Environmental factors	Benefit to salmonids and other ESA-listed species Benefit to other fish and wildlife species Potential negative effects to salmonids and/or other habitat
Sustainability (ecological)	Low / Medium / High
Impact on fluvial geomorphic processes	Cubic yards of sediment to remove Discharge capacity
O&M requirements	Low / Medium / High

Table 3-4. Evaluation of Initial Array of Bases

Base #	Base Name	Base Description	Cubic Yards to Remove/Length of Excavation	Discharge Capacity (With-Project Condition)	Meets Study Objectives*	Benefits to Salmonids/Habitat	Negative Effects to Salmonids/Habitat	O&M Requirements	Sustainability
1	Riverbed Excavation (RM 0-9)	Dredge from RM 0 to RM 9 (complete mainstem dredge). Includes placement of LWD.	2.5 million cubic yards; RM 0 to 9	2-year flood capacity within the dredged reach	1, 4	Increases channel capacity to allow construction of additional in-channel habitat features; reduces fish stranding; may enhance recovery of listed species	Short-term construction impacts associated with large-scale dredging (risk of perhaps 2 to 3 years/spawning cycles)	High	Medium
2	Confluence Channel Excavation	South Fork channel dredged at confluence reach, RM 7.3 to 9.0. Includes limited placement of LWD.	150,000 cubic yards; RM 7.3 to 9.0; 7,000 ft.	Capacity increased by ~4,000 cfs within the dredged reach	1	Maintains two active channel habitats; maintains a continuous flow of water in S. Fork	Temporary disturbance of substrate reducing prey (aquatic insects) in this reach for up to 1 year	High	Medium
3	North Fork/South Fork Confluence: Car Body Levee Removal	Remove car body levee on north side of mainstem near original North Fork confluence. Mainstem flows would naturally divert into the North Fork channel and reenter the mainstem at the existing confluence location. Includes limited placement of LWD.	<10,000 cubic yards/~3,500 feet	No Change	1	Improves fish migration in subsurface reach; allows for continuous passage for fish; levee removal restores river processes	Restricts habitat to a single active channel; limited opportunity for habitat improvements (LWD) in the mainstem; potential loss of North Fork habitat near mouth; prey reduction for 1 year	Low	High
4	North Fork/South Fork Confluence Channel	Reconstruct confluence to return North Fork flows to the mainstem channel. Includes limited placement of LWD.	50,000 cubic yards	No Change	1	Provides continuity; North Fork habitat will remain as quality backwater/rearing habitat	Continued deposition in South Fork; cuts off high quality North Fork habitat; restricts habitat to a single active channel; prey reduction for 1 year	High	Low
5	Riverbed Excavation (RM 3.5-9)	Dredge from RM 3.5 to RM 9 (intermediate mainstem dredge). Includes placement of LWD.	1.9 million cubic yards; RM 3.5 to 9	2-year flood capacity within the dredged reach	1, 4 (smaller scale than Base #1)	Increases channel capacity to allow construction of additional habitat features; reduces fish stranding; may enhance recovery of listed species	Short-term construction impacts associated with large-scale dredging (risk of perhaps 2 to 3 years/spawning cycles)	High	Medium

*Study Objectives: (1) Provide year-round passage near confluence; (2) Restore side channels and tributary network; (3) Restore in-channel and floodplain habitats; (4) Increase quantity, quality, and complexity of pools

3.6 Focused Array of Alternatives

Based on an evaluation of the initial array of alternatives using the decision criteria outlined in Table 3-4, the Corps PDT recommended carrying Bases #1, #2, and #5 forward into the focused array of alternatives because they meet the study objectives and have the largest anticipated benefits to species of concern in the Basin. In addition, the study sponsors requested that Base #3 be carried forward into the focused array because the Car Body Levee removal would allow natural river processes to be restored in a sustainable way. Thus, the focused array of bases includes the following:

- No Action Alternative
- Base #1 (Riverbed Excavation: RM 0-9)
- Base #2 (Confluence Channel Excavation)
- Base #3 (Car Body Levee Removal)
- Base #5 (Riverbed Excavation: RM 3.5-9)

Base #4 was not carried forward for further analysis because directing North Fork flows into the original confluence area would disrupt high quality fish habitat that already exists in this reach. Bases #1, #2, #3, and #5 meet a greater number of study objectives and are anticipated to have greater positive effects to salmonid habitat compared to Base #4, which was not carried forward to the focused array. All Bases carried forward to the focused array meet the purpose and need for action.

Increments

Increments were added to the focused array of four bases to capture supplementary benefits associated with restoration of additional channel and floodplain habitat features. Potential increments considered for addition to the bases were selected from the list of 18 proposed management measures and 40 potential restoration sites using best professional judgment. Of the approximately 40 potential restoration sites, eight sites were identified by the study team as high priority in-channel or floodplain increments that would optimize the environmental benefits for an alternative plan. Potential floodplain increments include removal of blockages at the mouths of tributaries, restoration of side channel habitat, creation of new side channels, and levee setbacks. A cost-effectiveness/incremental cost analysis (CE/ICA) determined the appropriate number and scale of cost effective increments. The combinability of projects to base plans is further described in Section 3.6.2 along with the overall CE/ICA framework for the study.

Management measures that have been identified as potential increments include upstream LWD installation, four side channel reconnections/restorations, two levee setbacks, and a road setback/relocation; these measures could be constructed at eight high-priority sites identified by the PDT. All but one of these measures can be included as an increment to any of the bases carried forward in the focused array.

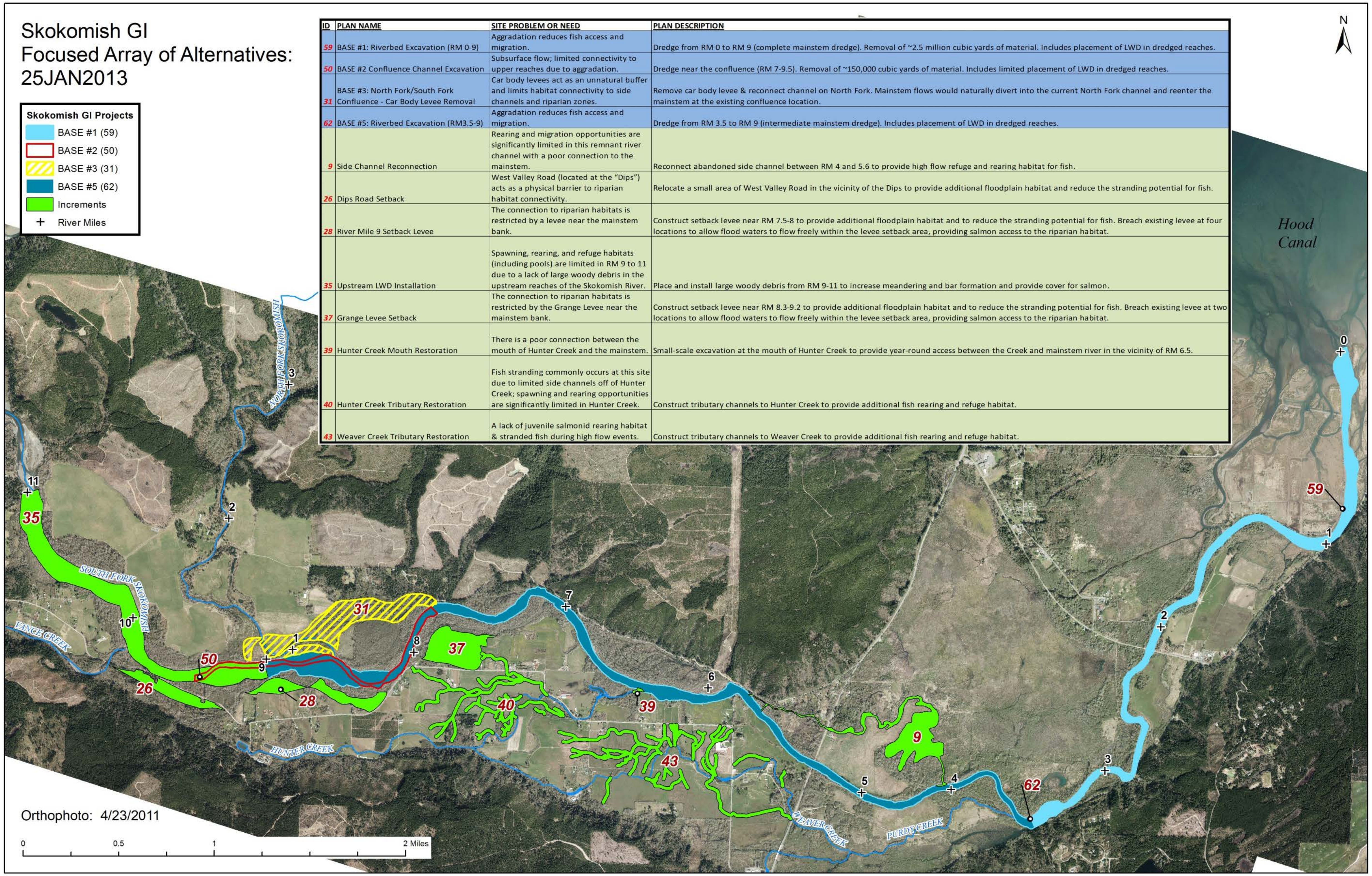
Table 3-5 includes key information about the proposed increments that could be added to the bases to capture added benefits associated with restoration of additional habitat features. Figure 3-3 shows the location of the focused array of bases and proposed increments within the study area.

Table 3-5. Proposed Restoration Increments

Project Site # (ID#)	Increment Name	Site Problem or Need	Increment Description	Increment to Base #	Dependencies
9	Side Channel Reconnection	Rearing and migration opportunities are significantly limited in this remnant river channel with a poor connection to the mainstem.	An abandoned channel that lies between RM 4 and 5.6 would be reconnected to the mainstem to provide high flow refuge and rearing habitat for fish. Restoration would involve constructing improvements to the channel inlet and outlet, while most of the channel would not be disturbed. The reconnected channel would only be connected to the mainstem river during high discharges and would not convey water year round. During high river discharges the reconnected channel would provide a low velocity refuge. During most of the year, the channel would provide pond habitat for fish rearing. Reconnecting the channel to the river could provide 45 acres of high quality, low velocity fish habitat. This increment would include planting of native vegetation.	1, 2, 3, 5	Stand Alone
26	Dips Road Setback	West Valley Road (located at the "Dips") acts as a physical barrier to riparian habitat connectivity.	The Dips Road relocation, located at RM 9.5-9.7, is intended to provide additional floodplain habitat and reduce the stranding potential for fish. A 3,700-foot section of the road between the Vance Creek and Swift Creek bridges would be relocated about 400 feet landward (south). This would place 17 acres of riparian forest on the riverward side of the road. The roadbed would be partially removed. Where the road embankment is higher than the adjacent ground the asphalt and roadbed material would be removed. Where the road is lower than adjacent ground only the asphalt would be removed. River sediments are expected to deposit in the remaining roadbed material and provide soil for vegetation to grow. This increment would include planting of native vegetation. The new road would follow the alignment #2 provided by Mason County on November 13, 2012 (reference Dips Road figures presented in the Draft Engineering Appendix). This alignment generally runs halfway between the river and the bluff to the south. If this increment is included in the recommend plan, refinement of the alignment will occur during the feasibility-level design phase. This increment is considered to be a relocation and will be entirely non-Federal sponsor expense.	1, 2, 3, 5	Stand Alone
28	River Mile 9 Setback Levee	The connection to riparian habitats is restricted by a levee near the mainstem bank.	The River Mile 9 Levee Setback, located at RM 8.3-9.2, is intended to provide additional floodplain habitat and reduce the stranding potential for fish. The levee would be moved landward (south) varying distances, generally around 200-300 feet. This would place more riparian forest and floodplain ponds on the riverward side of the levee. Four strategically located sections totaling approximately 950 feet of the levee would be removed. These breaches would allow flood waters to flow freely within the levee setback area, reconnecting the riparian zone to the aquatic habitat for the benefit of salmon and many other species. The entire levee would be designed for shallow overtopping. If Base #3 (car body levee removal) is selected, the overflow of this setback levee would be designed to function for 2-year and larger floods. If Base #1 (complete channel capacity dredging) or Base #5 (intermediate channel capacity dredging) is selected, the overflow could be designed to function for perhaps 10-year or larger floods. This increment would include planting of native vegetation. Construction of a setback levee is required to ensure there will be no induced flooding upstream or downstream of the site. Although the existing levees do not provide even 50% Annual Chance of Exceedance (ACE) flood risk management (less than a 2-year level of protection), they do control the distribution of floodwaters during the smaller floods that occur multiple times each year. The proposed setback levees are low (~5 feet) and would provide the same level of protection as currently exists for the structures located in the area. Therefore, the setback levees allow continued inundation to occur, and provide controlled access to additional floodplain, shallow-water, and riparian habitat without exacerbating flooding to the residents in the study area.	1, 2, 3, 5	Stand Alone

Project Site # (ID#)	Increment Name	Site Problem or Need	Increment Description	Increment to Base #	Dependencies
35	Upstream LWD Installation	Spawning, rearing, and refuge habitats (including pools) are limited in RM 9 to 11 due to a lack of large woody debris in the upstream reaches of the Skokomish River.	This increment, located from RM 9-11, would include placement and installation of large woody debris. Small LWD jams could be used in this reach to increase meandering and bar formation and provide cover for salmon. Under either base alternative, this reach of the channel may be able to incorporate 6 to 12 jams per mile without adverse flooding or erosion effects. Because there is already some LWD in the channel, this reach would only require 30 to 40 new single logs per mile to satisfy the biological criteria.	1, 2, 3, 5	Stand Alone
37	Grange Levee Setback	The Grange Levee near the mainstem bank restricts the connection to riparian habitats.	The Grange levee setback, located at RM 7.5-8, is intended to provide additional floodplain habitat and to reduce the stranding potential for fish. The levee would be moved landward (south) up to 1,200 feet. This would place about 40 acres of riparian habitat, forest, and floodplain ponds on the riverward side of the levee. Two strategically selected sections of the existing levee summing to approximately 800 ft would be breached. These breaches would allow flood waters to flow freely within the levee setback area, providing salmon access to the riparian habitat. The new setback levee would be around 2,900 feet long and would provide a similar level of flood risk reduction as the existing levee. The height of the setback levee could be lower if the large dredging alternative (base alternative #1 or base alternative #5) is the selected base plan. This increment would include planting of native vegetation. Construction of a setback levee is required to ensure there will be no induced flooding upstream or downstream of the site. Although the existing levees do not provide even 50% Annual Chance of Exceedance (ACE) flood risk management (less than a 2-year level of protection), they do control the distribution of floodwaters during the smaller floods that occur multiple times each year. The proposed setback levees are low (~5 feet) and would provide the same level of protection as currently exists for the structures located in the area. Therefore, the setback levees allow continued inundation to occur, and provide controlled access to additional floodplain, shallow-water, and riparian habitat without exacerbating flooding to the residents in the study area.	1, 2, 3, 5	Stand Alone
39	Hunter Creek Mouth Restoration	There is a poor connection between the mouth of Hunter Creek and the mainstem.	This increment involves a small-scale excavation at the mouth of Hunter Creek to provide year-round access between the Creek and mainstem river in the vicinity of RM 6.5.	2, 3	Stand Alone
40	Hunter Creek Tributary Restoration	Fish stranding commonly occurs at this site due to limited side channels off Hunter Creek; spawning and rearing opportunities are severely limited in Hunter Creek.	This increment involves the construction of tributary channels to Hunter Creek to provide additional fish rearing and refuge habitat. Hunter Creek is a perennial groundwater fed stream. The proposed restoration would consist of excavating small channels along existing swales down to slightly below the water table. The Hunter Creek channels would have a 4-foot bottom width and approximately 5-foot depth. The total length of channel would be approximately 21,250 feet. This increment would include planting of native vegetation.	1, 2, 3, 5	Dependent on Increment #39 (Hunter Creek Mouth Restoration) for Bases #2 and #3
43	Weaver Creek Tributary Restoration	A lack of juvenile salmonid rearing habitat and stranded fish during high flow events.	This increment involves the construction of tributary channels to Weaver Creek to provide additional fish rearing and refuge habitat. Weaver Creek is a perennial groundwater fed stream. The proposed restoration would consist of excavating small channels along existing swales down to slightly below the water table. The Weaver Creek channels would have a 4-foot bottom width and approximately 5-foot depth. The total length of channel would be approximately 27,110 feet. This increment would include planting of native vegetation.	1, 2, 3, 5	Stand Alone

*All increments are dependent on a base. No bases are combinable. Increment #39 (Hunter Creek Mouth Restoration) is not combinable with Base #1 or Base #5.



ID	PLAN NAME	SITE PROBLEM OR NEED	PLAN DESCRIPTION
59	BASE #1: Riverbed Excavation (RM 0-9)	Aggradation reduces fish access and migration.	Dredge from RM 0 to RM 9 (complete mainstem dredge). Removal of ~2.5 million cubic yards of material. Includes placement of LWD in dredged reaches.
50	BASE #2 Confluence Channel Excavation	Subsurface flow; limited connectivity to upper reaches due to aggradation.	Dredge near the confluence (RM 7-9.5). Removal of ~150,000 cubic yards of material. Includes limited placement of LWD in dredged reaches.
31	BASE #3: North Fork/South Fork Confluence - Car Body Levee Removal	Car body levees act as an unnatural buffer and limits habitat connectivity to side channels and riparian zones.	Remove car body levee & reconnect channel on North Fork. Mainstem flows would naturally divert into the current North Fork channel and reenter the mainstem at the existing confluence location.
62	BASE #5: Riverbed Excavation (RM3.5-9)	Aggradation reduces fish access and migration.	Dredge from RM 3.5 to RM 9 (intermediate mainstem dredge). Includes placement of LWD in dredged reaches.
9	Side Channel Reconnection	Rearing and migration opportunities are significantly limited in this remnant river channel with a poor connection to the mainstem.	Reconnect abandoned side channel between RM 4 and 5.6 to provide high flow refuge and rearing habitat for fish.
26	Dips Road Setback	West Valley Road (located at the "Dips") acts as a physical barrier to riparian habitat connectivity.	Relocate a small area of West Valley Road in the vicinity of the Dips to provide additional floodplain habitat and reduce the stranding potential for fish.
28	River Mile 9 Setback Levee	The connection to riparian habitats is restricted by a levee near the mainstem bank.	Construct setback levee near RM 7.5-8 to provide additional floodplain habitat and to reduce the stranding potential for fish. Breach existing levee at four locations to allow flood waters to flow freely within the levee setback area, providing salmon access to the riparian habitat.
35	Upstream LWD Installation	Spawning, rearing, and refuge habitats (including pools) are limited in RM 9 to 11 due to a lack of large woody debris in the upstream reaches of the Skokomish River.	Place and install large woody debris from RM 9-11 to increase meandering and bar formation and provide cover for salmon.
37	Grange Levee Setback	The connection to riparian habitats is restricted by the Grange Levee near the mainstem bank.	Construct setback levee near RM 8.3-9.2 to provide additional floodplain habitat and to reduce the stranding potential for fish. Breach existing levee at two locations to allow flood waters to flow freely within the levee setback area, providing salmon access to the riparian habitat.
39	Hunter Creek Mouth Restoration	There is a poor connection between the mouth of Hunter Creek and the mainstem.	Small-scale excavation at the mouth of Hunter Creek to provide year-round access between the Creek and mainstem river in the vicinity of RM 6.5.
40	Hunter Creek Tributary Restoration	Fish stranding commonly occurs at this site due to limited side channels off of Hunter Creek; spawning and rearing opportunities are significantly limited in Hunter Creek.	Construct tributary channels to Hunter Creek to provide additional fish rearing and refuge habitat.
43	Weaver Creek Tributary Restoration	A lack of juvenile salmonid rearing habitat & stranded fish during high flow events.	Construct tributary channels to Weaver Creek to provide additional fish rearing and refuge habitat.

Figure 3-3. Focused Array of Bases and Potential Increments. Legend key: bases are shaded in blue; increments are shaded in green. Bases will be combined with increments to form alternatives.

3.7 Evaluation of Focused Array of Alternatives

To effectively evaluate the focused array of alternatives, the PDT completed additional analysis including development of conceptual designs, development of parametric cost estimates, and evaluation of environmental outputs. Based on these parameters, a CE/ICA was completed to help evaluate and quantify significant contributions or effects of individual plans. The following sections outline the assumptions and outcomes of this work in addition to the results of the CE/ICA.

3.7.1 Cost Estimates

The basis of the cost estimates is conceptual design drawings prepared by the PDT. Additional information developed by the PDT is incorporated into the estimate. The cost estimates were prepared using Micro-Computer Aided Cost Estimating System (MCASES) MII version 4, build 4. Some aspects of the dredging work associated with the project were developed using the most current version of the Corps of Engineers Dredge Estimating Program. The MCACES estimate carefully documents the basis of information used in development of costs, down to the lowest reasonable level.

The cost estimates were prepared at a Class 4 level under the expectation this product will receive authorization from a higher authority. Per ER 1110-2-1302, a Class 3 estimate is supported by a discussion of scope and uncertainties, with particular attention paid to large cost items. The estimate for each feature of the project alternatives has detailed prepared quantities, and where gaps in scope occurred, these were clarified with the PDT. Uncertainties are documented in the informal Cost Risk Analysis risk register presented in Appendix K.

Table 3-6 shows the present value construction and real estate costs, computed interest during construction (IDC), periodic operations and maintenance (O&M) costs, and total investment costs and annualized costs for each base alternative and increment. It was assumed that the increments would require minimal maintenance; Base #3 is also expected to require minimal O&M. Minimal maintenance for Base #3 and the increments is expected to be approximately $5,000 per year or less and focus on minor inspection and periodic levee maintenance activities. Based on the expected sediment deposition, Bases #1, #2, and #5 would require periodic sediment excavation to maintain channel capacity. For Bases #1 and #5, maintenance is estimated to occur every 20 years (see Section 4.3.2.2), or for two cycles during the period of analysis (in years 20 and 40). The shallower Base #2 channel would require more frequent maintenance to preserve the channel. Base #2 is expected to require maintenance every 10 years, or five cycles during the period of analysis (in years 10, 20, 30, 40, and 50). More detailed cost information can be found in Appendix K.

Costs were annualized using the Institute for Water Resources (IWR) Planning Suite Annualization Tool (USACE certified version 2.0.6.0) using the construction cost, real estate cost, construction period (in months) for IDC computations, estimated O&M, the discount rate (the fiscal year 2013 discount rate is 3.75 percent), and a 50-year period of analysis.

Table 3-6. Average Annual Cost of Bases and Increments

Project Site Number (ID #)	Project Name	Construction Cost (1,000s)	Real Estate Cost Estimate ($1,000s)	Interest During Construction ($1,000s)	Total Investment Cost ($1,000s)	Cost for periodic O&M / Frequency	Total Average Annual Cost ($1,000s)
59	Base #1: Riverbed Excavation (RM 0-9)	$141,391	$2	$7,173	$148,567	$43.4 M / Every 20 years (2x)	$8,035
50	Base #2: Confluence Channel Excavation	$14,017	$2	$65	$14,084	$6.2 M / Every 10 years (5x)	$1,153
31	Base #3: Car Body Levee Removal	$6,721	$741	$62	$7,525		$335
62	Base #5: Riverbed Excavation (RM 3.5-9)	$94,756	$2	$2,816	$97,575	$38.0 M / Every 20 years (2x)	$5,548
9	Side Channel Reconnection	$1,024	$2,069	$3	$3,096		$138
26	Dips Road Setback	$5,148	$97	$40	$5,285		$236
28	River Mile 9 Levee Setback	$2,250	$101	$14	$2,365		$105
35	Upstream LWD Installation	$870	$2,357	$3	$3,229		$144
37	Grange Levee Setback	$2,722	$538	$17	$3,277		$146
39	Hunter Creek Tributary Mouth	$11	$193	$0	$204		$9
40	Hunter Creek Tributary Reconnection	$4,190	$1,100	$13	$5,303		$236
43	Weaver Creek Tributary Reconnection	5,318	$2,261	$25	$7,603		$339

3.7.2 Environmental Outputs

The Skokomish River Ecosystem Benefits Model is a habitat suitability index model, also called an ecosystem outputs (EO) model, accounting for the quality (suitability index score between 0.0 and 1.0) and quantity (area of restoration site) of available habitat for native salmonids, which are an indicator species for overall ecosystem health in the Pacific Northwest. Data published by the Washington Conservation Commission (Correa 2003) and USFWS (Peters et al. 2011) on the species' habitat requirements, preferences, and limiting factors were synthesized into a series of variables and suitability indices, which are mathematical representations of hypotheses regarding species-habitat relationships.

The EO model focuses on three key habitat requirements that most affect salmonid rearing, reproduction, and mortality in the Skokomish River – channel habitat quality, floodplain habitat connectivity, and channel capacity. Each key habitat requirement includes assessment metrics that were identified as indicators of the limiting factors. Channel habitat quality includes metrics for pools and woody debris to assess migration, resting, and rearing habitat. Floodplain habitat quality includes metrics for riparian cover and connectivity to assess refugia, feeding, and rearing habitat. Finally, the channel capacity factor is included to provide a score for reducing overbank flood probability of occurrence. In aggrading rivers, lack of channel capacity causes displacement of juvenile and adult fish during overbank flows in which they become stranded in floodplain areas without access to return to the river. It is impossible to quantify losses from stranding; however, studies on other rivers in the region show a high correlation between high river flows and reduced survival of incubating eggs to reach migrant fry life stage (Seiler et al. 2003, Beamer et al. 2005). This metric is used as a surrogate for quantifying mortality due to stranding, which affects reproduction, adult and juvenile migration, and survival (see Figure 7 and Figure 8 in Appendix F).

Table 3-7 summarizes the benefits for each base or increment to be carried forward for the cost effectiveness and incremental costs analyses. Complete documentation of the Skokomish River Environmental Benefits Model is presented in Appendix F.

Table 3-7. Environmental Outputs by Restoration Project

Project Site Number (ID #)	Project Name	Total Acres Affected	AAHU (EO Model)	AAHU (Shellfish Substrate)	Total AAHU
59	Base #1: Riverbed Excavation (RM 0-9)	219 + 843 shellfish = 1,062	184.2	210.8	395.0
50	Base #2: Confluence Channel Excavation	26	17.5	n/a	17.5
31	Base #3: Car Body Levee Removal	68	45.9	n/a	45.9
62	Base #5: Riverbed Excavation (RM 3.5-9)	132 + 219 shellfish = 643	111.0	127.8	238.8
9	Side Channel Reconnection	45	25.7	n/a	25.7
26	Dips Road Setback	17	12.7	n/a	12.7
28	River Mile 9 Levee Setback	23	13.6	n/a	13.6
35	Upstream LWD Installation	107	82.9	n/a	82.9
37	Grange Levee Setback	34	18.5	n/a	18.5
39	Hunter Creek Tributary Mouth Restoration	0.5	0.3	n/a	0.3
40	Hunter Creek Tributary Reconnection	29	20.1	n/a	20.1
43	Weaver Creek Tributary Reconnection	25	19.4	n/a	19.4

As the study team developed conceptual designs and cost estimates for the bases, several disposal options were identified for the riverbed excavation bases. Placement of dredged material in the Skokomish estuary and nearshore zone appeared as the most feasible disposal option (other options included disposal in a nearby quarry or open-water disposal). Dredged material from the Skokomish

River has been identified as suitable for placement by appropriate technical experts. Placement of dredged material in approximately 800 acres of the estuary would create high quality shellfish habitat (i.e., hard substrate for oyster attachment) and would significantly reduce costs associated with transportation and disposal of up to 2.5 million cubic yards of dredged material outside the study area.

It should be noted that the EO model does not formally account for the benefits associated with placing dredged material in the estuary for shellfish attachment; the model only captures benefits related to channel habitat quality, floodplain habitat connectivity, and mainstem river channel capacity to calculate Average Annual Habitat Units (AAHUs). To capture the approximate benefits associated with placement of hard substrate in the estuary for shellfish habitat, the study team developed a conservative estimate for the habitat quality change in the estuary and nearshore that would result from placement of dredged material. These outputs are presented in the "AAHU (Shellfish Substrate)" column of Table 3-7 and are fully described in the Economics Appendix (Appendix G). Habitat Units calculated by the EO model (presented in the "AAHU (EO Model)" column of Table 3-7 were added to habitat units calculated outside of the ecosystem benefits model (shellfish substrate) to determine total habitat units. The total outputs appear in the "Total AAHU" column of Table 3-7.

3.7.3 Cost Effectiveness and Incremental Cost Analysis

This section describes the model inputs for performing the cost effectiveness and incremental cost analyses using the IWR Planning Suite, version 2.0.6.0 (USACE certified model). The Corps' IWR developed this software to assist with the formulation and comparison of alternative plans. The software can assist with plan formulation by combining solutions to planning problems and calculating the additive effect of each combination, or "plan", by utilizing inputs on outputs (AAHU's), costs, and rules (combinability and dependency relationships) for combining solutions into plans. Plans are then compared in IWR Planning Suite by conducting CE/ICA, identifying the plans which are the best financial investments, and displaying the effects of each on a range of decision variables.

3.7.3.1 Cost Effectiveness Analysis

Multiple runs of CE/ICA were completed that included various sensitivity analyses. Cost effective plans are plans that provide a level of environmental output at the least cost. The CE/ICA results presented in this section include the additional shellfish substrate benefits that were discussed in Section 3.6.2.1. While the inclusion of these benefits in the analysis is an important factor, it should be noted that the array of best buy plans identified by the CE/ICA analysis does not change if CE/ICA is run without the inclusion of these additional benefits. Because inclusion of shellfish benefits more appropriately captures all possible benefits of the proposed restoration alternatives, they are presented in the CE/ICA results below.

A total of 705 possible plan combinations were evaluated in the CE/CIA analysis. Of these, 60 plans (including the No-Action Alternative) were identified as cost effective. These plans are listed in Table 3-8 and displayed in Figure 3-4 as those plans that provide a given level of output at the lowest cost denoted by blue triangles (cost effective plans) and red squares (best buy plans, refer to Section 3.6.3.2). Those plans that are not cost effective are denoted by clear circles.

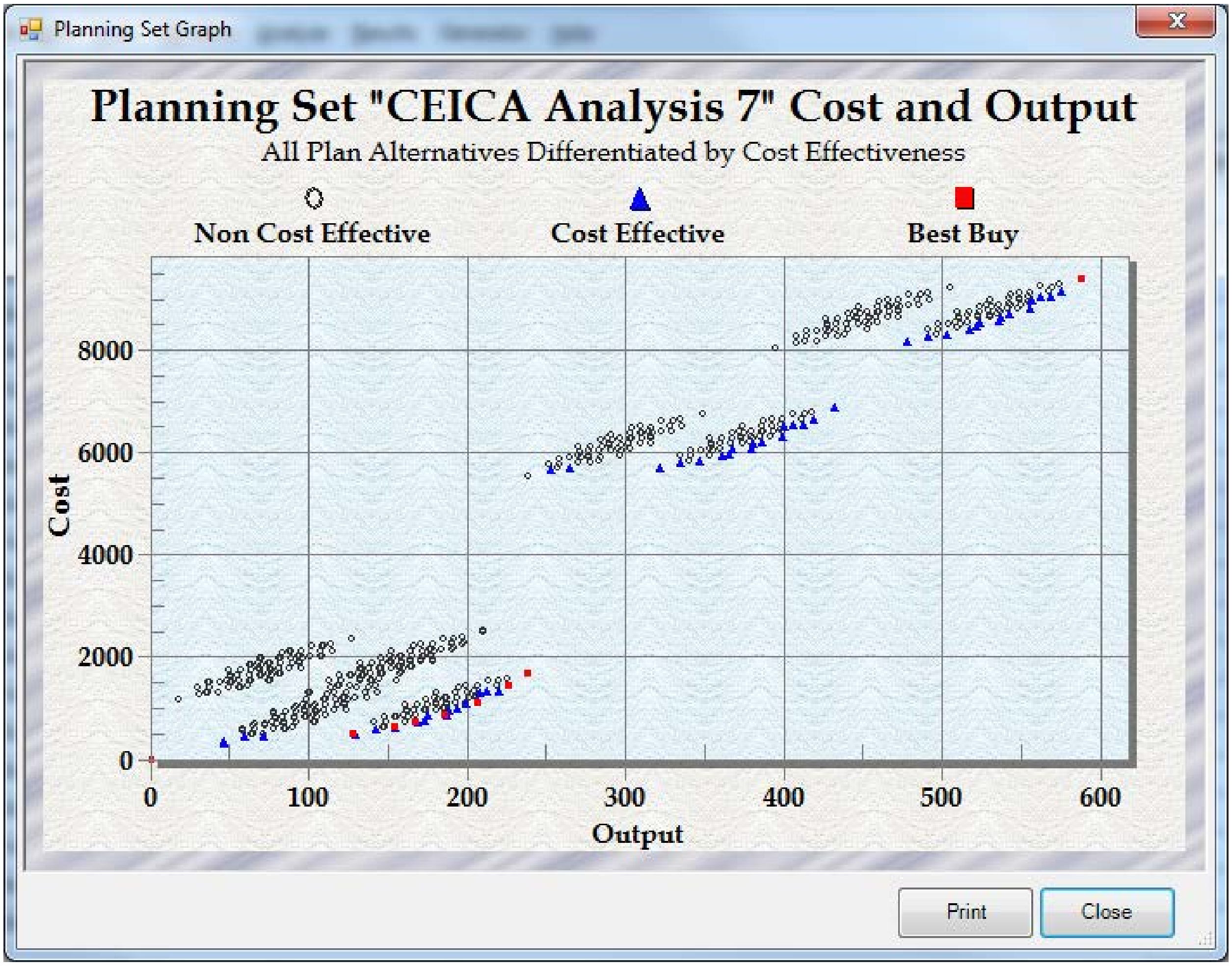


Figure 3-4. Cost Effectiveness Results

The table below outlines the 60 cost effective plans (including the No-Action Alternative) as identified using the CE/ICA analysis. Plans in bold represent "best buy" plans. The plans identified in color were carried forward into the final array of alternatives; this screening and evaluation process is described in subsequent sections of this chapter.

Table 3-8. Cost Effective Plans*

Alternative #	Plan Components	AAHU (In-Channel, Floodplain, and Capacity)	AAHU (Shellfish Substrate)	Total AAHU	Total Average Annual Cost ($1,000s)	Average Annual Cost/ AAHU
1	**No Action Plan**	**0.0**	**0.0**	**0.0**	**0**	
2	Base 3	45.9	0.0	45.9	335	7.30
3	Base 3+ Increment 39	46.2	0.0	46.2	344	7.45
4	Base 3+ Increment 28	59.5	0.0	59.5	440	7.39
5	Base 3+ Increments 28+39	59.8	0.0	59.8	449	7.51
6	Base 3+ Increment 9	71.6	0.0	71.6	473	6.61
7	**Base 3+ Increment 35**	**128.8**	**0.0**	**128.8**	**479**	**3.72**

Alternative #	Plan Components	AAHU (In-Channel, Floodplain, and Capacity)	AAHU (Shellfish Substrate)	Total AAHU	Total Average Annual Cost ($1,000s)	Average Annual Cost/ AAHU
8	Base 3+ Increments 35+39	129.1	0.0	129.1	488	3.78
9	Base 3+ Increments 35+28	142.4	0.0	142.4	584	4.10
10	Base 3+ Increments 35+28+39	142.7	0.0	142.7	593	4.16
11	**Base 3+ Increments 35+9**	**154.5**	**0.0**	**154.5**	**617**	**3.99**
12	Base 3+ Increments 35+9+39	154.8	0.0	154.8	626	4.04
13	**Base 3+ Increments 35+9+28**	**168.1**	**0.0**	**168.1**	**722**	**4.30**
14	Base 3+ Increments 35+9+28+39	168.4	0.0	168.4	731	4.34
15	Base 3+ Increments 35+9+37	173.0	0.0	173.0	763	4.41
16	Base 3+ Increments 35+9+37+39	173.3	0.0	173.3	772	4.45
17	Base 3+ Increments 35+9+39+40	174.9	0.0	174.9	862	4.93
18	**Base 3+ Increments 35+9+28+37**	**186.6**	**0.0**	**186.6**	**868**	**4.65**
19	Base 3+ Increments 35+9+28+37+39	186.9	0.0	186.9	877	4.69
20	Base 3+ Increments 35+9+39+40+28	188.5	0.0	188.5	967	5.13
21	Base 3+ Increments 35+9+37+39+40	193.4	0.0	193.4	1,008	5.21
22	Base 3+ Increments 35+9+28+37+26	199.3	0.0	199.3	1,104	5.54
23	**Base 3+ Increments 35+9+28+37+39+40**	**207.0**	**0.0**	**207.0**	**1,113**	**5.38**
24	Base 3+ Increments 35+9+28+39+40+43	207.9	0.0	207.9	1,306	6.28
25	Base 3+ Increments 35+9+37+39+40+43	212.8	0.0	212.8	1,347	6.33
26	Base 3+ Increments 35+9+28+37+39+40+26	219.7	0.0	219.7	1,349	6.14
27	**Base 3+ Increments 35+9+37+39+40+43+28**	**226.4**	**0.0**	**226.4**	**1,452**	**6.41**
28	**Base 3+ Increments 35+9+37+39+40+43+28+26**	**239.1**	**0.0**	**239.1**	**1,688**	**7.06**
29	Base 5+ Increment 28	124.6	127.8	252.4	5,653	22.40
30	Base 5+ Increment 9	136.7	127.8	264.5	5,686	21.50
31	Base 5+ Increment 35	193.9	127.8	321.7	5,692	17.69
32	Base 5+ Increments 35+28	207.5	127.8	335.3	5,797	17.29
33	Base 5+ Increments 35+9	219.6	127.8	347.4	5,830	16.78
34	Base 5+ Increments 35+9+28	233.2	127.8	361.0	5,935	16.44
35	Base 5+ Increments 35+9+37	238.1	127.8	365.9	5,976	16.33
36	Base 5+ Increments 35+9+40	239.7	127.8	367.5	6,066	16.51
37	Base 5+ Increments 35+9+28+37	251.7	127.8	379.5	6,081	16.02
38	Base 5+ Increments 35+9+28+40	253.3	127.8	381.1	6,171	16.19
39	Base 5+ Increments 35+9+40+37	258.2	127.8	386.0	6,212	16.09
40	Base 5+ Increments 35+9+40+37+28	271.8	127.8	399.6	6,317	15.81
41	Base 5+ Increments 35+9+28+40+43	272.7	127.8	400.5	6,510	16.25
42	Base 5+ Increments 35+9+28+40+43+37	277.6	127.8	405.4	6,551	16.16
43	Base 5+ Increments 35+9+40+37+28+26	284.5	127.8	412.3	6,553	15.89
44	Base 5+ Increments 35+9+40+37+28+43	291.2	127.8	419.0	6,656	15.89
45	Base 5+ Increments 35+9+40+37+28+43+26	303.9	127.8	431.7	6,892	15.96
46	Base 1+ Increment 35	267.1	210.8	477.9	8,179	17.11
47	Base 1+ Increments 35+28	280.7	210.8	491.5	8,284	16.85
48	Base 1+ Increments 35+9	292.8	210.8	503.6	8,317	16.52
49	Base 1+ Increments 35+9+28	306.4	210.8	517.2	8,422	16.28
50	Base 1+ Increments 35+9+37	311.3	210.8	522.1	8,463	16.21

Alternative #	Plan Components	AAHU (In-Channel, Floodplain, and Capacity)	AAHU (Shellfish Substrate)	Total AAHU	Total Average Annual Cost ($1,000s)	Average Annual Cost/ AAHU
51	Base 1+ Increments 35+9+40	312.9	210.8	523.7	8,553	16.33
52	Base 1+ Increments 35+9+28+37	324.9	210.8	535.7	8,568	15.99
53	Base 1+ Increments 35+9+28+40	326.5	210.8	537.3	8,658	16.11
54	Base 1+ Increments 35+9+40+37	331.4	210.8	542.2	8,699	16.04
55	Base 1+ Increments 35+9+40+37+28	345.0	210.8	555.8	8,804	15.84
56	Base 1+ Increments 35+9+28+40+43	345.9	210.8	556.7	8,997	16.16
57	Base 1+ Increments 35+9+28+40+43+37	350.8	210.8	561.6	9,038	16.09
58	Base 1+ Increments 35+9+40+37+28+26	357.7	210.8	568.5	9,040	15.90
59	Base 1+ Increments 35+9+40+37+28+43	364.4	210.8	575.2	9,143	15.90
60	**Base 1+ Increments 35+9+40+37+28+43+26**	**377.1**	**210.8**	**587.9**	**9,379**	**15.95**

*Plans in bold represent "Best Buy" plans.

3.7.3.2 Incremental Cost Analysis

An incremental cost analysis identified nine of the above plans as "Best Buy" plans, defined as those cost effective plans that provide the greatest incremental increase in output (benefits) for the lowest incremental increase in cost. These best buy plans are listed in Table 3-9 and displayed as a bar graph in Figure 3-5. Plans highlighted in color have been carried forward into the final array of alternatives. The process used to carry these plans forward is described in the following sections.

Table 3-9. Incremental Cost Analysis: Best Buy Plans

Alternative #	Plan Components	Total Output in AAHU's	Total Average Annual Cost (AAC in $K)	AAC/ AAHU ($K)	Incremental Cost/Incremental Output ($K)	Total Present Value Cost ($K)	Cost Effective and/or Best Buy?	Improves Egg-to-Fry Survival?
1	No Action Plan	0.0	0				Best Buy 1	No
7	Base #3: Car Body Levee Removal +35	128.8	479	$3.71	$3.71	$10,754	Best Buy 2	No
11	Base #3: Car Body Levee Removal +35+9	154.5	617	$3.99	$5.37	$13,850	Best Buy 3	No
13	Base #3: Car Body Levee Removal +35+9+28	168.1	722	$4.30	$7.72	$16,215	Best Buy 4	No
18	Base #3: Car Body Levee Removal +35+9+28+37	186.6	868	$4.65	$7.89	$19,492	Best Buy 5	No
23	Base #3: Car Body Levee Removal +35+9+28+37+39+40	207.0	1,113	$5.38	$12.01	$24,999	Best Buy 6	No
27	Base #3: Car Body Levee Removal +35+9+37+28+39+40+43	226.4	1,452	$6.41	$17.47	$32,602	Best Buy 7	No

Alternative #	Plan Components	Total Output in AAHU's	Total Average Annual Cost (AAC in $K)	AAC/ AAHU ($K)	Incremental Cost/Incremental Output ($K)	Total Present Value Cost ($K)	Cost Effective and/or Best Buy?	Improves Egg-to-Fry Survival?
28	Base #3: Car Body Levee Removal +35+9+37+28+39+40+43 +26	239.1	1,688	$7.06	$18.58	$37,887	Best Buy 8	No
45	Base #5: Riverbed Excavation RM 3.5-9 +35+9+37+28+40+43+26	431.7	6,892	$15.96	$27.02	$154,623	Cost Effective	Yes
60	Base #1: Riverbed Excavation RM 0-9 +35+9+37+28+40+43+26	587.9	9,379	$16.00	$22.05	$210,434	Best Buy 9	Yes

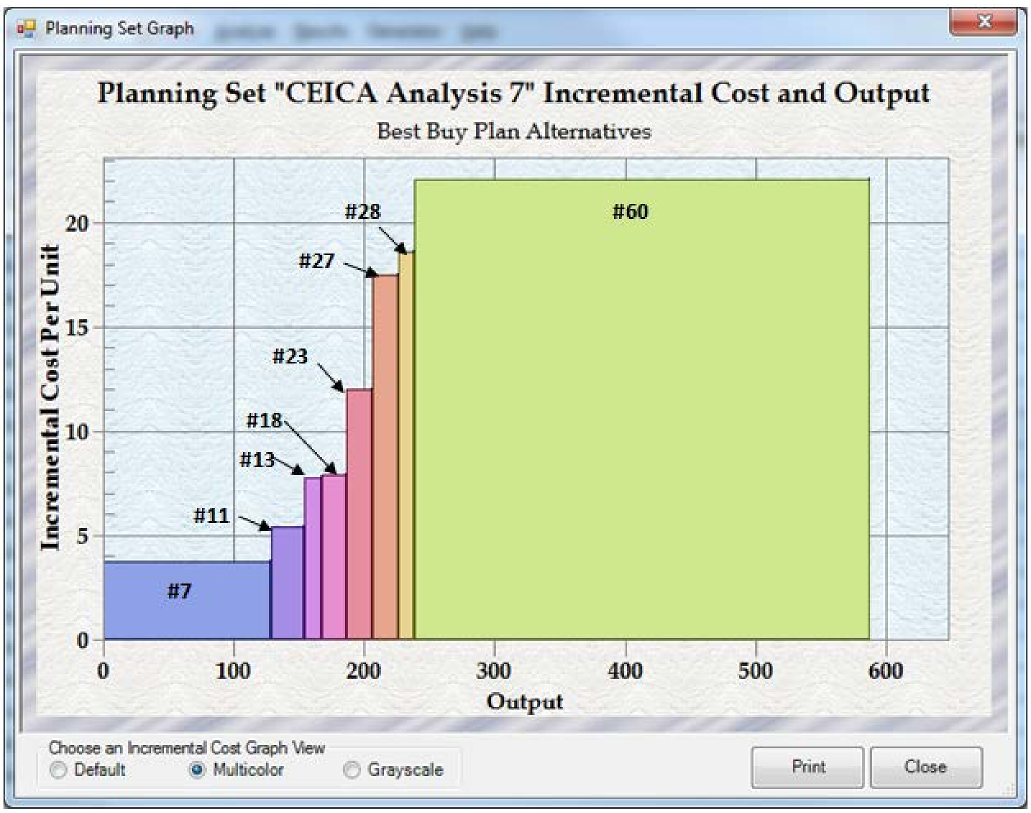


Figure 3-5. CE/ICA Results

3.8 Final Array of Alternatives

The alternatives carried forward for detailed evaluation in the final array were chosen based on CE/ICA results, total cost, incremental cost, and ecological value added between increments. This step resulted in carrying forward six alternatives (including the No Action Alternative) into the final array of alternatives. Alternative #7 was carried forward because it is the least cost best buy; this plan represents the minimum Federal investment for the study. Alternative #23 was carried forward because it is the first alternative that includes tributary restorations, a critical measure that restores spawning and rearing habitats in the floodplain. While Alternative #18 has a minimal increase in incremental cost for additional HUs, it was not carried forward because it does not include tributary restorations. Alternative #28 was carried forward because it represents the largest-scale Car Body Levee Removal alternative. While Alternative #45 is cost effective only, it was carried forward into the final array of alternatives because it meets the critical needs of the study area while requiring a smaller extent of dredging compared to Alternative #60. Alternative #60 was carried forward because it is the largest-scale Best Buy Plan and represents the most significant Federal investment for the study.

Each alternative included in the final array meets the purpose and need for action. The final array of alternatives is described below and identified in Figure 3-6.

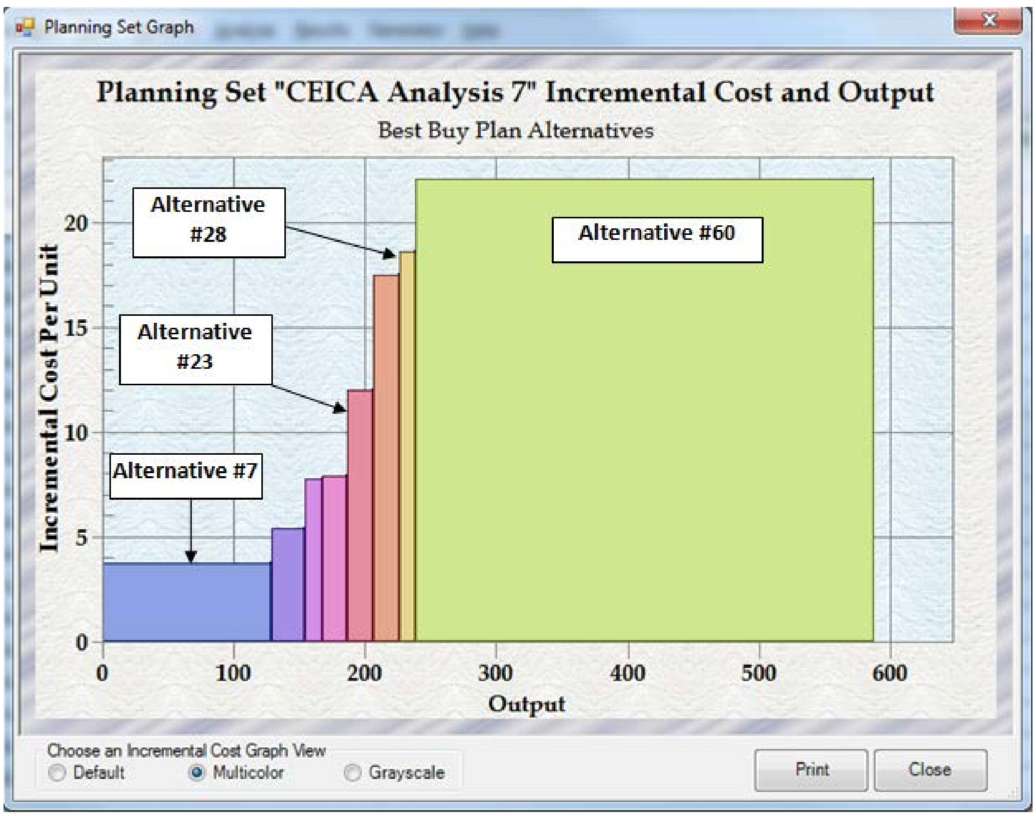


Figure 3-6. Final Array of Alternatives

No Action Alternative*

Under the No Action plan, which is synonymous with the "Future Without-Project Condition," the assumption is that no project would be implemented by the Corps to achieve the planning objectives.

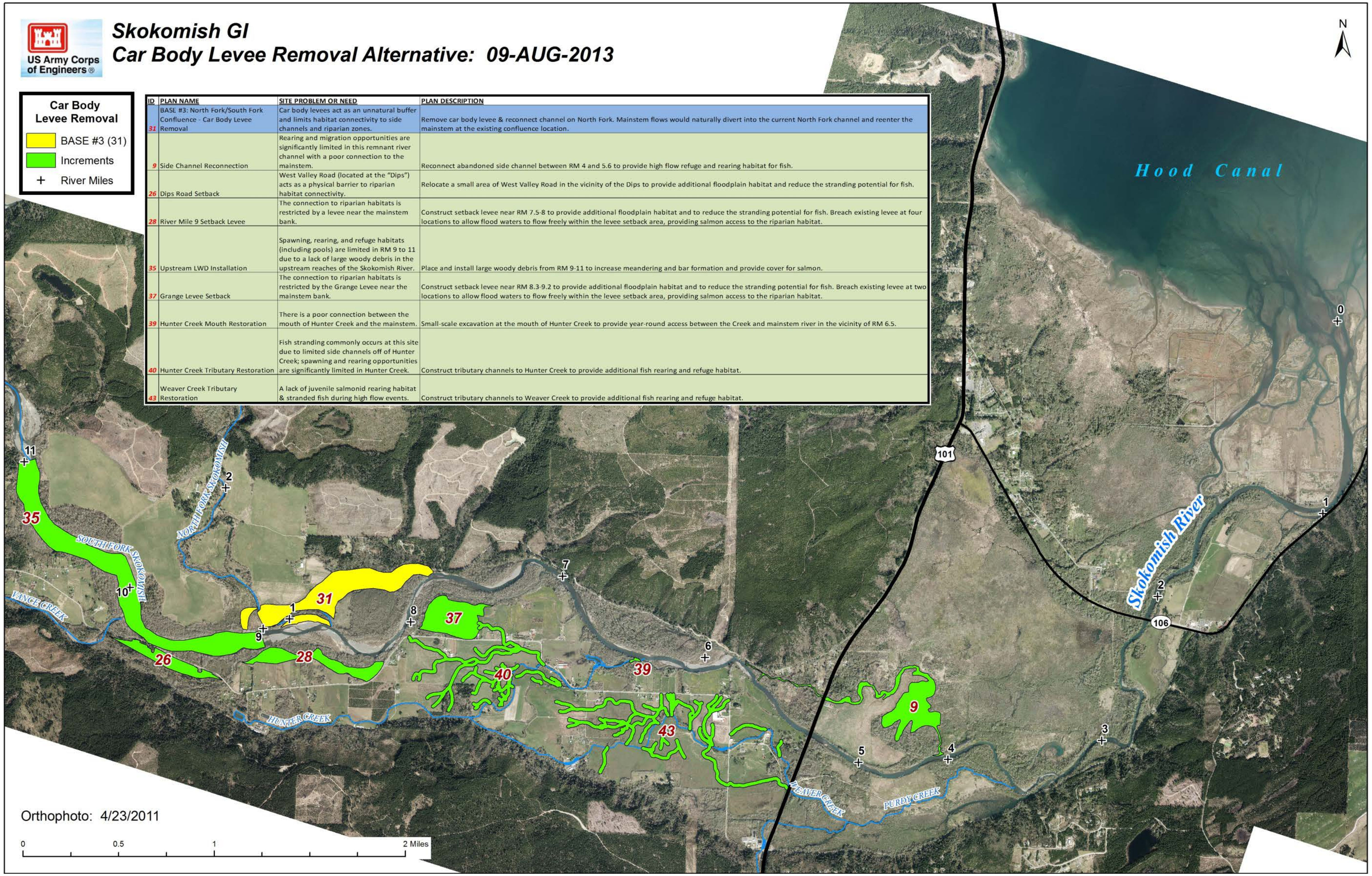
Car Body Levee Removal Alternatives

Three Car Body Levee Removal Alternatives were evaluated during this step of the planning process. Each plan represents a best buy plan identified during the CE/ICA. Alternative #7 is the least cost best buy plan; this alternative represents the minimum Federal investment for the study. Alternative #23 was carried forward because it is the first alternative that includes restoration of side channels or tributaries, identified as critical habitat in the study area. Alternative #28 represents the largest scale of the car body levee removal that includes all proposed restoration increments. The increments included in each scale of the Car Body Levee Removal Alternative are outlined in Table 3-10.

Table 3-10. Car Body Levee Removal Alternatives

Car Body Levee Removal (Alternative #7)	Car Body Levee Removal (Alternative #23)	Car Body Levee Removal (Alternative #28)
Base #3: Car Body Levee Removal	Base #3: Car Body Levee Removal	Base #3: Car Body Levee Removal
Increment #35: Upstream LWD Installation	Increment #35: Upstream LWD Installation	Increment #35: Upstream LWD Installation
	Increment #9: Side Channel Reconnection	Increment #9: Side Channel Reconnection
	Increment #37: Grange Levee Setback	Increment #37: Grange Levee Setback
	Increment #28: River Mile 9 Levee Setback	Increment #28: River Mile 9 Levee Setback
	Increment #39: Hunter Creek Mouth Restoration	Increment #39: Hunter Creek Mouth Restoration
	Increment #40: Hunter Creek Tributary Restoration	Increment #40: Hunter Creek Tributary Restoration
		Increment #43: Weaver Creek Tributary Restoration
		Increment #26: Dips Road Setback

The map shown below (Figure 3-7) indicates the location of the project features included in the largest Car Body Levee Removal Alternative (Plan #28).



ID	PLAN NAME	SITE PROBLEM OR NEED	PLAN DESCRIPTION
31	BASE #3: North Fork/South Fork Confluence - Car Body Levee Removal	Car body levees act as an unnatural buffer and limits habitat connectivity to side channels and riparian zones.	Remove car body levee & reconnect channel on North Fork. Mainstem flows would naturally divert into the current North Fork channel and reenter the mainstem at the existing confluence location.
9	Side Channel Reconnection	Rearing and migration opportunities are significantly limited in this remnant river channel with a poor connection to the mainstem.	Reconnect abandoned side channel between RM 4 and 5.6 to provide high flow refuge and rearing habitat for fish.
26	Dips Road Setback	West Valley Road (located at the "Dips") acts as a physical barrier to riparian habitat connectivity.	Relocate a small area of West Valley Road in the vicinity of the Dips to provide additional floodplain habitat and reduce the stranding potential for fish.
28	River Mile 9 Setback Levee	The connection to riparian habitats is restricted by a levee near the mainstem bank.	Construct setback levee near RM 7.5-8 to provide additional floodplain habitat and to reduce the stranding potential for fish. Breach existing levee at four locations to allow flood waters to flow freely within the levee setback area, providing salmon access to the riparian habitat.
35	Upstream LWD Installation	Spawning, rearing, and refuge habitats (including pools) are limited in RM 9 to 11 due to a lack of large woody debris in the upstream reaches of the Skokomish River.	Place and install large woody debris from RM 9-11 to increase meandering and bar formation and provide cover for salmon.
37	Grange Levee Setback	The connection to riparian habitats is restricted by the Grange Levee near the mainstem bank.	Construct setback levee near RM 8.3-9.2 to provide additional floodplain habitat and to reduce the stranding potential for fish. Breach existing levee at two locations to allow flood waters to flow freely within the levee setback area, providing salmon access to the riparian habitat.
39	Hunter Creek Mouth Restoration	There is a poor connection between the mouth of Hunter Creek and the mainstem.	Small-scale excavation at the mouth of Hunter Creek to provide year-round access between the Creek and mainstem river in the vicinity of RM 6.5.
40	Hunter Creek Tributary Restoration	Fish stranding commonly occurs at this site due to limited side channels off of Hunter Creek; spawning and rearing opportunities are significantly limited in Hunter Creek.	Construct tributary channels to Hunter Creek to provide additional fish rearing and refuge habitat.
43	Weaver Creek Tributary Restoration	A lack of juvenile salmonid rearing habitat & stranded fish during high flow events.	Construct tributary channels to Weaver Creek to provide additional fish rearing and refuge habitat.

Figure 3-7. Car Body Levee Removal Alternative (Alternative #28)

Riverbed Excavation Alternatives

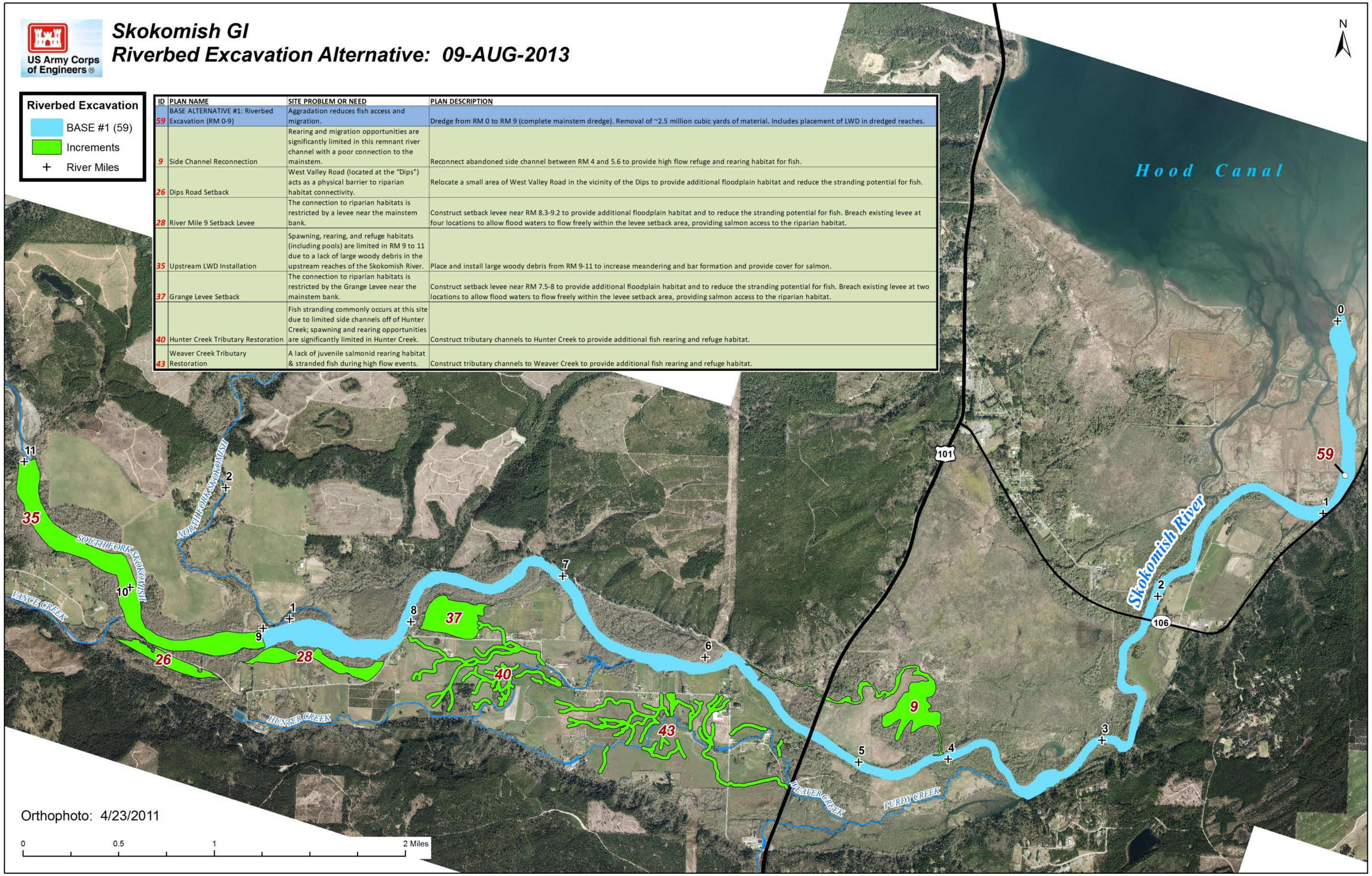
Two Riverbed Excavation alternatives were evaluated during this step of the planning process. Alternative #45 represents a smaller scale of riverbed excavation alternative. It should be noted that this plan is a cost effective plan only. The CE/ICA analysis did not indicate this plan is a best buy; however, it was carried forward to this stage of analysis because it meets the critical needs of the study area while requiring a smaller extent of dredging compared to Alternative #60. Alternative #60 represents the largest-scale best buy plan and represents the most significant Federal investment for this study.

The increments included in each scale of the riverbed excavation alternative are outlined in Table 3-11.

Table 3-11. Riverbed Excavation Alternatives

Riverbed Excavation (Alternative #45)	Riverbed Excavation (Alternative #60)
Base #5: Riverbed Excavation (RM 3.5-9)	Base #1: Riverbed Excavation (RM 0-9)
Increment #35: Upstream LWD Installation	Increment #35: Upstream LWD Installation
Increment #9: Side Channel Reconnection	Increment #9: Side Channel Reconnection
Increment #37: Grange Levee Setback	Increment #37: Grange Levee Setback
Increment #28: River Mile 9 Setback Levee	Increment #28: River Mile 9 Setback Levee
Increment #40: Hunter Creek Tributary Restoration	Increment #40: Hunter Creek Tributary Restoration
Increment #43: Weaver Creek Tributary Restoration	Increment #43: Weaver Creek Tributary Restoration
Increment #26: Dips Road Setback	Increment #26: Dips Road Setback

The map shown below (Figure 3-8) indicates the location of the project features included in the largest scale of the Riverbed Excavation Alternative (Plan #60).



ID	PLAN NAME	SITE PROBLEM OR NEED	PLAN DESCRIPTION
59	BASE ALTERNATIVE #1: Riverbed Excavation (RM 0-9)	Aggradation reduces fish access and migration.	Dredge from RM 0 to RM 9 (complete mainstem dredge). Removal of ~2.5 million cubic yards of material. Includes placement of LWD in dredged reaches.
9	Side Channel Reconnection	Rearing and migration opportunities are significantly limited in this remnant river channel with a poor connection to the mainstem.	Reconnect abandoned side channel between RM 4 and 5.6 to provide high flow refuge and rearing habitat for fish.
26	Dips Road Setback	West Valley Road (located at the "Dips") acts as a physical barrier to riparian habitat connectivity.	Relocate a small area of West Valley Road in the vicinity of the Dips to provide additional floodplain habitat and reduce the stranding potential for fish.
28	River Mile 9 Setback Levee	The connection to riparian habitats is restricted by a levee near the mainstem bank.	Construct setback levee near RM 8.3-9.2 to provide additional floodplain habitat and to reduce the stranding potential for fish. Breach existing levee at four locations to allow flood waters to flow freely within the levee setback area, providing salmon access to the riparian habitat.
35	Upstream LWD Installation	Spawning, rearing, and refuge habitats (including pools) are limited in RM 9 to 11 due to a lack of large woody debris in the upstream reaches of the Skokomish River.	Place and install large woody debris from RM 9-11 to increase meandering and bar formation and provide cover for salmon.
37	Grange Levee Setback	The connection to riparian habitats is restricted by the Grange Levee near the mainstem bank.	Construct setback levee near RM 7.5-8 to provide additional floodplain habitat and to reduce the stranding potential for fish. Breach existing levee at two locations to allow flood waters to flow freely within the levee setback area, providing salmon access to the riparian habitat.
40	Hunter Creek Tributary Restoration	Fish stranding commonly occurs at this site due to limited side channels off of Hunter Creek; spawning and rearing opportunities are significantly limited in Hunter Creek.	Construct tributary channels to Hunter Creek to provide additional fish rearing and refuge habitat.
43	Weaver Creek Tributary Restoration	A lack of juvenile salmonid rearing habitat & stranded fish during high flow events.	Construct tributary channels to Weaver Creek to provide additional fish rearing and refuge habitat.

Figure 3-8. Riverbed Excavation Alternative (Alternative #60)

3.9 Evaluation and Comparison of Final Array of Alternatives*

Alternatives are evaluated by assessing or measuring the differences between each with- and without-plan condition and by appraising or weighting those differences. Evaluation consists of four tasks: (1) forecast the most likely with-project conditions expected from each alternative; (2) compare each with-project conditions to the without-project conditions and document differences between the two; (3) characterize the beneficial and adverse effects by magnitude, location, timing, and duration; and (4) qualify plans for further consideration. The following sections outline these steps and describe the final evaluation, comparison, and trade-off analyses to identify a TSP.

Plans were evaluated based on the following criteria: outputs and plan effects, contributions to the Federal objective (National Ecosystem Restoration - NER), the study goals and objectives, the Planning Guidance Notebook's four evaluation criteria (completeness, effectiveness, efficiency, and acceptability), and other criteria deemed significant by participating stakeholders. The following sections outline the results of the evaluation and comparison steps. The results of the evaluation and comparison of effects to significant resources are presented in Chapter 4 while evaluation of compliance with environmental protection requirements is presented in Chapter 6.

3.9.1 Outputs and Plan Effects

Table 3-12 summarizes the costs and beneficial environmental outputs for each alternative.

Table 3-12. Costs and Outputs of the Final Array of Alternatives

Alternative #	Plan Components	Habitat Units (In-Channel, Floodplain, and Capacity)	Habitat Units (Shellfish Substrate)	Total Habitat Units	Total Acres Restored	Total Annual Cost ($1,000s)
No Action Alternative						
1	No Action Plan	0	n/a	0	0	$0
Car Body Levee Removal Alternatives						
7	Car Body Levee Removal Alternative #7: *Base #3: Car Body Levee Removal* Increment 35 – Upstream LWD	128.8	n/a	128.8	175 In-Channel, Floodplain, & Capacity	$479
23	Car Body Levee Removal Alternative #23: *Base #3: Car Body Levee Removal* Increment 35 – Upstream LWD Increment 9 – Side Channel Restoration Increment 37 – Grange Levee Setback Increment 28 – River Mile 9 Levee Setback Increment 39 – Hunter Creek Tributary Mouth Increment 40 – Hunter Creek Tributary Restoration	207.0	n/a	207.0	306.5 In-Channel, Floodplain & Capacity	$1,113

Alternative #	Plan Components	Habitat Units (In-Channel, Floodplain, and Capacity)	Habitat Units (Shellfish Substrate)	Total Habitat Units	Total Acres Restored	Total Annual Cost ($1,000s)
28	Car Body Levee Removal Alternative #28: *Base #3: Car Body Levee Removal* Increment 35 – Upstream LWD Increment 9 – Side Channel Restoration Increment 37 – Grange Levee Setback Increment 28 – River Mile 9 Levee Setback Increment 39 – Hunter Creek Tributary Mouth Increment 40 – Hunter Creek Tributary Restoration Increment 43 – Weaver Creek Tributary Restoration Increment 26 – Dips Road Setback	239.1	n/a	239.1	348.5 In-Channel, Floodplain, & Capacity	$1,688
Riverbed Excavation Alternatives						
45	Riverbed Excavation Alternative #45: *Base #5: Riverbed Excavation (RM 3.5-9)* Increment 35 – Upstream LWD Increment 9 – Side Channel Restoration Increment 37 – Grange Levee Setback Increment 28 – River Mile 9 Levee Setback Increment 40 – Hunter Creek Tributary Restoration Increment 43 – Weaver Creek Tributary Restoration Increment 26 – Dips Road Setback	303.9	127.8	431.7	412 In-Channel, Floodplain, & Capacity + 511 Shellfish = 923 Total Acres Restored	$6,892
60	Riverbed Excavation Alternative #60: *Base #1: Riverbed Excavation (RM 0-9)* Increment 35 – Upstream LWD Increment 9 – Side Channel Restoration Increment 37 – Grange Levee Setback Increment 28 – River Mile 9 Levee Setback Increment 40 – Hunter Creek Tributary Restoration Increment 43 – Weaver Creek Tributary Restoration Increment 26 – Dips Road Setback	377.1	210.8	587.9	499 In-Channel, Floodplain, & Capacity + 843 Shellfish = 1,342 Total Acres Restored	$9,379

3.9.2 Contributions to the Federal Objective (NER) and Study Objectives

Alternative plans were compared to each other with emphasis on benefits and impacts with respect to study goals, objectives, and NER objectives. Table 3-13 provides a summary of how each alternative plan meets the study objectives. Alternatives #7, #23, and #28 partially meet the planning objective of improving the quantity, quality, and complexity of pools in the Skokomish River; only Alternative #45 and #60 would fully achieve this objective. While improving pool habitat in the Skokomish River is an important objective that would help to address significant problems in the study area, it cannot be fully accomplished by implementing Alternatives #7, #23, or #28. While recommending a TSP that fully meets all planning objectives is desirable, fully meeting all objectives by recommending Alternative #45 or #60 is not achievable given environmental, real estate, and cost considerations. The analysis presented in Section 3.8.1 outlines these and other trade-offs between the alternatives.

Table 3-13. Comparison of Alternative Plans and Study Objectives

Objectives	Provide year-round passage near confluence	Restore side channel and tributary network	Improve quality and complexity of floodplain habitats	Improve quantity, quality, and complexity of pools
Alternative 1: No Action	No	No	No	No
Alternative #7	Yes	No	No	Partially
Alternative #23	Yes	Partially	Yes	Partially
Alternative #28	Yes	Yes	Yes	Partially
Alternative #45	Yes	Yes	Yes	Yes
Alternative #60	Yes	Yes	Yes	Yes

3.9.3 Completeness, Effectiveness, Efficiency and Acceptability

Completeness, effectiveness, efficiency, and acceptability are the four evaluation criteria specified in the Corps' Principles and Guidelines (Paragraph1.6.2(c)) in the evaluation and screening of alternative plans. Alternatives considered in any planning study should meet minimum subjective standards of these criteria in order to qualify for further consideration and comparison with other plans.

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects.

Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

Efficiency is the extent to which an alternative plan is the most cost effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment.

Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

Table 3-14. Comparison of Completeness, Effectiveness, Efficiency, and Acceptability

	Completeness	Effectiveness	Efficiency	Acceptability
Alternative 1: No Action	No	No	No	No
Alternative #7	No	No	Yes	Yes
Alternative #23	Yes	Yes	Yes	Yes
Alternative #28	Yes	Yes	Yes	Yes
Alternative #45	Yes	Yes	No	Partially
Alternative#60	Yes	Yes	Yes	Partially

Alternative 1 (No-Action Alternative)*

The No Action Alternative does not meet the completeness criterion because it does not provide any means to realize the planning objectives of this feasibility study.

The No Action Alternative does not meet the effectiveness criterion because it does not achieve any of the planning objectives.

The No Action Alternative is the least efficient alternative because it is not the most cost effective means of alleviating the problems and realizing the opportunities of the study area.

The No Action Alternative is the least acceptable plan with respect to acceptance by State and local entities and the public.

Alternative #7 – Car Body Levee Removal

Alternative #7 does not meet the completeness criterion because it will require actions by others to achieve the planning objectives. This alternative only proposes restoration of approximately 3 river miles of an 11 mile system. Restoration of structure, function, or processes downstream of RM 8 will not occur under this alternative unless others take action to restore downstream areas of the study area.

The effectiveness criterion is not fully addressed by Alternative #7 because it does not achieve the side channel restoration objective. Additionally, this alternative does not restore high quality or complex floodplain habitats in the study area.

Alternative #7 is an efficient plan. However, it only achieves one of the four planning objectives (restore year-round passage near the confluence) and therefore is less efficient for achieving the objectives.

Alternative #7 is acceptable. This alternative does not violate public laws or regulations.

Alternative #23 – Car Body Levee Removal

All actions required to achieve the planning objectives are accounted for in Alternative #23 and it is not significantly dependent on the actions of others. Alternative #23 is a complete plan that will enhance the overall goals of restoration of the Skokomish River Basin by complementing other restoration efforts.

Alternative #23 is effective because it alleviates the specified problems and achieves the specified opportunities. This alternative meets all planning objectives to some degree.

Alternative #23 is an efficient plan. It has higher incremental costs compared to Alternative #7 but meets all the planning objectives to some degree.

Alternative #23 is acceptable. This alternative does not violate public laws or regulations.

Alternative #28 – Car Body Levee Removal

All actions required to achieve the planning objectives are accounted for in Alternative #28 and it is not significantly dependent on the actions of others. Alternative #28 is a complete plan that will enhance the overall goals of restoration of the Skokomish River Basin by complementing other restoration efforts. This alternative can be considered more complete than Alternative #23 because it represents a more comprehensive restoration alternative; it restores one of the largest tributaries in the study area and reconnects a significant area of floodplain habitat.

Alternative #28 is more effective than Alternative #23 because it includes more features that will contribute to restoring ecosystem structure and function. Inclusion of an additional side channel restoration feature as well as a road setback adds significant value to overall restoration goals of the study and meets planning objectives to a higher degree than Alternative #23. The inclusion of an additional side channel and road setback will reconnect an additional 42 acres of floodplain habitat to the mainstem Skokomish River.

The inclusion of the Weaver Creek tributary restoration is a key increment contributing to the overall completeness and effectiveness of Alternative #28. When discussing whether the inclusion of Weaver Creek is "worth it" compared to Alternative #23, we can make the case that tributaries to mainstem rivers play a vital role in salmon spawning and rearing productivity. Maintaining the integrity of tributary connections is essential for promoting habitat complexity and community structure. Weaver Creek is one of only two perennial groundwater fed streams in the lower Skokomish Basin. Restoration of fluvial and biological processes in Weaver Creek would provide an additional 27,110 linear feet (over 5 miles) of stream channel. This more than doubles the total tributary restoration of the TSP when added to the Hunter Creek increment. This tributary habitat is a critical component in the study area and would benefit all of the fish and wildlife species present in this reach of the floodplain. Inclusion of this increment in the TSP is worth the relatively small cost of doing so.

Alternative #28 is an efficient plan. The incremental cost for this alternative compared to Alternative #23 is negligible ($110/unit). This incremental cost is minimal compared to the significant increase in habitat units (32 additional HUs) and acres restored (42 additional acres) compared to Alternative #23.

Alternative #28 is acceptable. This alternative does not violate public laws or regulations.

Alternative #45 – Riverbed Excavation

All actions required to achieve the planning objectives are accounted for in Alternative #45 and it is not significantly dependent on the actions of others. Alternative #45 is a complete plan that will enhance the overall goals of restoration of the Skokomish River Basin by complementing other restoration efforts.

Alternative #45 is effective because it alleviates the specified problems and achieves the specified opportunities. However, this plan is less effective than Alternatives #7, #23, or #28 because there are significant short-term environmental impacts associated with construction activities for this plan as well as risks of longer-term impacts to salmon spawning habitat.

Alternative #45 is not efficient compared to Alternative #60. This alternative is a cost effective plan only and does not provide the greatest incremental increase in output (benefits) for the lowest incremental increase in cost.

Alternative #45 is partially acceptable. Resource agencies are not supportive of large-scale dredging for ecosystem restoration due to the anticipated significant short-term environmental consequences associated with construction of this plan as well as significant risk that salmon would not be able to find appropriate spawning habitat for one or more years as sediments stabilize and the river experiences higher channel-forming flows. This alternative does not violate public laws or regulations.

Alternative #60 – Riverbed Excavation

All actions required to achieve the planning objectives are accounted for in Alternative #60 and it is not significantly dependent on actions of others. Alternative #60 is a complete plan that increases channel capacity throughout the most important part of the study area, RM 3.5-9. This alternative will enhance the overall goals of restoration of the Skokomish River Basin by complementing other efforts.

Alternative #60 is effective because it alleviates the specified problems and achieves the specified opportunities. However, this plan is less effective than Alternatives #7, #23, or #28 because there are significant short-term negative environmental effects associated with construction activities for this plan as well as risks of longer-term negative effects to salmon spawning habitat.

Alternative #60 is a cost effective means of achieving the study objectives. Incremental costs of Alternative #45 and Alternative #60 are nearly the same; however, due to significantly greater incremental costs compared to Alternative #28, Alternative #60 is a less efficient means of achieving study objectives.

Alternative #60 is partially acceptable. Resource agencies are not supportive of large-scale dredging for ecosystem restoration due to the anticipated significant short-term environmental consequences associated with construction of this plan as well as significant risk that salmon would not be able to find appropriate spawning habitat for one or more years as sediments stabilize and the river experiences higher channel-forming flows. This alternative does not violate public laws or regulations.

3.9.4 Trade-Off Analysis

Trade-off analysis is the procedure the Corps uses to identify the potential gains and losses associated with producing a larger or lesser amount of given outputs. The results of trade-off analysis are used in the formulation, evaluation, comparison, and selection of the recommended plan. The study team identified several trade-offs between the Car Body Levee removal alternatives and the riverbed excavation alternatives. Although the final array of alternatives includes three scales of the Car Body Levee Alternative and two scales of the Riverbed Excavation Alternative, the following table summarizes the key trade-offs between the largest scales of the Car Body Levee Removal Alternative (Alternative #28) and the Riverbed Excavation Alternative (Alternative #60).

Table 3-15. Trade-Off Analysis

Trade-Off Criteria	No Action Alternative	Car Body Levee Removal (Alternative #28)	Riverbed Excavation (Alternative #60)
Cost (Total First Cost)	$0	$48 million	$258 million
Total Habitat Units	0 AAHUs	239 AAHUs	588 AAHUs
Acres Restored	0 acres	348.5 acres (in-channel, floodplain, and channel capacity only)	1,342 acres (499 in-channel, floodplain, and channel capacity acres + 843 shellfish acres)
Cost Per Acre (total first cost divided by total acres)	$0	$138K	$192K

Trade-Off Criteria	No Action Alternative	Car Body Levee Removal (Alternative #28)	Riverbed Excavation (Alternative #60)
Direct benefit to shellfish or oysters	No	No	Yes (placement of dredged material in nearshore zone for shellfish attachment)
Directly increases channel capacity	No	No	Yes
Allows for placement of additional in-channel habitat features (LWD)	No	Yes, RM 9 to RM 11	Yes, RM 0 to RM 11
Addresses summer low flow reach; restores year-round channel near confluence	No	Yes	Yes
Improves habitat connectivity	No	Yes	Yes
Reduces fish stranding	No	Limited reduction in fish stranding; improves floodplain connectivity	Yes
Short-term negative environmental effects	None	Low	High
Sustainability	N/A	High	Medium
O&M	None	Minimal	Periodic re-dredging ($43M every 20 years)
Private property impacts	None	High	High

Among the factors considered, this analysis identified key trade-offs between the alternatives. Additional trade-offs are presented in the environmental consequences documentation in Chapter 4.

The bases of the two Riverbed Excavation alternatives are considered to be highly engineered versus the more process-based restoration components included in the Car Body Levee Removal alternatives. While the Riverbed Excavation Alternative restores significantly more acres compared to the Car Body Levee Removal alternatives, provides benefits to shellfish, and allows for placement of habitat features like LWD in the mainstem river channel by directly increasing channel capacity, it has significant expected short-term environmental impacts and is cost prohibitive in both construction and O&M costs.

The presumed benefits of river sediment excavation (Alternatives #45 and #60) are that providing the capacity for the 50% annual chance of occurrence (ACE) would greatly reduce the frequency of overbank flows and thereby reduce the problem of fish stranding on high ground after they are flooded out of the river and then trapped with no channel access back into the river. However, such broad-scale alteration of the river bottom would cause significant short-term risks to salmon habitat; these are described in detail in section 4.4.1.2. As of yet, no entity or agency has been able to quantify the adult and juvenile fish stranding problem beyond the anecdotal reports from Skokomish Valley residents and local news media reports. Given the lack of quantification of the magnitude of the stranding problem and the level of potential environmental risks from riverbed excavation, it is difficult to weigh the risks versus benefits of Alternatives #45 and #60.

While Alternative #45 and #60 would have additional direct benefits to shellfish through the disposal of dredged gravel in the estuary, availability of real estate for disposal of dredged material in the estuary and avoiding negative effects to eelgrass beds in the estuary complicates the overall design and implementation of this alternative.

Finally, construction and maintenance of the Riverbed Excavation alternatives are extremely cost prohibitive. The study sponsors do not have the financial capability to cost-share in construction of these alternatives or maintain them per Corps O&M requirements. If O&M cannot be sustained, it is anticipated that restoration benefits would be foregone at some time during the 50-year project life. Additionally, the requirement for on-going maintenance (re-dredge the channel every 20 years) for the Riverbed Excavation alternatives would have similar short-term construction impacts as those experienced during initial construction (environmental impacts are discussed in Chapter 4), causing these alternatives to be less sustainable compared to the Car Body Levee Removal alternatives.

The base of the Car Body Levee Removal Alternative is a minimally engineered restoration solution and includes features that restore the ecosystem structures, functions, and processes of the study area. The Car Body Levee Removal Alternative restores fewer acres of habitat and does not provide direct benefits to shellfish. However, it improves habitat connectivity and restores a year-round channel near the confluence with minimal negative environmental effects. It also has lower construction costs and requires minimal O&M (anticipated to be $5,000 yearly or less for inspections and minimal maintenance). Although this alternative does not allow for placement of additional in-channel habitat features like LWD because it does not directly increase channel capacity, additional floodplain increments (like side channel reconnections or levee setbacks) are warranted to create a comprehensive restoration solution. The full suite of incremental projects listed in Alternative #28 are recommended because of the additional 27,110 linear feet of restored side-channel in Weaver Creek and the surrounding 25 acres of floodplain habitat restored through native vegetation plantings, as well as the 17 acres of riparian habitat that would be reconnected to nearly a mile of the Skokomish River by relocating Dips Road. Alternative #28 restores 42 more acres of floodplain and wetland habitat than Alternative #23 and is therefore considered more complete and more effective.

The information developed by the CE/ICA and evaluation, comparison, and trade-off analyses have informed the decision-making process by helping to answer whether the proposed Federal investment of each alternative in the final array is justifiable and viable from a cost perspective; that is, whether the environmental benefit of the additional output in the next level of investment is worth its additional cost. Per the general decision-making guidelines outlined in Appendix E of ER-1102-2-100, the following factors assist in making it justifiable and viable from a cost perspective:

- Output target: Although a formal habitat unit target has not been identified for the study, the PDT has indicated that restoration of side channel and floodplain habitats adds significant value to the proposed alternatives. Additional investment to restore these critical habitat types are worth the relatively small cost of doing so; alternatives that include additional increments that propose restoration of floodplain or side channel habitats are worth the investment. The additional restoration of side-channel and wetland development as well as a road relocation to reconnect a riparian zone to the riverbank will have high returns in ecosystem functions.

- Cost affordability: Non-Federal sponsor implementation funds are a constraint. The Riverbed Excavation Alternatives are not affordable to the Non-Federal sponsors in terms of both construction costs and O&M requirements.
- Unintended effects: The Riverbed Excavation Alternatives have anticipated significant short-term environmental consequences associated with construction of this plan as well as significant risk that salmon would not be able to find appropriate spawning habitat for one or more years as sediments stabilize and the river experiences higher channel-forming flows. Chapter 4 describes these environmental effects in more detail.

3.10 Summary of the Tentatively Selected Plan *

The evaluation and comparison of alternatives led the study team to originally recommend Alternative #28 as the TSP. This plan includes the Dips Road Setback increment, a road setback that is considered to be a relocation and would be funded solely by the non-Federal sponsor(s). However, during initial policy reviews of the TSP by USACE Headquarters, it was determined that this increment could only be included in the TSP as a Locally Preferred Plan (LPP). As such, the study team determined that the Dips Road increment would not be included in the TSP or carried forward as a LPP.

The next smallest best buy alternative, Alternative #27, includes the same project features as Alternative #28 with the exception of the Dips Road Setback increment. This alternative achieves similar benefits as the larger Alternative #28 without any large-scale relocations. Thus, Alternative #27 is the TSP and the NER plan (agency preferred alternative) as determined by all of the evaluation criteria discussed throughout Chapter 3. Selecting the NER plan requires careful consideration of planning goals, objectives, and constraints. The NER plan reasonably maximizes environmental benefits considering cost effectiveness and incremental cost analyses, significance of outputs, completeness, efficiency, effectiveness, and acceptability. The following chapters describe the direct, indirect, and cumulative environmental effects of each alternative including the TSP.

4. Affected Environment and Environmental Consequences of the Alternatives*

This chapter describes the existing conditions and future without-project conditions used for analysis during the Skokomish River Basin feasibility study, as well as the probable environmental outcomes of implementing each proposed alternative. Existing conditions are the physical, chemical, biological, and sociological characteristics of the study area. Characterizing resource conditions is critical for understanding the probable future condition of those resources (i.e. the future without-project condition) and for defining problems and opportunities. The assessment of environmental effects is based on a comparison of conditions with and without implementation of the proposed plan and a reasonable range of alternatives; in this case, various scales of two action alternatives were formulated through the screening process and are compared to the No-Action Alternative. The analysis focuses only on significant resources that are potentially affected by the alternatives and have a material bearing on the decision-making process. The spatial scale of analysis focuses on the locations of the proposed sites to provide a comparison between the No-Action Alternative and the various scales of the two action alternatives. The time scale for analysis is a 50-year period beginning in 2015 and extending to 2065.

Chapter 3 outlines the formulation and evaluation of alternatives. The final array of alternatives carried forward for the assessment of environmental effects in Chapter 4 is the following:

No Action Alternative

Car Body Levee Removal Alternatives

Car Body Levee Removal (Alternative #7)	Car Body Levee Removal (Alternative #23)	Car Body Levee Removal (Alternative #28)
Base Alternative #3: Car Body Levee Removal	Base Alternative #3: Car Body Levee Removal	Base Alternative #3: Car Body Levee Removal
Increment #35: Upstream LWD Installation	Increment #35: Upstream LWD Installation	Increment #35: Upstream LWD Installation
	Increment #9: Side Channel Reconnection	Increment #9: Side Channel Reconnection
	Increment #37: Grange Levee Setback	Increment #37: Grange Levee Setback
	Increment #28: River Mile 9 Levee Setback	Increment #28: River Mile 9 Levee Setback
	Increment #39: Hunter Creek Mouth Restoration	Increment #39: Hunter Creek Mouth Restoration
	Increment #40: Hunter Creek Side Channel Restoration	Increment #40: Hunter Creek Side Channel Restoration
		Increment #43: Weaver Creek Side Channel Restoration
		Increment #26: Dips Road Setback

Riverbed Excavation Alternatives

Riverbed Excavation (Alternative #45)	Riverbed Excavation (Alternative #60)
Base Alternative #5: Riverbed Excavation (RM 3.5-9)	Base Alternative #1: Riverbed Excavation (RM 0-9)
Increment #35: Upstream LWD Installation	Increment #35: Upstream LWD Installation
Increment #9: Side Channel Reconnection	Increment #9: Side Channel Reconnection
Increment #37: Grange Levee Setback	Increment #37: Grange Levee Setback
Increment #28: River Mile 9 Setback Levee	Increment #28: River Mile 9 Setback Levee
Increment #40: Hunter Creek Tributary Restoration	Increment #40: Hunter Creek Tributary Restoration
Increment #43: Weaver Creek Tributary Restoration	Increment #43: Weaver Creek Tributary Restoration
Increment #26: Dips Road Setback	Increment #26: Dips Road Setback

The five action alternatives are grouped into two types: Car Body Levee Alternatives and Riverbed Excavation Alternatives. The No Action Alternative and the two groups of action alternatives were analyzed for direct and indirect effects on each resource and whether those direct and indirect effects result in a significant cumulative effect when added to other past, present, and reasonably foreseeable future actions. Because environmental impact analysis occurs concurrently with plan formulation, this chapter includes the Dips Road Setback increment in the analysis of effects, even though it was ultimately screened out of the preferred alternative.

4.1 Resources Analyzed and Resources Screened from Detailed Analysis

The following table identifies the resources analyzed or screened from detailed analysis including a rationale for inclusion or exclusion. Resources were excluded from detailed analysis if they are not potentially affected by the alternatives or have a material bearing on the decision-making process.

Table 4-1. Resources Analyzed and Resources Screened from Detailed Analysis

Resource	Included in Detailed Analysis (Y/N)	Rationale for inclusion or exclusion
Hydraulics and Hydrology	Y	Problems identified center on the relationships among hydraulics, hydrology, and sedimentation. Proposed alternatives require study of these characteristics.
Geomorphology and Sediment Transport	Y	Problems identified center on the relationships among hydraulics, hydrology, and sedimentation. Proposed alternatives require study of these characteristics.
Groundwater	N	The preferred alternative would only have minor, localized effects to groundwater. Local residents did raise this issue as a significant concern and it was reviewed in project screening. This review concluded that elevated groundwater could be better addressed locally with Natural Resource Conservation Service (NRCS) agricultural best management practices (BMPs) on individual properties in conjunction with the preferred alternative.
Water Quality	Y	One alternative would have significant short-term effects to turbidity.
Air Quality	N	The air-pollutant concentrations in the study area have consistently been below the National Ambient Air Quality Standards. Mason County (which includes the study area) does not have a non-attainment area. Air quality for the study area is rated 8.8 on a scale of 0 to 10 where 10 is the best indicator of air quality. Proposed action alternatives are predicted to have a negligible contribution to pollutants; however, the effect would be only during construction and would not be expected to exceed the ecological or human tolerance standards, nor change the rating of 8.8.
Greenhouse Gas Emissions	Y	Required to be analyzed by CEQ guidance (2010).

Resource	Included in Detailed Analysis (Y/N)	Rationale for inclusion or exclusion
Climate Change and Sea Level Rise	Y	USACE Engineering Circular 1165-2-212 requires feasibility studies to consider the sensitivity and adaptability of projects to sea level change. Predicted effects of climate change are described for the alternatives.
Underwater and Airborne Noise	N	Airborne noise caused by construction would be attenuated by distance from the source to any sensitive receptors and would therefore not cause any significant impact. Underwater noise from construction would occur when sensitive receptors would not be present, and in shallow water such that the sound waves would be attenuated quickly. Therefore, there would not be a significant impact.
Hazardous, Toxic, and Radiological Waste	N	The proposed action alternatives would not create a significant hazard to the public or the environment through transport, use, or disposal of hazardous materials. There are no CERCLA-regulated substances involved with any of the proposed restoration sites. The cars that give Car Body Levee its name are all parked above ground at the base of the levee and do not appear to be contaminating the surrounding area.
Fish	Y	One of the proposed alternatives may have a significant negative effect to fish populations in the mainstem river channel. All alternatives would provide long-term significant benefits for fish populations.
Mammals	N	Mink, beaver, and river otter are associated with riparian and aquatic habitats. While some construction may be disruptive, none of the alternatives would have a significant negative effect on the animals or their habitat. Resulting conditions for these species would likely improve with any of the action alternatives.
Birds	N	Construction of the action alternatives may be temporarily disruptive, but would not occur during nesting season. None of the avian species identified in the study area would experience significant effects from any of the proposed alternatives.
Shellfish and other Macroinvertebrates	Y	Shellfish would likely benefit from the proposed ecosystem restoration. One or more of the action alternatives may have a significant negative effect to benthic macroinvertebrates in the mainstem river.
Vegetation (Wetland, Riparian, Estuarine)	Y	Proposed action alternatives may affect size and type of wetlands, and may affect estuarine vegetation such as eelgrass.
Rare, Threatened, and Endangered Species	Y	One of the proposed action alternatives may have a significant short-term impact on ESA-listed species in the lower mainstem river.
Invasive Species	N	None of the alternatives would affect more than one acre of invasive species in the Skokomish Valley, and none of the alternatives would increase invasive populations.
Cultural Resources	Y	Potential exists for inadvertent discovery of cultural resources; discovery during construction could have an adverse effect to those resources.
Indian Trust Assets	Y	One of the alternatives has a risk for negative effects to tribal resources.
Environmental Justice Communities	Y	Required to be analyzed by presidential executive order.
Aesthetics	N	None of the proposed alternatives will affect scenic resources or visual characteristics.
Land Use and Agricultural Resources	N	Population in the study area is predicted to decline, and many area residents are likely to abandon agriculture as an economic base. Although individual property owners may be affected, none of the proposed alternatives will have a significant effect on present or forecasted land use or agricultural resources across the study area.
Recreation Resources	N	Significant recreation activities (boating, camping, bicycling, hunting, etc.) occur outside the study area in the upper watershed or beyond Annas Bay. The alternatives would not have more than a negligible effect on fishing activity within the study area.
Public Services and Utilities	N	None of the alternatives would have a substantial effect on electricity, water, wastewater and stormwater collection, sewer and solid waste, natural gas, oil/petroleum, or telecommunications services.
Public Health and Safety	N	None of the alternatives would have any effect on public health and safety.
Transportation and Traffic	Y	Construction may cause temporary disruptions to local traffic, and construction vehicles could require additional traffic controls for the duration of work.

4.2 Cumulative Effects Approach

Cumulative effects can result from the incremental effects of the proposed action when added to the effects of other past, present, and future actions, regardless of which government agency or private entity undertakes such actions. When effects that are individually minor combine over space or time, the cumulative effects can be significant. NEPA requires analyzing whether the incremental effect of the proposed action will cause a significant impact to the environment when added to past, present, and reasonably foreseeable future actions. This section will summarize actions that have affected the environment, and each resource in Sections 4.3 through 4.6 will be analyzed for whether it would accrue a significant cumulative effect.

Past Actions

The Skokomish River channel has migrated within a narrow band along its present course for at least 400 years. The watershed remained relatively unaltered by human activity until Euro-American settlers arrived in the mid-nineteenth century. During the last 150 years, there have been many changes to the environment along that alignment caused by both natural and anthropogenic factors. High bedload transport caused by the removal of LWD and disturbance of the stream banks, combined with altered depositional patterns caused by bank protection, side-channel closures, and flow regulation by the Cushman Project have caused riverbed aggradation and increased flooding. Logging and agricultural development have reduced riverbank riparian habitat and cleared LWD from the channel. The riverbank has been stabilized in places to protect roads and farmland. Land management has been geared toward agriculture and timber harvest. Significant land use and development including mining, logging, and fishing have altered the historical physical and biological characteristics of the Skokomish Basin. Table 4-2 outlines the historical timeline of significant events in the Skokomish Watershed.

Table 4-2. Skokomish Watershed Settlement and Development Historical Timeline

Decade	Event
Pre-1850	Only minor alterations of watershed by humans; homeland of Twana people
1850	Euro-Americans begin settling lower Skokomish floodplain
1860	Land clearing and agricultural development of lower Skokomish floodplain
late-1800's	Commercial and recreational fishing became popular among non-Tribal settlers
1899	Fish stocks had become so depleted that a hatchery was built on the river
1900	Logging of lower valleys; Logjam clearing; Log driving; Farm development continued
1910	Extensive logging of lower NF; State Route 106 (old State Road 21 and 14)
1920	Construction of Cushman dams; diversion of NF flow out of Basin at Cushman Dam No. 2 in 1930
1922	Hood Canal was closed to commercial fishing due to decreased salmon runs
1930	Clearcut logging begins on USFS lands in the SF; Diking within river delta for farm development; Channel straightening; River channel gravel mining; Highway 101 bridges built at Purdy Cr., Weaver Cr., north Skokomish overflow channel, and the Skokomish River; Evidence of aggradation in river.
1940	Creation of Shelton Cooperative Sustained Yield Unit (CSYU) Agreement on Simpson Timber and USFS lands in the SF (1946); logging accelerates

Decade	Event
1940	Lower mainstem experiences 29 floods in 29 years between 1912 and 1941; Lower mainstem aggrades 1.5 feet
1950	Clearcutting in SF anticipating hydroelectric project; Diking in Vance Creek and lower river; Minimal aggradation in lower river between 1944 and 1964
1960	Extensive development of dikes; Accelerating road building and logging in the CSYU; Aggradation resumed in lower river
1970	Dike and revetment system lengthened and repaired; Road building and logging in CSYU occurring at high rates; Highway 101 bridge at Weaver Creek re-built
1980	Rapid logging of CSYU continues to early 1980s, then declines later in the decade; Dike structural repairs and additions to various structures made; Highway 101 bridges over the Skokomish and State Route 106 bridge rebuilt
1990	Logging on Olympic National Forest (ONF) lands in SF reduced significantly then essentially stopped (mid-1990's); Watershed restoration begins on ONF lands: over 200 miles of roads decommissioned or stabilized, 247 miles of upland soil stabilization, nearly 4 miles of instream restoration and riparian enhancement (Anderson et al. 2007); Extensive logging of second growth on Simpson lands; Forest and Fish Law enacted (1999); nearly 4 feet of aggradation since 1964 measured at Highway 101
1999	Puget Sound Chinook Salmon, Hood Canal Summer-Run Chum Salmon, and the Coastal/Puget Sound Bull Trout listed at threatened under the Endangered Species Act; Corps GI Reconnaissance Study concluded.
2000	Logging of second growth timber on Simpson lands; Continued aggradation in lower river; Restoration work in upper SF to close logging roads; Bourgault/North channel and North channel oxbow restoration; LWD bank protection projects on the Skokomish Mainstem, South Fork, and Vance Creek (2000-2012); Corps GI initiated; Cushman Dam settlement reached (2009)
2007	Puget Sound Steelhead listed as threatened under the Endangered Species Act.
2010	Cushman settlement agreement implemented; Floodplain restoration in South Fork by USFS; Estuarine restoration commences with dikes removed and borrow ditches filled on Nalley Island and Slough by the Skokomish Tribe; Purdy Creek Bridge improved by WSDOT in 2009

Notes: NF = North Fork, SF = South Fork, CR = Creek

Sources: Peters et al. 2011, Barreca 2001, Smoker et al, 1952

Present Actions

The Skokomish Watershed Action Team (SWAT) is a diverse, informal partnership of government agencies, land managers, and others collaborating to restore the Skokomish watershed. The SWAT has designed a three-year action plan to implement over 40 projects in the upper and lower watershed at an approximate cost of $48.6 million. Types of ecosystem restoration projects the SWAT has undertaken within the past 10 years include significant lengths of road decommissioning and stabilization, culvert replacements, in-stream large wood placement, riparian plantings, and control of invasive species. Similar actions are underway. The Skokomish Tribe and Mason County have recently restored the estuary in three phases of construction to remove dikes and restore hydrology. A query of the WDFW Habitat Work Schedule and Recreation and Conservation Office (RCO) Project Information System (PRISM) databases reveal the following active projects within the study area: Phase 3 of estuary restoration; Southern Hood Canal Riparian enhancement along the mainstem Skokomish; floodplain restoration near Purdy Creek, near Highway 101 bridge, and at RM 8; Five Mile Creek LWD placement;

removal of car bodies along the lower mainstem with riparian restoration; and riparian planting near Sunnyside Road (WDFW et al. 2013).

Skokomish Valley has remained relatively undeveloped for many years, and no significant building is occurring at the time of this analysis. Among the activities in the valley, aerial photography analysis reveals that the most significant land disturbances in the watershed over the past five years are large patches of clear-cut logging in the uplands.

Future Actions

Proposed ecosystem restoration projects that Olympic National Forest plans to implement include more road decommissioning, additional large wood in the South Fork, Pine Lake restoration, trail stabilization, prairie restoration, and thinning of overstocked forest stands to enhance wildlife habitat and biodiversity (USFS 2011a, 2011b). The WDFW Habitat Work Schedule and the Washington State RCO databases list the following proposed projects within the study area: Lower Skabob Creek restoration of habitat complexity; Vance Creek LWD placement; Southern Hood Canal Riparian enhancement along the Skokomish Phase 2; placing engineered logjams after the confluence reach is restored; 150 acres of floodplain restoration at the confluence reach; and parcel acquisition for permanent protection of a side channel just upstream from the Highway 101 bridge (WDFW et al. 2013).

Planned developments within Skokomish Valley include adding 19 homes into the 746-acre property of Skokomish Valley Farms (Capitol Press 2013); these will be 40-acre parcels in which 35 acres will have a permanent agricultural easement. This farm qualifies for two programs under the Natural Resources Conservation Service's Environmental Quality Incentives Program: a permanent easement on land that is frequently inundated, as well as a five-year wildlife protection program. Approximately 24,000 trees have been planted under these programs (Capitol Press 2013).

Cushman Settlement Agreement

A settlement and relicensing agreement for Tacoma Power's Cushman Hydroelectric Project was signed in 2009. The agreement resolved a $5.8 billion damages claim and long-standing disputes over the terms of a long-term license for Cushman Dam. The licensing settlement agreement concludes nearly two years of negotiations and decades of contention between Tacoma Power, the Skokomish Indian Tribe, and the many State and Federal agencies that will oversee implementation of the terms of the agreement. While multiple sections of this chapter outline the existing, future without-project conditions, and future with-project conditions under specific provisions of the Cushman Settlement, a summary of the key requirements of the agreement as they relate to this study are outlined below.

Current and future activities required by the Cushman Settlement occur primarily in the North Fork Skokomish River, which is outside the Corps' General Investigation study area. These activities include the construction of fish passage facilities, construction and operation of two fish hatcheries, construction of a new powerhouse at Cushman Dam No. 2, and recreation improvements near Lake Cushman. As described in Section 4.4.1.1., these activities would benefit separate stocks of fish that use different forks of the Skokomish River; habitat for the ESA-listed fish species that are found within the Corps' study area remains in a severely degraded state.

At this time, there are no confirmed activities required under the Cushman Settlement within the Corps' study area. Additionally, Tacoma Power is not yet required to develop or implement additional measures to address flooding, channel capacity, sediment transport, or habitat restoration within the Corps' study area. Any future action required by Tacoma Power under the Cushman Settlement is dependent upon procedural and technical findings. If findings determine action is required on the mainstem Skokomish River, activities must be approved by NMFS, BIA, USFWS, and the Skokomish Tribe; Tacoma Power is also required to seek comments and recommendations from the Corps to ensure that any recommendations will be complementary to the TSP and will not affect the success or benefits accrued from the Federal (Corps) project.

4.3 Physical Environment

This section provides an analysis of the existing and future without-project condition of the significant physical resources in the study area, as well as how each alternative would affect these resources.

4.3.1 Hydrology and Hydraulics

A summary of the basin hydrology is presented in this report and detailed analyses appear in Appendix B. The Skokomish River drains approximately 240 square miles of forested terrain into Hood Canal. Three main tributaries contribute to the river system: the North Fork, the South Fork, and Vance Creek. Tacoma's Cushman Hydroelectric Project (Cushman Project), regulates the North Fork's flow, provides flood discharge reductions, and maintains year-round base flows in the 150 to 180 cfs range. The South Fork and Vance Creek are unregulated and provide most of the flood discharges. Average monthly discharges in the South Fork, at the USGS gage upstream of Vance Creek, range from less than 200 cfs in August and September to about 1,400 cfs in December and January. Downstream of the North Fork/South Fork confluence, average monthly discharge ranges from 250 cfs in August to 2,400 cfs in December. In recent years, North Fork and mainstem Skokomish summer base flows below the North Fork confluence have increased because of higher releases from the Cushman Project. Hunter and Weaver creeks are groundwater fed tributaries to the mainstem Skokomish River.

Channel capacity of the mainstem and South Fork Skokomish Rivers, as well as Vance Creek has been significantly reduced due to sediment accumulation. The mainstem has lost about 10,000 cfs of flow capacity since 1941 (Appendix B). Typically, flooding occurs three to four times every year because of the low channel capacity. Along the south bank of the river, floodwater flows away from the river channel in the upper valley causing widespread, shallow flooding. The southern floodwaters flow southeast through Purdy Creek and rejoin the river downstream of Highway 101 near RM 3.5. The recently completed Purdy Creek bridge improved flood conveyance and should lower flood depths immediately upstream of Highway 101.

There is not a continuous, competent, well planned levee system along the Skokomish River. The existing levees, dikes and revetments were built by valley residents to combat local flood problems. The levees were built using available materials, and were constructed without engineering design. Most of the levees along the river were originally constructed in the 1950s and 1960s, and were raised or connected during the 1980s and 1990s. None of the levees are considered competent enough to provide reliable flood risk management, although they do provide some localized relief (less than a 2-year level of protection) from the frequent small floods that occur several times a year. The existing levees are approximately 4 to 6 feet high in some areas and should be considered to perform more like agricultural berm structures rather than fully engineered levees.

The sediment accumulation has altered flow conditions in the summer. The riverbed of the South Fork is higher than that of the North Fork near the confluence. This causes all the South Fork discharge to flow sub-surface and a subsurface riverbed to develop in the South Fork in the late-summer/early fall. This dry riverbed prevents fish access to the upper reaches of the South Fork.

Finally, the Cushman Settlement includes provisions for a minimum volume and distribution of flow releases to the North Fork as well as provisions to allow for releases of sediment transport flows (i.e., "flushing flows") to increase sediment transport in the mainstem Skokomish River. While the future without-project condition for H&H includes the anticipated minimum flow releases now and in the future, the flushing flows are not assumed to be implemented in the future. Flushing flows were attempted in the past but this approach has been abandoned because (1) limited channel capacity causes downstream flooding when larger flushing flows are released, and (2) flushing flows that do not worsen downstream flooding are ineffective at transporting sediment throughout the system.

4.3.1.1 No-Action Alternative/Future Without-Project Conditions

The hydrology of the Skokomish River is not expected to change significantly over the project life. Logging is expected to continue in the South Fork and Vance Creek watersheds. Logging on Forest Service land could increase or decrease depending on Federal policy, but either course is unlikely to have a significant impact on seasonal or flood hydrology. The Cushman Project FERC license has been issued for a 50-year term, so North Fork hydrology should remain very similar to the existing conditions, at least through 2060.

Sediment accumulation is expected to continue to reduce the channel capacities of the mainstem and South Fork Skokomish Rivers as well as Vance Creek. Flooding is expected to become even more frequent, but only small increases in flood depths are likely due to the broad floodplain in the valley. Continuing sediment accumulation is expected to cause the subsurface river channels in the South Fork and Vance Creek during the late summer/early fall to become more frequent and last longer. A channel avulsion that would create an entirely new channel is possible within 20 years (see Geomorphology and Sediment Transport, Section 4.3.2.1.).

4.3.1.2 Action Alternatives/Future With-Project Conditions

<u>Aspects common to both groups of action alternatives</u>

Reconnecting the abandoned channel between RM 4 and 5.6 to the river would provide a high flow side channel. This channel carries overbank floodwaters, but is not directly connected to the river. Restoration would involve constructing improvements to the channel inlet and outlet, while most of the channel would not be disturbed. The reconnected channel would be connected to the river only during high discharges and would not convey water most of the time.

Two levee setbacks, located at RM 7.5-8 and RM 8.3-9.2, are intended to provide additional floodplain habitat for fish. The levees would be moved landward (south) varying distances, around 200 to 300 feet between RMs 8.3-9.2, and up to 1,200 ft between RMs 7.5-8. This would place more riparian forest and floodplain ponds on the riverward side of the levee. Strategically located sections of the existing levees would be removed to allow floodwaters to flow freely within the levee setback area. The setback levees would be designed for shallow overtopping to function for 50% annual chance of occurrence (ACE) and larger floods. The levees would allow flooding to occur similar to existing conditions to avoid increasing downstream flood risks.

The construction of tributary channels to Hunter and Weaver Creeks would expand the valley's drainage network. The existing creeks are perennial groundwater fed streams. The proposed restoration would consist of excavating small channels along existing swales down to slightly below the water table. The new channels may facilitate faster drainage of floodwaters.

Small LWD jams would be placed in the South Fork from RM 9 to 11 to increase meandering and bar formation, and provide cover for salmon. The river channel in this reach is wider and has more flow capacity than the downstream river channels in the study area. The LWD jams would have small cross-sectional areas and be built parallel to flow to minimize the hydraulic disturbance. The channel may be able to incorporate 6 to 12 jams per mile without adverse flooding or erosion effects.

The Dips Road setback would not initially alter river geometry and thus would not affect river hydraulics. This location is one of the first in the study area to flood; to avoid increasing downstream flood risks, the road setback would be designed and built to allow flooding to occur similar to existing conditions.

Car Body Levee Removal Alternatives #7, 23, and 28

Removing the Car Body Levee and diverting the South Fork into the North Fork near the pre-2003 confluence would provide a year-round connection to the South Fork. The combined discharges would provide a continuous low flow channel in what is now the North Fork channel. The reach of the South Fork that runs subsurface in late-summer/early-fall would be abandoned during those low flow periods. These alternatives would have little effect on flooding since the South Fork channel would still convey flood discharges, and both sides of the river frequently flood in this location already.

Riverbed Excavation Alternatives #45 and 60

Alternative #60, excavation of the mainstem and South Fork Skokomish Rivers from RM 0-9, would increase the channel capacity and is expected to greatly reduce the chances of the South Fork channel running subsurface in late summer/early fall. The riverbed excavation would average 8 to 11 feet deep. The river would be returned to a cross-section size similar to what may have existed in the early-1900s. The proposed excavation would produce a river channel with an approximate 50% ACE, or two-year flood capacity, considerably reducing the flood risk in the valley. Floods larger than the 50% ACE would still cause overbank flooding, but to a lesser degree than present. The increased channel capacity allows the placement of LWD habitat structures in the river without increasing the flood risks in the valley.

The smaller scale of this alternative, #45, is excavation of RM 3.5-9. This action starts just upstream of where the southern floodwaters re-enter the mainstem. It would provide 50% ACE flow capacity in the excavated reach and reduce flood risks in much of the valley. Downstream of RM 3.5, channel capacity and flooding would be unchanged. LWD habitat structures could be placed in the excavated reach of the river and flood risks would still be less than they are now.

For both alternatives #45 and #60, the excavated riverbed would have less capacity for subsurface flow (less gravel to transmit water through) and is expected to place the thalweg below the existing water table. Both of these factors should help to maintain surface flows in the mainstem and South Fork during summer low flow conditions.

Cumulative Effects

No significant negative cumulative effects to hydrology or hydraulics are anticipated to accrue from any of the alternatives. The alternatives would not alter rainfall/runoff hydrology on restored USFS lands in the headwaters. Riverbed Excavation alternatives could work in conjunction with the new Highway 101 Purdy Creek Bridge to reduce flood risks.

4.3.2 Geomorphology and Sediment Transport

The Skokomish River Basin headwaters are typified by steep, rugged terrain carved by past glaciations. Numerous small mountain streams discharge into the three principal tributaries, which flow through deep, narrow valleys and gorges to the head of the Skokomish Valley. Channels in the valley have little bedrock control. Valley channel morphology ranges from wide and braided in the South Fork, to a narrow single thread throughout most of the mainstem.

The dominant geomorphic process within the study area is sediment aggradation in the South Fork and mainstem Skokomish Rivers. The total duration of active riverbed aggradation is unknown, but it has been documented that mainstem aggradation has been underway since at least 1965. It is likely that aggradation was underway prior to 1912 as the frequent flooding experienced at that time suggests an undersized channel already existed. The headwaters of the Skokomish basin contain large volumes of glacially derived unconsolidated sediment. During storms, gravel and cobbles eroded from landslide deposits and active river channels in the upper watershed are slowly transported to the Skokomish Valley channels as bedload. In the valley, the South Fork and mainstem Skokomish rivers do not have enough stream energy to transport the incoming bedload to Hood Canal; thus bedload sediment has accumulated in the channels causing them to aggrade.

Various human activities have altered geomorphic processes. Around the turn of the twentieth century, loggers cleared logjams, removed riparian trees, and transported logs in the Skokomish Valley river channels. Stream stabilization measures such as bank protection and side-channel closures have been constructed on Vance Creek and the South Fork and mainstem Skokomish rivers to protect farmlands from erosion. The flood peak reductions from the Cushman Project have reduced bedload transport in the mainstem. The above actions have all contributed to altering the bedload transport and deposition in the South Fork, Vance Creek, and the mainstem Skokomish River.

The Skokomish River channels had an abundance of natural LWD. By the early 1900s, loggers and farmers had removed most of the natural LWD. Today, LWD typically lies along the channel margins where it has been transported by floodwaters. In-channel LWD suitable for fish habitat is scarce.

4.3.2.1 No-Action Alternative/Future Without-Project Conditions

Sediment deposition is expected to continue to aggrade the channels of the mainstem and South Fork Skokomish Rivers and Vance Creek. Abundant sediment sources in the upper watersheds can be expected to supply sediment to the lower rivers throughout the project life. The amount of LWD in the river channels is expected to increase.

How floods and aggradation will interact to alter channel alignment is very uncertain. However, there is a substantial risk of a channel avulsion in the foreseeable future. While an unexpected event such as a large logjam could alter the river very rapidly, the most likely scenario is for the river channel to aggrade to a level where base flows would divert onto the floodplain. Locations with the highest risk of avulsion are near the old North Fork confluence (RM 8-9) and near the Purdy Creek confluence (RM 3.5-4).

The most likely location for an avulsion to originate is near the old North Fork confluence (near RM 8-9). An avulsion at this location would be caused by the filling of the channel to elevations high enough to divert the winter base flows, approximately 800 to 1,000 cfs, onto the floodplain. The surfaces of some of the gravel bars in this reach are already near the top of bank elevations and are higher than the nearby floodplains. The channel is expected to continue to fill slowly, as has been occurring for decades, until the riverbed elevation exceeds the bankline elevation and then low flows could be diverted onto the floodplain. Based on the recent deposition rates, this could occur in about 20 years. There is a risk that the low flow channel could fill rapidly if the channel becomes blocked by a logjam during a flood. The flow could be diverted to either the south or north side of the main channel, depending on the depositional pattern. Given the uncertainty of river processes, the timing of an avulsion could be anytime from the next big storm to 20 years in the future. Flow diverted to the south at RM 8-9 would likely follow a path south and east across farmland toward Purdy Creek and re-enter the river near RM 3.5. This path has no defined channels and the river would have to undergo a long-term process of channel and riparian development. The river channel would likely be very unstable as erosion and deposition could cause the channel to meander. This avulsion would cut across Skokomish Valley Road, disrupting transportation in the valley. On the north side near RM 9, flow would combine with the North Fork and return to the existing channel near RM 7.3. This reach was an active channel in the 1930s before it was blocked. Portions of the South Fork winter base flows have already been diverted into the North Fork at this location. The existing (North Fork) channel would become unstable with the increased discharge and bedload from the South Fork. The combined channel is likely to aggrade and widen. As the combined channel aggrades, it is likely to meander across the northern floodplain, forming and abandoning gravel bars as it migrates. Eventually, the river may meander across the entire 1,000- to 2,000-foot wide floodplain between the old and new confluences and north of the existing channel. Based on the recent deposition rates in the vicinity, deposition could average 1 to 2 feet over this area in a 20-year period. Gravel bars covered approximately 170 acres in this area in 1938.

The second highest risk of an avulsion is near the Purdy Creek confluence (RM 3.5-4). The bedload volume reaching this location is much smaller than that reaching the North Fork confluence, yet the riverbed is aggrading here and has a very low capacity. When this channel fills, base flows will most likely be diverted to the wetlands on the north side of the river and return to the river at State Route 106 (RM 1.9). Based on the recent deposition rates, the timing of this diversion is estimated to be in the next 30 to 50 years. However, it could also occur quickly if the channel becomes blocked by a logjam. A logjam could accelerate a diversion by increasing deposition at a point or causing bank erosion that could erode through the natural levee along the north bank.

In addition to the near-term risk of avulsion in the future without-project condition, long-term projections show sediment will continue to travel from the upper to lower watershed. Sediment already in the upper watershed channels may take 20 to 160 years to travel downstream to the Skokomish Valley. Channel aggradation and instability can be expected to continue for the foreseeable future.

4.3.2.2 Action Alternatives/Future With-Project Conditions

Aspects common to both groups of action alternatives

Reconnecting the abandoned channel between RM 4 and 5.6 to the river would provide a high flow side channel. This channel carries overbank floodwaters but is not directly connected to the river. The direct connection would produce higher suspended sediment loads than this channel currently receives from overbank flows. This could cause some additional deposition along the channel. Most of this channel is heavily vegetated and erosion is not expected to be an issue. The Monitoring and Adaptive Management Plan (Appendix E) will be refined through the feasibility-level design phase and will include a component to determine whether deposition is occurring.

The construction of tributary channels to Hunter and Weaver Creeks would expand the valley's drainage network. The proposed restoration would consist of excavating small channels along existing swales down to slightly below the water table. Small, steady flow rates and vegetated banks should keep erosion to a minimum along these tributary channels. The drainage of floodwaters could cause some erosion and possibly headcutting in some channels.

Small LWD jams would be placed in the South Fork from RM 9-11 to increase channel complexity and provide cover for salmon. The active high-flow channel in this reach is generally 300 to 500 feet wide, providing room to contain a meandering channel. LWD jams would be small, typically 4 to 6 logs, and placed to encourage meandering and bar formation. The LWD jams would have small cross-sectional areas and be built parallel to flow to minimize the hydraulic disturbance. The LWD would be placed to create a meandering channel near the center of the active high-flow channel that would avoid erosion effects along the riverbanks. Some LWD may be used to reduce the risk of harmful bank erosion, similar to the Five Mile Creek LWD project sponsored by Mason Conservation District. Over the 50-year project life, additional LWD is likely to accumulate on some of the constructed LWD jams and some jams are likely to be abandoned as the river naturally migrates; it is likely that the natural formation and accumulation of LWD jams would influence geomorphic processes more than the installed jams.

The Dips Road setback would not initially alter river geometry and thus would not affect sedimentation or geomorphology. If the final design includes removal of the bank protection, then the river would be able to erode the bank and migrate south toward the new road. The new road would limit any channel migration to about 400 feet.

Car Body Levee Removal Alternatives #7, 23, and 28

Removing the Car Body Levee would divert much of the South Fork water and bedload into the existing North Fork channel. The abandoned reach of the South Fork would remain active during high flows. These alternatives would have a very similar geomorphic effect to the northern avulsion near RM 9 described in the Future Without-Project Conditions section above. Bedload deposit would quickly begin to aggrade the combined South Fork/North Fork channel. Based on the recent deposition rates, the initial deposition rate in the combined channel could be in the 0.1 +/- 0.05 feet/year range. As the channel aggrades, it would meander across the floodplain, forming and abandoning gravel bars. During the 50-year project life, there could be two to three feet of deposition across the entire 1,000- to 2,000-foot wide floodplain between the old and new confluences and north of the existing channel. Levee removal would greatly reduce the risk of the avulsion to the south near RM 9 that is described in the Future Without-Project Conditions section above.

Two levee setbacks included in Alternatives #23 and #28, located at RM 7.5-8 and RM 8.3-9.2, are intended to provide additional floodplain habitat for fish. The levees would allow flooding to occur similar to existing conditions, thus there would be no significant change in sediment deposition or erosion. The riverbanks in this reach have been stable in recent years and are expected to continue to be stable with the South Fork diverted toward the northern floodplain.

Riverbed Excavation Alternatives #45 and 60

Alternative #60, excavation of the mainstem and South Fork Skokomish Rivers from RM 0 to RM 9, would increase channel capacity and increase the bedload transport potential. The riverbed excavation would average around 8 to 11 feet deep. The river would be returned to a cross-section size similar to what it may have been in the early-1900s. The proposed excavation would produce a river channel with an approximate 50% ACE flood capacity. The higher in-channel discharges would increase the bedload transport and reduce deposition from RM 9 downstream to Highway 101 (RM 5). The bankfull bedload transport at Highway 101 could increase from approximately 2,500 tons/day to around 10,000 tons/day. Between Highway 101 and RM 3.5 there would be a proportional increase in deposition, as the minimum bedload transport capacity (less than 200 tons/day) occurs just upstream on RM 3.5. Downstream of RM 3.5, bedload transport potential would increase, but transport would be limited by the amount of material available to be scoured from the riverbed. The average bedload deposition rate is expected to remain at about 0.08 to 0.14 feet per year range observed in recent years. At that deposition rate, sediment accumulation in the excavated channel would aggrade the riverbed by about two feet in 20 years, lowering the channel capacity from 50% ACE (17,500 cfs) to 75% ACE (13,500 cfs). It is recommended that maintenance be done at 20-year intervals to retain the design channel capacity. If the channel is not excavated to maintain the channel capacity, it could return to its pre-excavation capacity in roughly 65 to 75 years. The excavation would allow the placement of LWD to form pool habitat. LWD jams would be small, typically four to six logs, and placed to encourage meandering and bar formation. A few LWD structures would be placed along the riverbank to reduce the risk of accelerated bank erosion due to the channel excavation.

Alternative #45 would involve excavation of RM 3.5-9. This would have the same channel dimensions as the longer excavation alternative, but would start just upstream of where the southern floodwaters re-enter the mainstem. As with the longer alternative, it increases the bedload transport and reduces deposition from RM 9 downstream to Highway 101 (RM 5). Between Highway 101 and RM 3.5 there would be a proportional increase in deposition. Downstream of RM 3.5, bedload transport potential would not change. The channel aggradation rates would be similar to the longer alternative and the channel could return to pre-excavated conditions in 65 to 75 years. The excavation would allow placement of LWD for habitat and bank protection along the deeper channel.

Alternatives #45 and #60 include two levee setbacks, located at RM 7.5-8 and RM 8.3-9.2, which are intended to provide additional floodplain habitat for fish (see Figure 3-7). Because of the increased channel capacity, setback levees may be built to overtop during the 10% ACE and larger floods. Deposition on the floodplain would be reduced because of the lower frequency of overbank flooding. The riverbanks in this reach have been stable in recent years; however, the deeper excavated channel could result in bank instability. Bank instability is not expected to be extensive as the river has followed a narrow alignment for hundreds of years.

Cumulative Effects

No significant negative cumulative effects to geomorphology or sediment transport are anticipated to accrue from any of the alternatives. Hydraulic effects of Alternative #60 could benefit sediment transport processes in estuary channels adjacent to the Skokomish Tribe's restored estuarine habitats.

4.3.3 Water Quality

Water quality within the Skokomish River, tributaries, and estuary is influenced by the dominant land uses of the Basin, which are largely agricultural fields and livestock pastures with rural homes on septic systems. Water quality impairments such as fecal coliform, dissolved oxygen (DO), and temperature can affect salmonids and marine life, recreation opportunities, commercial fishing, tribal fishing, and cultural resource use rights. Recreational and commercial shellfish beds are an important resource at Annas Bay and are sensitive to the water quality affected by the land uses in the valley. Characteristic uses of the study area such as recreation, domestic water supply, and shellfish harvesting are commonly inhibited due to fecal coliform levels. Sources of fecal coliform pollution include humans, domestic animals, wild animals, and septic system failures due to flooding and high water tables. Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas as well as bacteria and nutrients from livestock can contribute to non-point source water pollution in the study area. Reduced vegetative cover in combination with aggradation have led to concerns about reduced DO levels and increased temperature in lower reaches of the river following review of past sampling data from near the Highway 101 Bridge (Peters et al. 2011).

Hood Canal has exhibited the symptoms of hypoxia (inadequate DO) and monitoring data confirms that low DO conditions persist for extended periods (Correa 2009). Low concentrations of DO in Hood Canal are causing increased stress to the ecosystem including extensive fish kills. Additionally, valuable species such as shellfish and Dungeness crabs may be adversely affected by hypoxic conditions. Restoring conditions to benefit these species is critical to overall health of the Skokomish River, Hood Canal, and ultimately Puget Sound.

4.3.3.1 No-Action Alternative/Future Without-Project Conditions

In the future without-project condition, fecal coliform levels will continue to be a concern in the lower Basin and pose a risk to public health. Operation of the Cushman Project for power generation, forestry practices, road building, construction of levees, agricultural practices, and other land use practices will continue to contribute non-point-source pollution (Correa 2003). Continued operation of the three fish hatcheries in the study area will contribute point-source pollution. Changes to forestry, agricultural, or fish hatchery practices to reduce point and non-point pollution would occur outside Corps authorities. Continued nutrient input from humans, domestic and wild animals, and agricultural activities (livestock culture, hay production, etc.) may enter Hood Canal from the Skokomish River and tributaries, contributing to an ecological imbalance and low dissolved oxygen (DO) levels. Bottom-dwelling species will continue to suffer and die when oxygen levels are too low. Additionally, Annas Bay may continue to experience hypoxia and fish deaths in the summer when DO levels become critically low.

4.3.3.2 Action Alternatives/Future With-Project Conditions

<u>Aspects common to both groups of action alternatives</u>

Construction work for ecosystem restoration projects in the Skokomish Valley may have a temporary negative effect to turbidity through the duration of construction. Turbidity is the primary water quality concern for determining whether the alternatives would have a significant impact. Short-term exceedances, such as up to 12 hours, of the state water quality regulations at WAC 410-201A do not typically constitute a significant impact. For activities that would cause prolonged elevated turbidity levels, such as longer than 24 hours, exceptional effort would need to occur to minimize effects.

Potential benefits of ecosystem restoration are that restored wetlands may assist with reducing pollution from the non-point sources through the added filtration that increased wetland area and quality would provide. Restoration would increase pool habitat, which would provide cooler water temperatures important for most aquatic species in the Pacific Northwest.

<u>Car Body Levee Removal Alternatives #7, 23, and 28</u>

Car Body Levee removal would have minimal or no in-water work; however, several of the increments would involve significant in-water disturbance of substrates and thereby cause turbidity in the channel. These include installation of LWD at the upstream end of the study area, reconnection of the side channel at RM 4, and the restoration work within Hunter and Weaver Creeks. Implementing these projects would cause localized turbidity during construction. The Corps would have a Clean Water Act section 401 water quality certification from the Washington Department of Ecology (WDOE) and would implement all best management practices and adhere to fish work windows established by WDFW to minimize effects. Alternative #28 includes all of the increments, so this would have the greatest amount of turbidity during construction with roughly 141 days of in-water work. Alternative #23 does not include Weaver Creek Channel Restoration or Dips Road Setback and would therefore have roughly 94 days of in-water work, and Alternative #7 eliminates all increments except for the upstream LWD installation for an estimated 26 days of in-water work. For quantities excavated and construction duration, see Table 4-4 in Section 4.4.

Among the post-construction benefits to water quality, the Hunter Creek and Weaver Creek increments would provide additional pool habitat, and improved flow through these tributary habitats may help to deliver cooler water into the mainstem. The levee removal site as well as all increments except for LWD placement would have significant riparian planting, so this would improve shading of the river to help cool water temperature in the summer.

Riverbed Excavation Alternatives #45 and 60

Riverbed excavation would cause significant amounts of turbidity throughout the duration of the work, which would take from three to five years or longer to complete, depending on dredge productivity and timing limitations of fish work windows. This would cause gill irritation and stress for all fish in the river over the relatively long-term duration of work. Sediments in the river are generally coarse, so plumes of turbidity would likely dissipate within the length of mixing zone that is allowed under State law, 300 feet downstream from the source (WAC 173-201A-400). Alternative #60 would involve over 600 days of in-water work for dredging in the river, and Alternative #45 would have roughly 350 days of in-water work for dredging. For quantities excavated and construction duration, see Table 4-4 in Section 4.4.

The resulting channel morphology after construction of either Alternative #45 or #60 would likely have a vastly improved number of pools throughout the study area. This would allow cooler water temperatures in the depths of the pools. Both Alternatives #45 and #60 include all increments, so benefits of Hunter and Weaver Creek increments would be the same as described above.

Cumulative Effects

The short-term cumulative effects to water quality during and immediately following the Car Body Levee Removal alternatives would not be measurable, and would end as construction ended. Long-term cumulative effects are anticipated to be an overall benefit to water quality in the Skokomish Valley.

The short-term cumulative effects to water quality during construction of the Riverbed Excavation alternatives, when added to past, present, and reasonably foreseeable future actions would be a temporary significant degradation of water quality due to the dredging action. Summertime water temperatures are high enough to cause stress to aquatic species, and the added stress of the significant amount of turbidity may cause mortality of fish and benthic invertebrates.

4.3.4 Greenhouse Gas Emissions

Estimating the total quantity of greenhouse gasses (GHG) that each alternative would produce would require extensive analysis and numerous assumptions about each site's final design and construction. Qualitative comparisons, however, can be drawn from a simplified estimation of GHG production. Emissions of carbon dioxide from hauling activities represent a significant fraction of GHG that would be produced under the various alternatives. Furthermore, all of the action alternatives feature significant hauling requirements for their completion. Therefore, the Corps performed a simplified estimation of GHG emissions for hauling activities for all alternatives and compared the results.

Table 4-3 shows the estimated volumes of materials to be excavated for each of the alternatives, total gallons of diesel consumed, which includes an estimate of truck trips for placement of materials as well as for excavation hauling, and an estimate of carbon dioxide that would be produced from all truck trips.

The estimate assumes that trucks can hold 12 cy of material and have an average fuel efficiency of 6.5 miles per gallon of diesel fuel. The estimate further assumes that haul routes for most activities are 20 miles round trip, and for hauling associated with dredging (Alternatives #45 and #60) that the haul routes are 10 miles round trip.

Table 4-3. Estimated volumes of excavated material and carbon dioxide produced by hauling activities

	Cubic yards excavated material	Total gallons of diesel consumed	Tons carbon dioxide
No Action Alternative	0	0	0
Car Body Levee Removal Alternatives			
#7	23,200	6,118	68.5
#23	125,620	43,583	487.7
#28	213,420	69,172	774.0
Riverbed Excavation Alternatives			
#45	2,180,220	318,407	3,563.0*
#60	3,014,220	425,375	4,759.9*

*Actual amounts of CO_2 for these alternatives are likely to be significantly higher than these figures; these figures do not include emissions from dredge equipment.

To put these quantities into perspective, a passenger vehicle that travels 10,000 miles per year and burns diesel at a rate of 20 miles per gallon emits approximately 5.6 tons of carbon dioxide per year.

4.3.4.1 No-Action Alternative/Future Without-Project Conditions

GHG emissions would not be expected to increase or decrease as a result of the No-Action Alternative.

4.3.4.2 Action Alternatives/Future With-Project Conditions

Car Body Levee Removal Alternatives #7, 23, and 28

The estimated amount of carbon dioxide produced under these alternatives varies from approximately 68 tons to 774 tons. Alternatives #7, 23, and 28 are not expected to cause any substantial adverse cumulative impacts associated with global climate change, and there are no formally adopted NEPA thresholds of significance for GHG emissions.

Riverbed Excavation Alternatives #45 and 60

The estimated amount of carbon dioxide produced under these alternatives varies from approximately 3,500 tons to 4,800 tons. These figures likely significantly underestimate GHG emissions as they do not account for emissions associated with dredging operations. Alternatives #45 and 60 are not expected to cause any substantial cumulative impacts associated with global climate change, and there are no formally adopted NEPA thresholds of significance for GHG emissions.

Cumulative Effects

The potential effects of GHG emissions are by nature global and cumulative because they mix throughout Earth's atmosphere from various global sources. While the GHG releases from the proposed project will contribute to the GHG accumulating in Earth's atmosphere, an effect to global climate change would only occur when GHG emissions from all sources and sinks combine with the GHG emissions from the proposed actions on a global scale. Therefore, it is reasonable to assume that none of the alternatives for this project is large enough to have an appreciable effect on the climate because it would represent a very small portion of the total GHG emissions produced globally.

4.3.5 Climate Change and Sea Level Rise

Climate change may cause unprecedented alterations to the hydrology and hydraulics in the Skokomish Basin. The basin's seasonal hydrology and flood conditions may be altered. The three main parameters of interest in this study are sea level rise, altered hydrology, and increased sediment yields.

4.3.5.1 No-Action Alternative/Future Without-Project Conditions

USACE Engineering Circular 1165-2-212; 1 October 2011 (SLC Circular) requires feasibility studies to examine three scenarios to consider the sensitivity and adaptability of projects to sea level change (SLC). These scenarios include a low, intermediate, and high forecast of SLC for the period of analysis, which is 2015 to 2065. The guidelines require an active tide station with at least a 40-year record to estimate sea-level change for a project. Therefore, data from the National Oceanic and Atmospheric Administration (NOAA) tide station in Seattle, established in 1900, was used for the analysis, as data at the Union (local) Station has only been collected since 1996 and is of insufficient duration for developing sea level trends. The long-term trend for the Seattle station indicates the range of increases for the mouth of the Skokomish River are low 0.37 foot, intermediate 0.79 foot and high 2.15 feet. The effects predicted for global sea level change may be partially offset by vertical land rise of 0.6 foot at the mouth of the Skokomish River. A two-foot increase in average sea level would move the intertidal estuary environment landward about 1,000 feet. Higher sea level would increase the cross-sectional area and decrease velocities of estuary channels, resulting in a decrease in bedload transport to Hood Canal.

Skokomish Basin hydrology may change due to global climate change. Recent climate change projections for the Olympic Peninsula predict rising temperatures will cause more fall and winter precipitation to fall as rain rather than snow, decreasing winter snow packs. Those projections indicate that such a change in precipitation would increase winter stream flows and reduce summer base flows. Because the Skokomish Basin already receives most of its precipitation as rain, this shift in runoff is expected to be moderate. Climate change could make winter flooding even more frequent in the valley. Any reductions in summer base flows in the South Fork or Vance Creek could aggravate the summer/fall subsurface channel conditions in both streams. In the North Fork and mainstem Skokomish River, the climate change effects may be partially offset by the regulated discharges from the Cushman Project.

Climate change caused increases in winter storm discharges would result in increased bedload inflow and channel aggradation. Channel aggradation would be accelerated and potential for avulsions could develop earlier. The magnitude and timing of any increase in aggradation would depend on the unknown magnitude of the climate change related hydrologic changes.

4.3.5.2 Action Alternatives/Future With-Project Conditions

<u>Aspects common to both groups of action alternatives</u>

The Hunter and Weaver Creek tributary channels, LWD jams on the South Fork, and the Dips Road relocation would not be directly affected by climate change similarly to without-project conditions.

Car Body Levee Removal Alternatives #7, 23, and 28

The Car Body Levee removal would not be affected by sea level change, as none of the proposed actions are within the estuary.

Climate change influences on flooding with the Car Body Levee removal alternatives would be similar to those in the without-project condition (No Action Alternative). The summer/fall subsurface channel would not occur on the South Fork, as the combined North Fork/South Fork discharges should be enough to maintain a flowing stream in the new combined channel. Subsurface channel conditions on Vance Creek would be similar to the future without-project conditions.

Increased storm discharges and bedload inflows would accelerate the sediment deposition in the combined South Fork/North Fork channel formed by the Car Body Levee removal. Increased suspended sediment inflows would also increase deposition in the reconnected channel at RM 4-5.6 and in the riparian areas of the two levee setbacks (RM7.5-8 and RM 8.3-9.2).

Riverbed Excavation Alternatives #45 and 60

Higher sea levels would increase the cross-sectional area and decrease velocities of the estuary channels, resulting in a decrease in bedload transport to Hood Canal. The RM 0-9 channel excavation would likely experience some reduction in bedload transport near the mouth due to sea level rise. In the RM 3.5-9 excavated channel, sea level rise would not directly affect bedload transport, but the natural channel downstream of RM 3.5 would experience a reduction in bedload transport similar to that expected for the without-project conditions (No Action Alternative).

Climate change caused increases in winter storm discharges are expected to result in increased bedload and suspended sediment inflow. Deposition in the reconnected channel at RM 4-5.6 and in the riparian areas of the two levee setbacks (RM 7.5-8 and RM 8.3-9.2) would depend on the magnitude of the increase in flood discharges. Higher discharges generally produce higher suspended sediment loads that would cause higher deposition; however, the higher suspended sediment load would be countered in the excavated channel by the reduced frequency of flooding.

Climate change effects on flooding with the channel excavation alternatives would be less than those in the without-project condition. The increased channel capacity provided by the excavated channel would reduce the frequency of flooding. The risk of lower summer/fall discharges causing a subsurface channel on the South Fork would be low, as the excavated channel bottom is expected to be below the groundwater table. Subsurface channel conditions on Vance Creek would be similar to the without-project conditions.

The increased storm discharges and bedload inflows with climate change would accelerate the sediment deposition in the excavated channels. The channel aggradation rates would be higher than current rates and the channels could likely return to pre-excavation conditions in less than 65 years. Increased suspended sediment inflows would also increase deposition in the reconnected channel at RM 4-5.6 and in the riparian areas of the two levee setbacks (RM 7.5-8 and RM 8.3-9.2).

4.4 Biological Environment

The Skokomish River Basin is a diverse landscape with abrupt changes in elevation, making the watershed home to a variety of different habitat types and wildlife resources. Located in the Olympic Mountain Range, the Skokomish Basin is somewhat geographically isolated and not as diverse as the river basins in the neighboring Cascade Mountain Range. Over the last 150 years, there have been significant alterations to the habitats of the Skokomish watershed. Subsequently, wildlife populations, distribution, and diversity have been similarly affected. Much of the Basin's species composition (wildlife and vegetation), structure (trees, snags, soil, and tree canopy), as well as some physical processes (evapotranspiration, surface and subsurface flow of water) have been altered at a very large scale. See Appendix A, Peters et al. 2011, for a comprehensive analysis of biological baseline conditions.

The predicted significant environmental impacts of the proposed action alternatives would occur during the construction phase should one of the action alternatives be implemented. Table 4-4 provides a summary of known and assumed components of construction of the base alternatives and increments.

Table 4-4. Summary of Construction Components Analyzed for Effects to Resources

Project Features		Included in Alternative	Staging area cleared (acres)	Construction acres cleared (project footprint)	Material excavated	Material placed	Equipment on site (# calculated for schedule)	Construction duration	Number of truckloads (12 CY Truck)	Total haul distance
Bases	Riverbed Excavation (RM 0-9)	Alternative #60	3 Staging areas totaling: 30,000 SF 0.69 AC	219	2,684,000 cy O&M: 700,000 cy ea. 20 years	50 logs per mile	(1) 16" cutter head, pipeline dredge (3) 4 CY, Crawler, dragline crane (18) 18 CY, 6x6 off-road dump trucks (3) 3.2 CY, crawler, loader (3) Trailer mounted, 6'x20' grizzly screener	631 work days	199,728 + 65 (Staging area)	10-Mile cycle
Bases	Riverbed Excavation (RM 3.5-9)	Alternative #45	3 Staging areas totaling: 30,000 SF 0.69 AC	132	1,870,000 cy O&M: 600,000 cy ea. 20 years	50 logs per mile	(3) 4 CY, Crawler, dragline crane (18) 18 CY, 6x6 off-road dump trucks (3) 3.2 CY, crawler, loader (3) Trailer mounted, 6'x20' grizzly screener	363 work days	137,313 + 65 (Staging area)	10-Mile cycle
Bases	Car Body Levee Removal	Alternatives #7, 23, and 28	3 Staging areas totaling: 30,000 SF 0.69 AC	68	23,200 cy	30 logs	(3) 2 CY, Crawler, Excavators (12) 18 CY, 6x6 off-road dump trucks (3) 3.2 CY, crawler, loader (1) 75 HP, Dozer	107 work days; Minimal or no in-water work	2,417 + 65 (Staging area)	20-Mile cycle
Increments	Upstream LWD Installation	Alternatives #45 and 60 Alternatives #7, 23, and 28	Staging areas assumed to be within footprint	107	none	80-100 logs 80-100 stones @ 5'diameter	(1) 2 CY, Crawler, Excavator (1) Log Skidder (1) 1.5 CY, Crawler, Excavator w/ Thumb	26 work days	~6 stone per truck ~3 rootwads per truck	20-Mile cycle
Increments	Side Channel Reconnection	Alternatives #45 and 60 Alternatives #23 and 28	Staging areas assumed to be within footprint	45	8,500 - 16,000 cy	30 logs 30 stones to anchor logs	(6) 1.5 CY, Crawler, Excavator (4) 18 CY, 6x6 off-road dump trucks (1) 3.2 CY, Crawler,	22 work days	845	20-Mile cycle
Increments	Grange Levee Setback	Alternatives #45 and 60 Alternatives #23 and 28	Staging areas assumed to be within footprint	34	5,220 cy	23,500 cy	(3) 2 CY, Crawler, Excavators (12) 18 CY, 6x6 off-road dump trucks (3) 3.2 CY, crawler, loader (1) 75 HP, Dozer	63 work days No in-water work	2,992	20-Mile cycle
Increments	River Mile 9 Levee Setback	Alternatives #45 and 60 Alternatives #23 and 28	Staging areas assumed to be within footprint	23	6,000 cy	20,000 cy	(3) 2 CY, Crawler, Excavators (12) 18 CY, 6x6 off-road dump trucks (3) 3.2 CY, crawler, loader (1) 75 HP, Dozer	63 work days No in-water work	2,396	20-Mile cycle
Increments	Hunter Creek Side Channel	Alternatives #45 and 60 Alternatives #23 and 28	1 Staging area: 10,000 SF 0.23 AC	29	Approx 75,000 cy	None	(6) 1.5 CY, Crawler, Excavator (4) 18 CY, 6x6 off-road dump trucks (1) 3.2 CY, Crawler, Loader	39 work days	6,493	20-Mile cycle
Increments	Hunter Creek Mouth	Alternatives #45 and 60 Alternatives #23 and 28	Staging areas assumed to be within footprint	0.5	Approx 200 cy	None	(6) 1.5 CY, Crawler, Excavator (4) 18 CY, 6x6 off-road dump trucks (1) 3.2 CY, Crawler, Loader	7 work days	16	20-Mile cycle
Increments	Weaver Creek Side Channel	Alternatives #45 and 60 Alternative #28	1 Staging area: 10,000 SF 0.23 AC	25	Approx 75,000 cy	None	(6) 1.5 CY, Crawler, Excavator (4) 18 CY, 6x6 off-road dump trucks (1) 3.2 CY, Crawler, Loader	47 work days	8,283	20-Mile cycle
Increments	Dips Road Setback	Alternatives #45 and 60 Alternative #28	Staging areas assumed to be within footprint	17	1,800 cy at old road loc. 10,000-11,000 cy of organic material	11,000-12,000 cy	(1) 0.8 CY, wheel, loader (1) Excavator, pulverizer, 3,000 lb (1) 3.5 CY, wheel, loader (1) 1.5 CY, wheel, excavator (1) 2.7 ton, vibratory, double drum, roller (1) 135 HP, grader w/ blade (1) 250 hp, crawler, dozer (1) 10' wide, asphalt paver	99 work days No in-water work	3,274	20-Mile cycle

4.4.1 Fish

The Skokomish River system hosts at least 22 species of fish (Watershed Management Team 1995; Peters et al. 2011). Nearly half of these are the many species of the Salmonidae family, which includes salmon, trout, and char. Species present include Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), chum salmon (*O. keta*), rainbow trout/steelhead (*O. mykiss*), sea-run and resident cutthroat trout (*O. clarki*), bull trout (*Salvelinus confluentus*), and mountain whitefish (*Prosopium williamsoni*) (Peters et al. 2011). Sockeye salmon (*O. nerka*) and pink salmon (*O. gorbuscha*) were historically found in the Skokomish River but have been functionally extirpated (Peters et al. 2011). Five species of sculpin (*Cottus* sp.) inhabit the Skokomish River, including prickly sculpin (C. *asper*), coast range sculpin (C. *aleuticus*), riffle sculpin (C. *gulosus*), reticulate sculpin (C. *perplexus*), and shorthead sculpin (*C. confusus*). River lamprey (*Lampetra ayrsi*), western brook lamprey (*L. richardsoni*), and Pacific lamprey (*L. tridentata*) have been observed in the Basin (Peters et al. 2011). Three-spined sticklebacks (*Gasterosteus aculeatus*) are abundant in the Skokomish River. Species associated with the estuarine and nearshore habitat include shiner perch (*Cymatogaster aggregata*), surf smelt (*Hypomesus pretiosus*), Pacific staghorn sculpin (*Leptocottus armatus*), and starry flounder (*Platichthys stellatus*).

Two WDFW hatcheries, George Adams and McKernan, release hatchery Chinook, coho, chum, and steelhead into the Skokomish River Basin. The two facilities release approximately 3.8 million Chinook, 300,000 coho, 8.5 million chum, and 34,000 steelhead annually (Peters et al. 2011). A third hatchery, Eels Springs, raises cutthroat trout, rainbow trout, and kokanee salmon (i.e., land-locked sockeye salmon; [*O. nerka*]) for put-and-take fisheries in local lakes (Peters et al. 2011).

Salmonid species can have separate stocks, also called runs, within a single river system. Table 4-5 is a summary of the stocks known to occur in the Skokomish watershed, including those that are functionally extinct but that may still have a few representatives each year.

Table 4-5. Salmonid stocks that occur in the Skokomish watershed with their spawning timing and locations summarized from Peters et al. (2011)

Species and stock designation	Spawning timing	Spawning location
Chinook – Fall/summer	Sept-Oct	Mainstem, S. and N. Forks, Purdy, Weaver, Vance Creeks
Chinook – Spring (extinct)	July	Mainstem, S. and N. Forks, Purdy, Weaver, Vance Creeks
Chum – upper Skok late fall	Dec-Jan	Most tributaries and lower 5 miles of N. Fork
Chum – lower Skok fall	Nov-Dec	Purdy and Weaver Creeks, and lower mainstem
Chum – summer (extinct)	Mid-Sept to mid-Oct	Lower watershed
Coho	Oct through March	Most tributaries, N. Fork, Vance Creek
Steelhead – summer	Feb to April	S. Fork canyon reach
Steelhead – winter	Mid-Feb to Mid June	Mainstem and S. Fork
Bull trout – South Fork stock	Mid-Sept through Dec	Use S. Fork and all tributaries, but specific spawning locations are unknown
Cutthroat (sea-run)	Late winter through spring, peak in Feb	Small tributaries

Riffle and side channel habitats are important for lamprey spawning. Lamprey larvae are most abundant where the stream channel is relatively deep (0.4−0.5 m), gradient is low (<0.5%) and the riparian canopy is open (Torgerson and Close 2004). Ammocoetes (juvenile lamprey) rear in reaches where spawning occurred (Pletcher 1963). At finer scales, larval occurrence corresponds positively with low water velocity, pools, and suitable burrowing habitat (Roni 2002; Pirtle et al. 2003; Torgerson and Close 2004; Graham and Brun 2005). Prickly sculpin and coastrange sculpin typically inhabit the lower reaches with prickly sculpin inhabiting pools and other slow-water habitats while coastrange sculpin inhabit riffles and other fast-water habitats. Riffle sculpin and reticulate sculpin usually occur in middle reaches in a variety of habitat types. Shorthead sculpin typically occur at higher elevations than the other four species.

Degraded conditions continue to affect fish populations in the study area. Habitat requirements for the Salmonidae family make a good surrogate for overall ecosystem health when considering the full range of anadromous fish habitat requirements, including off-channel habitats, food web interactions, and spatial relationships among habitats. These habitat requirements are the focus of the discussion of future without-project conditions (No Action Alternative) and effects of the alternatives on fish species in the study area. Each salmonid species differs in the timing of critical life history events and the way it uses various habitats, but all of the anadromous fish in the system have the same basic requirements:

- Adequate water quality and appropriate water temperatures
- Balanced sediment budget
- Stable spawning gravels
- Pools and instream structure including large boulders and logs
- A functional riparian zone
- Connected freshwater migratory and refuge habitats
- A complex of healthy estuarine and nearshore habitats to allow transition from freshwater to seawater

All of these critical factors were found to be compromised or lacking to some extent in the study area. Much of the degradation originates from alteration of the river environment by the removal of LWD, channel realignments, bank protection, aggradation in the channel, changes in flows, and disconnection of access for fish into aquatic habitats in the floodplain and off-channel wetlands.

As discussed in Section 4.3.1, the lack of channel capacity for even the one-year return interval discharge causes displacement of fish during overbank flows. Effects of this are that the adults may become stranded in floodplain areas where they die before spawning, or they are forced to spawn in areas that become dewatered killing the eggs; additionally, the offspring that do survive in isolated ponds are unable to return to the river to rear and migrate out to sea. Those that remain in the channel have little refuge habitat and are therefore forced downstream to the lower river and estuary where they become vulnerable to predators or are unable to survive in saltwater as they have not yet smolted (changed physiology for saltwater life stage).

Along with reduced channel capacity, significant aggradation causes the river to flow subsurface during the summer months. Subterranean flow occurs in the South Fork and lower Vance Creek and significantly affects fish. In recent years during the late summer and early fall, no surface hydraulic connection has existed between the mainstem and the South Fork and Vance Creek (USACE 2000). Lack of access to upstream habitat means a drastically reduced area for spawning and blocked migration for fish moving to upstream or downstream reaches. Another characteristic of the Skokomish River is that the removal of large wood decades ago and the filling of pools due to wood removal and sedimentation have significantly reduced the variety of habitat types. This reduction in habitat complexity leads to reduced resilience of the river's salmon populations (Waples et al. 2009). The Ecosystem Benefits Model developed to quantify benefits of the alternatives includes a detailed description of habitat limiting factors for salmonids in the Skokomish watershed (see Appendix F).

4.4.1.1 No-Action Alternative/Future Without-Project Conditions

The Skokomish River will continue to face numerous limiting factors for fish. Major problems affecting salmon survival and migration will continue. Habitat availability, quality, complexity, and connectivity will continue to deteriorate. Winter high flows will continue to transport both juvenile and adult salmon out of the river, stranding them in the floodplain to die. As sediment continues to accumulate in the mainstem, upstream passage will continue to be delayed or completely blocked during summer low flows. The overall condition of the channel is anticipated to remain severely degraded; reduced holding pool quality and availability will continue to render adults vulnerable to predation/harassment, and reduced channel complexity will lead to more frequent and severe scouring of redds. Ultimately, the future without-project condition for fish resources in the mainstem and South Fork reaches of the study area is expected to remain in a severely degraded state and would not be able to support recovery of ESA-listed species.

Salmon return to spawn in the streams and tributaries where their parents spawned and where they spent the first months of their lives. Therefore, the stocks that use the North Fork habitat (the area of the basin affected by the Cushman Settlement) are largely distinct from the populations that use the mainstem and South Fork reaches of the Skokomish River. For this reason, the Cushman Settlement will benefit mainly the North Fork stocks of fish. While the Settlement will benefit the estuary and lower eight miles of River, conditions will not significantly improve the habitat of the entire TSP area. The TSP includes off-channel habitats and tributaries that are not affected by the Cushman Settlement. Additionally, the ESA-listed runs of fish that use habitat upstream from the confluence will still encounter severely degraded habitat conditions. The summer low-flow blockage problem is upstream from the confluence and therefore requires attention that the Cushman Settlement measures do not address. The Cushman Settlement measures are complementary to, but independent from the action alternatives described in this chapter.

4.4.1.2 Action Alternatives/Future With-Project Conditions

<u>Car Body Levee Removal Alternatives #7, 23, and 28</u>

Construction for removal of the Car Body Levee would have no in-water work and minimal disturbance for fish as machinery works on the riverbank. Construction work for the increments associated with all three alternatives would involve some in-water work and would there for have short-term disturbance to fish species still present during the fish work window that is timed for when juvenile salmon are absent, 15 July to 15 September. Turbidity is the primary concern for stress to fish species. Background turbidity during the summer is typically very low. Construction methods would employ best management practices to minimize turbidity. For duration of in-water construction for each increment, see Table 4-4. The preferred alternative, #28, would have 141 in-water workdays; Alternatives #23 and #7 would have 94 and 26 in-water workdays, respectively.

Car Body Levee removal would resolve the problem of the river going subsurface in the summer months by providing a bypass to this reach as the South Fork combines with the North Fork. The benefit of this year-round connection for fish is that adult salmon migrating upstream would have access to their spawning areas and would not have to endure delays to migration and the complete blockage of access to critical spawning habitat.

Riverbed Excavation Alternatives #45 and 60

Alternatives #45 and #60 would have significant short-term detrimental effects to all fish species in the Skokomish River due to the wide-scale sediment excavation. These alternatives are designed to remove the top 8 to 10 feet of riverbed sediments for 9 miles in #60 and for 4.5 miles in #45. This work would remove the benthic macroinvertebrates that serve as the primary food source for most fish, and would likely kill most of the sculpin and lamprey species present in the length of channel that would be dredged. Construction would adhere to fish work windows, but these are timed to protect salmon that are in the channel only during juvenile and adult life stages. Sculpin and lamprey inhabit the river throughout their lives, and are less capable of avoiding dredge machinery. Loss of these fish populations could take many years to recover.

Such broad-scale alteration of the river bottom would cause significant risk to salmon habitat. Salmon spawn throughout the lower 12 miles of the river, and gravel at the depths achieved by dredging is assumed to be similar to the top layers; however, in-stream sediment removal directly alters the channel geometry and risks leaving morphology unfavorable to salmonids. Some risks include the following: salmon have a narrow range of parameters for spawning depth, velocity, and substrate size (Bjornn and Reiser 1991), and therefore may not find appropriate spawning habitat for one or more years as sediments stabilize and channel morphology adjusts (Kondolf et al. 2002); disturbed substrate has a lower velocity threshold for scour of eggs incubating in the gravel (NOAA Fisheries 2004); and such significant quantity of gravel removal can reduce the amount of water that flows through the hyporheic zone, which can lead to elevated water temperatures without the cooling effect of intragravel flow. A variety of other biological consequences are associated with sediment extraction from streams (Collins 1995, Kondolf et al. 2002).

Benefits of river sediment excavation for both Riverbed Excavation alternatives are that providing the capacity for the 50% ACE would greatly reduce the problem of fish stranding on high ground after being flooded out of the river and then trapped with no channel access back into the river. Additionally, the increased flow capacity would allow for placement of LWD habitat structures throughout the excavated reach of river without exacerbating flooding in the valley. Dredging would also resolve the problem of flow going subsurface in the late summer. If this alternative were selected as the preferred alternative, the Corps would further investigate the quantification and magnitude of the fish-stranding problem, as well as pursue an analysis of whether the assumed benefits outweigh the impacts and speculated risks.

Cumulative Effects

Cumulative effects of Alternative 2 are assumed to be countervailing to the history of development in the Skokomish Valley and are expected to be additive to the benefits of all other restoration effort that has occurred in the estuary and upper watershed.

Short-term effects of Riverbed Excavation pose a significant risk to all fish species, and especially to salmon that may not find suitable spawning habitat for an unpredictable number of years. This potential negative effect would be added to the list of events in Table 4-2 that have caused environmental degradation around the Skokomish watershed. Long-term cumulative benefits of Riverbed Excavation are assumed that increased channel capacity would significantly reduce stranding of juvenile and adult salmon such that they may be able to rebuild their populations to some degree above the low numbers that have endured for at least a decade. Similarly to the Car Body Levee Removal alternatives, the benefits of the Riverbed Excavation alternatives would be additive to all other restoration work around the watershed.

4.4.2 Shellfish and other Macroinvertebrates

Shellfish

The Annas Bay estuary area contains a rich shellfish resource that is used by tribal, commercial, and recreational harvesters. Shellfish species common in Annas Bay include Dungeness (*Cancer magister*) and red rock (*Cancer productus*) crabs; butter (*Saxidomus giganteus*), manila (*Venerupis philippinarum*), littleneck (*Protothaca staminea*), and purple varnish (*Nuttallia obscurata*) clams; and Pacific oysters (*Crassostrea gigas*) (Dethier 2006; WDFW 2013a). The WDFW Priority Habitats and Species database has a record of geoduck in narrow bands along the shorelines around Annas Bay (WDFW 2013b). These native and non-native species are associated with the intertidal and subtidal zones; crabs and oysters dwell on the substrate surface while the clams bury themselves at various shallow depths. The substrate preferences range from mud and sand to gravel and rocks (Dethier 2006).

Shellfish resources have been declining due to reduced availability of suitable substrate for shellfish attachment in the estuary as well as high fecal coliform levels in Annas Bay and Hood Canal. The Washington State Department of Health downgraded 300 acres on the east side of Annas Bay growing area from *Approved* to *Prohibited* in August 2005 based on high fecal coliform bacteria levels. Mason County was therefore required by RCW 90.72.045 to establish a shellfish protection district and program to address the cause of the pollution. The study area for this feasibility report includes a significant portion of the shellfish protection district (Figure 4-1).

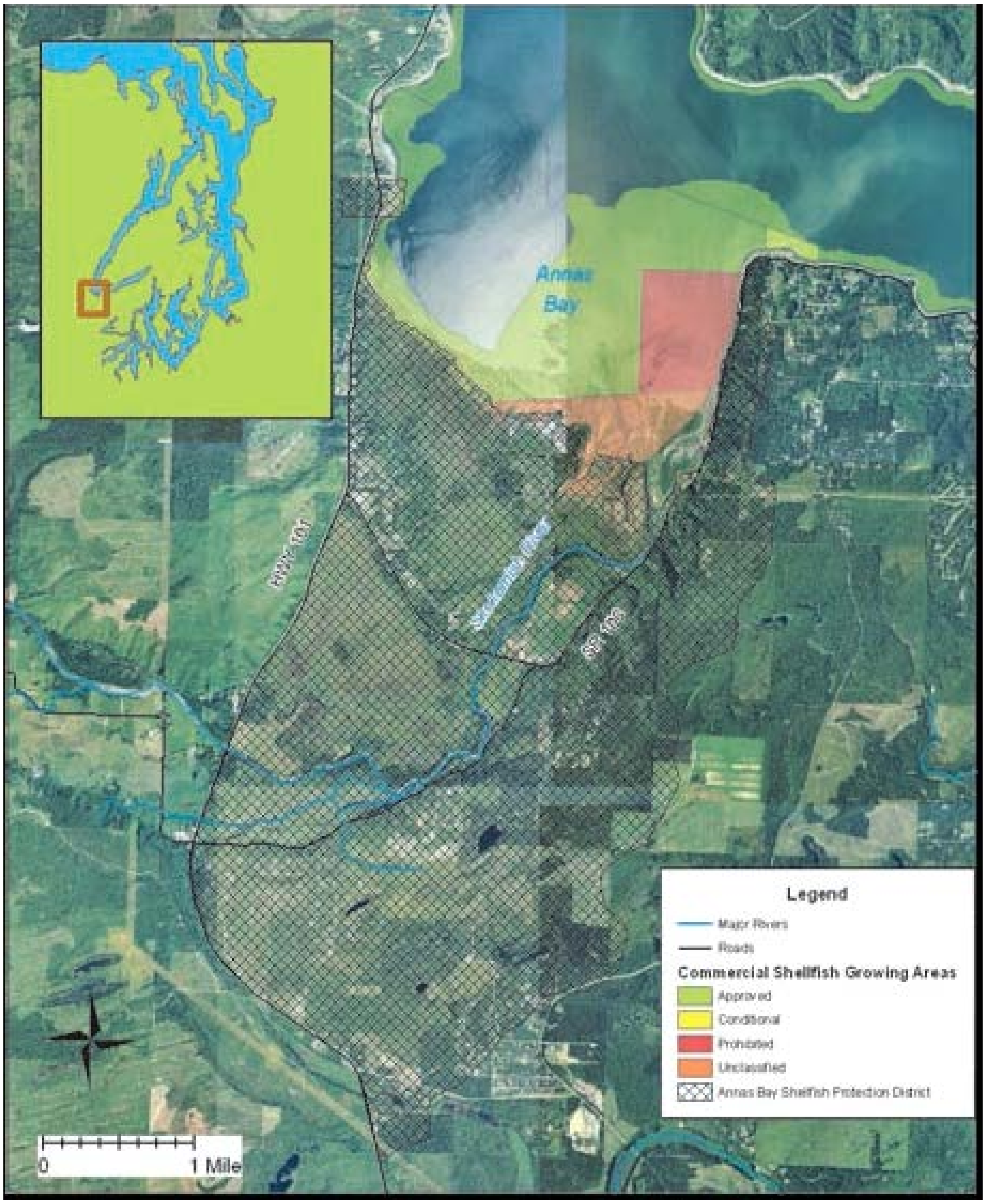


Figure 4-1. Mason County Public Health Department Shellfish Protection District and designations of shellfish harvest areas in the Skokomish River estuary and extended nearshore area

Benthic Macroinvertebrates

The freshwater benthic macroinvertebrates of concern in this feasibility study are the aquatic insects that dwell in the substrate of the river and tributaries. The five orders of insects that typically inhabit Pacific Northwest freshwater habitats are the black flies including mosquitoes (Diptera), caddisflies (Trichoptera), mayflies (Ephemeroptera), stoneflies (Plecoptera), and true bugs (Hemiptera). Dragonflies and damselflies (Odonata) are associated with wetlands and pools at the edges of streams as well. These aquatic insects provide critical ecosystem services such as the following (Allan 1995):

- Breaking down detritus inputs from riparian vegetation (shredders)
- Removing excess algae from rocks and other surfaces (scrapers)
- Water filtration by collecting suspended particles (collector-filterers)
- Mixing bottom sediments (burrowers)
- Population control of other invertebrates (predators)
- Serving as key food sources for fish, birds, and other aquatic-oriented animals (prey)

USFWS conducted biological monitoring for this feasibility study, which revealed that the aquatic insect population is generally healthy, but that long-lived species populations are very low (see Appendix A, Peters et al. 2011).

4.4.2.1 No-Action Alternative/Future Without-Project Conditions

Shellfish – The crabs, clams, and oysters in Annas Bay may continue the recent population declines that have been occurring due to reduced suitable substrate. Local work to reduce fecal coliform is expected to slowly improve conditions. Given multiple confounding factors, it is difficult to predict with any confidence what the shellfish populations could be through the 50-year study period.

Benthic Macroinvertebrates – The aquatic insect community in the river is not expected to change as no activities are planned for the reach of river in the study area that would cause shifts in population or community structure. Aggradation and/or frequent flooding may be the cause of the dearth of long-lived species, and these two characteristics are not expected to change in the 50-year study period. Recent restoration in the estuary is anticipated to improve the community structure of the benthic macroinvertebrates found there.

4.4.2.2 Action Alternatives/Future With-Project Conditions

Car Body Levee Removal Alternatives #7, 23, and 28

Shellfish – None of these alternatives would be expected to have a significant effect on the shellfish populations, although improved water quality expected from Alternative #23 and #28 may be of benefit to shellfish. Alternative #7 does not include enough wetland restoration to provide water quality benefits that would reach as far as the estuary.

Benthic Macroinvertebrates – All three Car Body Levee Removal alternatives would have measurable, localized improvements in numbers and diversity of the aquatic insect communities. This may have a positive effect upstream and downstream from the restoration sites; however, ability to quantify improvements decreases with distance from the restored area. Alternative #28 would see the greatest improvement as this alternative has more increments and does not involve significant sediment removal. Alternative #7 would provide the least improvement of all the alternatives because the only increment included is the upstream LWD installation.

Riverbed Excavation Alternatives #45 and 60

Shellfish – For Alternatives #45 and 60, sediment excavated from the river would be strategically placed at specific locations in the lower intertidal and subtidal areas of the estuary and adjacent nearshore zone. Material would be placed to create swales that are two to eight feet high over an area that is approximately 800 acres. Alternative #60 disposal quantity would be nearly 2.7 million cubic yards, and Alternative #45 would be less at just under 1.9 million cubic yards. The grain size distribution of this dredged and disposed material would be beneficial for the shellfish species that attach to the substrate, such as oysters and mussels. Other benthic invertebrates in the estuary would be expected to recover within about one year (Bolam and Rees 2003).

Benthic Macroinvertebrates – Alternatives #45 and 60 would have significant negative effects to the aquatic insect populations in the river. Dredging effectively removes and kills nearly all aquatic insects within the dredged channel, and insects that remain in the channel are subjected to the settling of fine sediments that become suspended during the dredging work (Kondolf et al. 2002). Recolonization across the many miles of river would take varying amounts of time depending on species mobility and trophic habits (Mackay 1992). A direct effect of such widespread removal of the benthic macroinvertebrates that dwell among the substrate is that any fish remaining in the river that were not killed during dredging would have little to no food source available. Additionally, the young salmon that emerge from redds the following spring will have extremely poor feeding conditions as their primary food sources would not likely have had enough time to recover to previous abundance.

Cumulative Effects

Cumulative effects that would accrue for shellfish and benthic macroinvertebrates with implementation of any of the action alternatives are the improved water quality from restoration of wetlands, which would add to the efforts of Mason County Public Health Department to improve water quality for the Shellfish Protection District. The Riverbed Excavation Alternatives would have additional direct benefits to shellfish through the disposal of dredged gravel in the estuary.

The negative effects for benthic macroinvertebrates would have significant cumulative effects for salmonid species that already face greatly reduced and degraded habitats in the channel and floodplain.

4.4.3 Vegetation (Wetland, Riparian, Estuarine)

The Skokomish watershed’s topography is widely varied, consisting of steep mountain slopes, moderately sloping foothills, and flat valley bottoms, which causes a corresponding variation in vegetation throughout the Basin. Logging and forest management for timber production have caused large-scale alteration of flora and fauna. Effects include reduction of habitat diversity, fragmentation of the landscape, and soil disruption that potentially lead to mass wasting. Mass wasting can completely alter the vegetation potential of the land; plant communities that reoccupy these sites are usually much different from the preceding mature communities. Logging and road construction effects are felt throughout the Basin; however, the proposed action focuses on aquatic habitats. This section therefore focuses on the riparian, wetland, and estuarine habitats for analysis of the future with and without-project conditions.

Agricultural conversion of the Valley began in the late 1800s with removal of large Douglas fir and cedar trees that were cut and floated down the Skokomish River to Hood Canal. By the early 1900s, most of the Skokomish River floodplain had been cleared of timber and converted to pastureland, reducing the amount of riparian forest along the river. By 1995, about 2,700 acres in the study area had been converted to agriculture and urban uses (USFS 1995).

Wetland Vegetation

The Lower Skokomish Basin is one of the few areas in the Hood Canal area to increase in wetland coverage over the last 20 years. Wetlands in the study area were inventoried for their extent and type using the Cowardin classification system (see: Anchor QEA 2011, Appendix C). The analysis resulted in mapping 231 individual wetland habitat polygons covering 4,553 acres within the study area and an additional 995 acres of subtidal wetland in the Skokomish river delta. In addition to areas of development including the Skokomish Tribal Reservation, there are 1,640 acres of agricultural lands in the study area. Of these 1,640 acres, about 216 acres (13 percent) are wetlands.

Riparian Vegetation

Riparian zones have a diverse selection of vegetation including an overstory of red cedar, cottonwood, alder, and Douglas fir as well as an understory of salmonberry, snowberry, Indian plum, swordfern, blackberry, willow, and various grasses. In addition to preventing pollution and stabilizing bank erosion, the diverse vegetation of the riparian zone sustains a wide variety of fauna. The fish and wildlife that live in the stream and along riverbanks are very dependent on the zone for their food and habitat requirements. Suitable habitat characteristics including LWD, riparian vegetation, and aquatic vegetation are necessary for providing refugia from predation and optimal growth for juvenile salmon. Riparian vegetation provides shade to keep water temperatures lower during summer months.

Although there are pockets of good riparian vegetation in the mainstem Skokomish, approximately 62% of the mainstem is sparsely vegetated, has been cleared for agriculture, has a riparian buffer less than 66 feet wide, and does not provide LWD recruitment necessary to maintain structurally diverse channels (WDFW and PNPTT 2000). Deciduous trees dominate the riparian areas where historically the riparian corridor was mixed forest (Correa 2003). Riparian vegetation appears to be degraded within the Skokomish Basin, with the greatest degradation occurring in the lower Skokomish reach and in mainstem channels relative to upstream tributaries. The Skokomish River's riparian zones consist of younger tree age classes with higher percentages of hardwoods and reduced LWD potential (U.S. Dept. of Agriculture 1995). The Skokomish mainstem, Weaver Creek, Hunter Creek, and the lower South Fork Skokomish have poor riparian conditions (Correa 2003).

Estuarine Vegetation

The Skokomish River has the largest estuary and intertidal delta in the Hood Canal Basin. The delta includes a broad estuarine wetland complex and supports extensive submerged aquatic vegetation including eelgrass beds. Analysis of historical maps indicates that emergent vegetation dominated up to 75 percent of the estuarine wetlands in the Skokomish delta (Collins and Sheikh 2005). Estuarine scrub-shrub wetlands comprised about 13 percent of the complex, compared to current wetland maps showing no scrub-shrub wetlands in the complex (Collins and Sheikh 2005). Recent projects have breached dikes around islands in the lower estuary to restore tidal inundation of historic salt marsh areas. These breached areas make up the majority of the estuarine wetlands across the delta.

Eelgrass (*Zostera marina*) is the most common native vegetation in intertidal and subtidal beach habitats and embayments of Puget Sound. Large eelgrass beds can grow on the fringes of large river deltas where the salinity is high enough and sediment supply is sufficient. Biological diversity of eelgrass beds is much higher than that of surrounding areas because the three dimensional structure provides substantial habitat value. Eelgrass meadows support many small vertebrate and invertebrate organisms that provide prey for larger species, including juvenile salmon and sea-going trout that use the area heavily for feeding and protective cover during their outmigration. Eelgrass beds provide habitat for other fish, adult and larval crabs, great blue herons, crustaceans, and many other kinds of marine life. Eelgrass serves an important spawning substrate for Pacific herring (Penttila 2007). Additionally, eelgrass supplies organic material to nearshore areas, and its roots stabilize sediments.

The Skokomish estuary has about 17% less eelgrass compared to historical conditions (Jay and Simenstad 1996). Recent sampling shows Annas Bay has approximately 10 acres of eelgrass coverage (WDNR 2009). Based on data collected from 2000 to 2008, WDNR places Hood Canal in a category of high concern for eelgrass decline; however, the sampling location in Annas Bay showed no evidence of decline as of 2008 (WDNR 2009), and has actually been increasing in coverage area according to the 2010 surveys. Figure 4-2 shows the general area of eelgrass around the Skokomish estuary as recorded in WDFW’s Priority Habitat and Species database. WDNR’s most recent survey of the extent of eelgrass coverage is shown in Figure 4-3.

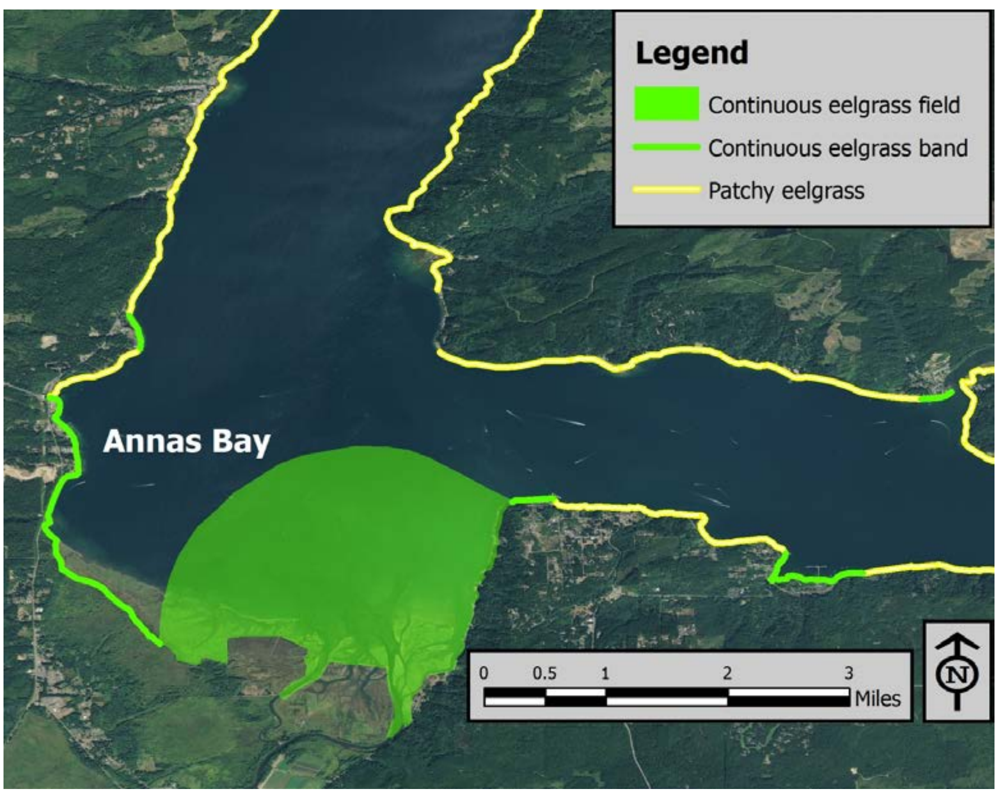


Figure 4-2. General location of eelgrass meadows and bands around Skokomish estuary and nearshore (Source: WDFW 2013b).

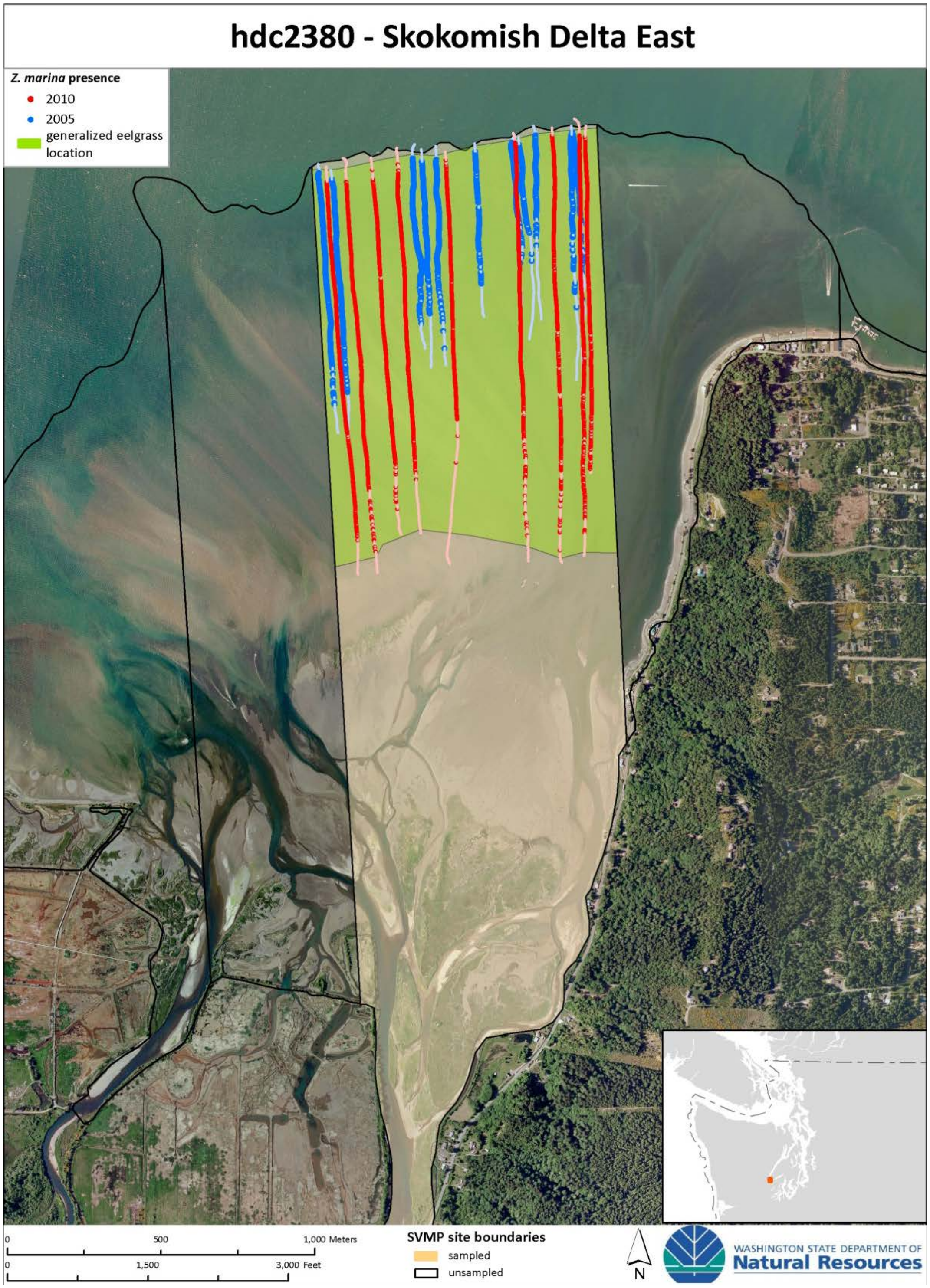


Figure 4-3. One of the eelgrass monitoring sites with sampled transects from 2005 (blue) and 2010 (red). Image courtesy of Washington Department of Natural Resources.

4.4.3.1 No-Action Alternative/Future Without-Project Conditions

Wetlands in the study area may continue their trend of increasing in area even without directed restoration efforts to restore or increase their area and quality.

In the higher elevations, riparian zones are recovering as improved forestry practices focus on increasing riparian buffers and providing vegetated corridors. However, without restoration actions in valley, the upper watershed improvements will not be realized in the lower river. Local entities will likely undertake various vegetation enhancement projects to address the loss of riparian vegetation. Mason Conservation District is employing invasive species removal and riparian restoration efforts in the Skokomish Valley including working with Washington Conservation Corps crews to inventory and treat Japanese knotweed. Efforts to restore native riparian vegetation are focused on a 70-acre Conservation Reserve Enhancement Program buffer and a 43-acre floodway easement. In addition, approximately 25 to 30 acres have been planted on Skokomish Farms, WDNR, and Skokomish Reservation lands. However, due to the large percentage of privately owned lands, the extent to which these actions can comprehensively restore vegetation depends on the willingness of private landowners to participate in the restoration projects. With no large-scale changes planned to improve riparian vegetation on the tributaries and the mainstem, riparian vegetation is anticipated to remain in poor condition.

Estuarine emergent marshes will slowly continue to improve due to the restoration efforts of the Skokomish Tribe and Mason County at dike breaching in the estuary. Without restoration efforts, eelgrass around Hood Canal is expected to continue its decline, although the eelgrass meadow in the Skokomish estuary may remain the same size or continue its trend of expansion (WDNR 2009).

4.4.3.2 Action Alternatives/Future With-Project Conditions

Car Body Levee Removal Alternatives #7, 23, and 28

Construction impacts to vegetation from implementation of Alternative #28 would be a temporary clearing of approximately 1.15 acres of upland vegetation bordering on riparian zones for staging areas for the Car Body Levee removal, and for the restoration of Hunter and Weaver Creeks. Alternative #23 would have 0.92 acre of uplands cleared for staging areas, and Alternative #7 would have 0.69 acre cleared. The Corps would select staging areas based partly on avoidance of large trees and would replant all staging areas at the end of construction. Vegetation would be expected to reach pre-construction conditions within approximately three years.

The proposed actions would have great benefits to riparian and wetland vegetation. Implementation of Alternative #28 would involve 242 acres of mixed riparian and wetlands habitats. The proposed restoration would result in improvement of existing wetland and riparian zones and connection of uplands to riverbank, creating new riparian zones through levee setback projects. Alternative #23 would provide the same types of improvements, but to less acreage at 200 total acres of wetlands and riparian zone improved or created. Alternative #7 would only provide reconnection of 68 acres of riparian uplands at the location of the Car Body Levee removal. None of these three alternatives would have a significant effect on eelgrass in the estuary.

Riverbed Excavation Alternatives #45 and 60

Both of these alternatives would have the same acreage of staging areas at approximately 1.15 acres. Construction impacts to vegetation would be the same as described for the Car Body Levee Removal alternatives. Alternatives #45 and 60 include all of the increments; therefore, both would improve the same acreage of wetland and riparian vegetation as Alternative #28 at approximately 242 acres.

Cumulative Effects

The Corps anticipates no significant adverse cumulative effects to vegetation to accrue from any of the alternatives. Restoration of riparian and wetland vegetation in the Skokomish Valley would add to the work of the USFS in the Federal forestlands in the upper watershed and to the 1,000 acres of estuarine restoration that the Skokomish Tribe and Mason County have achieved. The proposed restoration would provide an important connection between these two valuable habitat types in the Skokomish Basin and would therefore have a cumulative benefit to overall biodiversity of the vegetation communities.

4.4.4 Rare, Threatened, and Endangered Species

Nine species identified under the ESA as endangered or threatened potentially occur in the study area: four fish species, four bird species, and rare sightings of killer whales (USFWS 2010a; NOAA-NMFS 2009, 2010). These species are presented in Table 4-6. No Federally listed plants, invertebrates, amphibians, or reptiles are found in the study area (USFWS 2010a; NOAA-NMFS 2009, 2010). The Corps is undertaking ESA Section 7(a) consultation as part of the EIS process. Results of the consultation will be incorporated into the Final EIS. Preliminary effects determinations as anticipated through this initial analysis are included in the following descriptions of effects of the alternatives.

Table 4-6. Federally listed, proposed, and candidate species that may occur in the study area.

Common Name (*Scientific name*)	Federal Listing Status/ Critical Habitat	Year Listed	Potential for Occurrence	Preliminary Effect Determination of the TSP/ agency preferred alternative
Northern spotted owl (*Strix occidentalis caurina*) [/1]	Endangered / Designated	1990	Likely	No effect
Marbled murrelet (*Brachyramphus marmoratus*) [/1]	Endangered / Designated	1992	Likely	No effect
Streaked horned lark (*Eremophila alpestris strigata*) [/1]	Threatened / Designated	2012	Unlikely	No effect
Western yellow-billed cuckoo DPS (*Coccyzus americanus*) [/1]	Proposed/ None designated	2001	Unlikely	No effect
Southern Resident killer whale *(Orcinus orca*) [/2]	Endangered / Designated	2003	Unlikely	No effect
Puget Sound Chinook Salmon ESU (*Oncorhynchus tshawytscha*) [/2]	Threatened / Designated	1999	Confirmed	Not likely to adversely affect
Hood Canal Summer-Run Chum Salmon ESU (*Oncorhynchus keta*) [/2]	Threatened / Designated	1999	Extirpated from System	Not likely to adversely affect
Puget Sound Steelhead DPS (*Oncorhynchus mykiss*) [/2]	Threatened / Proposed	2007	Confirmed	Not likely to adversely affect
Coastal/Puget Sound Bull trout DPS (*Salvelinus confluentus*) [/1]	Threatened / Designated	1999	Confirmed	Not likely to adversely affect

[/1] USFWS 2010a

[/2] NMFS 2009

The existing condition and future without-project condition (No Action Alternative) for each confirmed or likely ESA species is discussed below, followed by analysis of effects in the future with-project condition (action alternatives) for the broader group of species.

Northern Spotted Owl

Northern spotted owls inhabit old growth or late successional coniferous or mixed conifer-hardwood forests, and the Skokomish watershed is within their range. The only report of spotted owls recorded in the WDFW (2013b) database is a sighting in 1994 at Frigid Creek, a tributary to the North Fork Skokomish River. No critical habitat is located within five miles of the study area. In the future without-project condition, northern spotted owl populations are expected to continue to decline due to habitat loss, reduction in prey, and competition for home range from other species such as the barred owl.

Marbled Murrelet

Marbled murrelets occur in the Hood Canal region in small numbers compared to the more northern areas of Puget Sound. Marbled murrelets nest in mature and old growth forests and forage in deeper water of entrance channels of rocky shores, estuaries, and protected bays where they dive in pursuit of prey fish such as Pacific herring, sand lance, and surf smelt. Critical habitat includes upland forested stands used for nesting, but does not include marine water. Marbled murrelets have been observed within their designated critical habitat in forested areas upstream from the study area (WDFW 2013b).

Recent trends indicate a continued steady decline of marbled murrelets, with a decrease in population of eight percent from 2000 to 2009 in Puget Sound and the Strait of Juan de Fuca (USFWS 2009). The 2010 population estimate for Puget Sound and Strait of Juan de Fuca was around 4,000 (Pearson et al. 2011). Population declines occur through habitat loss from timber harvest and natural events such as wildfires, insect outbreak, and windthrow in their terrestrial environment, and harmful algal blooms, declining prey availability (forage fish), and catastrophic events such as oil spills in their marine environment. In the future without-project condition, marbled murrelet population declines may occur through habitat loss and catastrophic events beyond the scope of this feasibility study, such as oil spills.

Streaked Horned Lark

The historical breeding range for Streaked horned lark extended from southern British Columbia through the Puget lowlands and Washington Coast south to the Willamette and Rogue River valleys. These birds nest on bare ground in sparsely vegetated sites that are mostly grassy, such as prairies, coastal dunes, fallow agricultural fields, and seasonal wetlands. There are no historical breeding records for Mason County and this species is considered not likely to occur in the study area.

Yellow-billed cuckoo

This migratory bird formerly had a range across much of North America, but is now limited primarily to the eastern and central United States with a few populations in the West. The preferred breeding habitat is open lowland deciduous woodlands with clearings and shrubby vegetation, especially near rivers and streams with nests in willows and cottonwoods that make up long contiguous riparian zones. Yellow-billed cuckoos are not expected to occur in the study area because their habitat requirements are not present.

Puget Sound Chinook Salmon

Puget Sound Chinook salmon are ESA-listed as threatened (NMFS 2005). Critical habitat was designated throughout Puget Sound and its tributaries in 2005. Puget Sound populations are largely summer/fall runs; however, the Skokomish River once supported a run of spring Chinook salmon. The stock was reported in decline as early as 1950, but still used the lower five miles of the South Fork and 13 miles of the North Fork. Nehlsen et al. (1991) reported the stock extinct in 1991. This extinction is likely due to overfishing and the construction of the Cushman Dams (James 1980), which blocked access to a major component of their habitat and altered hydraulic patterns in the system (Skokomish Indian Tribe and WDFW 2010). Fall/Summer Skokomish Chinook were classified as threatened as a component of Puget Sound Chinook ESA listing in 1999, and this status was reaffirmed in 2005 (70 FR 37160); they were designated as their own stock in WDFW's 2002 Salmonid Stock Inventory (SASSI) based on geographic location and have been rated as depressed.

According to Peters et al. (2011), for the last several years, fewer than 100 fall Chinook were documented in the South Fork. Juvenile Chinook were observed in the mainstem, tributaries, and off-channel pond habitats in the Skokomish Valley. Juvenile Chinook were common in the estuary and were quite abundant (i.e., 55,000) compared to their observed abundance in freshwater habitats, despite the fact that a very small portion of the estuary was sampled. This suggests that a majority of juvenile Chinook in the system may be migrating directly to the estuary without rearing in the freshwater environment, likely due to the severe lack of appropriate pool habitat.

Although a recovery plan is in place, poor habitat conditions continue to affect Chinook in the study area. The lack of LWD, established riparian corridors, and riverbed aggradation have reduced channel capacity to critically low levels in several locations. Summer low flows can block adult migration, resulting in an unsuccessful migration to spawning grounds. Eggs are susceptible to being smothered by sediment or scouring during winter storms. In the future without-project condition, fall Chinook numbers in the North Fork may increase due to actions from the Cushman Dam settlement agreement. Habitat conditions on the South Fork, Vance Creek, and mainstem will continue to degrade, leading to a decline in fall Chinook numbers and potential extirpation from these areas. The Skokomish Tribe and Mason County have collaborated to accomplish significant restoration in the estuary, but without complementary restoration of the freshwater habitat, this effort will have limited success at restoring Chinook numbers.

Hood Canal Summer-Run Chum Salmon

Hood Canal summer-run chum salmon were listed as threatened in March 1999; this status was reaffirmed in 2005 (70 FR 37160). Critical habitat was designated in September 2005. Today, summer-run chum are extirpated from the Skokomish River. A few adults are observed in the mainstem each year, but are not enough to be described as a self-sustaining population. In the future without-project condition, summer-run chum are not anticipated to fully recover in the Skokomish River.

Puget Sound Steelhead

Puget Sound steelhead were listed as a threatened species in May 2007 (72 FR 26722); critical habitat is under development. An estimated 300 to 400 winter steelhead occur in the South Fork but there are no credibly documented summer steelhead in this area (Peters et al. 2011; Skokomish Tribe 2011).

In the future without-project condition, steelhead numbers may increase in the North Fork due to actions from the Cushman Dam settlement agreement. South Fork, Vance Creek, and mainstem habitat conditions would continue to degrade due to the excessive sediment input and lack of LWD. This is expected to continue the decline in steelhead numbers downward from the 1,000 natural adult winter steelhead in the Skokomish River.

Bull Trout

The Coastal/Puget Sound bull trout was listed as a threatened species in November 1999 (64 FR 14307); critical habitat was designated in September 2005 (USFWS 2005) and revised in 2010 (USFWS 2010b). The Skokomish River Watershed hosts three distinct stocks of bull trout, a fluvial population in the South Fork, a lacustrine-adfluvial population in Lake Cushman, and a fluvial population in the upper North Fork (Peters et al. 2011). Bull trout in the Skokomish River watershed do not appear to be anadromous (Correa 2003) indicating that they are almost entirely dependent on freshwater habitats throughout their life histories (Brenkman et al. 2007; Peters et al. 2011). It is thought they can be found in all reaches of the watershed below anadromous barriers.

Bull trout populations above Lake Cushman are healthy and are not likely to face habitat limiting factors in the foreseeable future. Bull trout numbers may remain stable on the North Fork due to actions from the Cushman Dam settlement agreement. The depressed South Fork population could improve in the future without-project condition due to reduced logging activities, decommissioning of logging roads, and other restoration activities in the upper watershed; however, positive effects of restoration activities may not be fully realized without complementary restoration action in the lower watershed.

4.4.4.1 No-Action Alternative/Future Without-Project Conditions

In the future without-project condition, ESA-listed salmonid species will continue to face obstacles within the mainstem migration corridor including the following: spawning at less than optimal sites due to variable gravel movement; inability to gain access to the upper watershed to spawn due to continued blockage of key migration corridors; winter high flows transporting juvenile and adult salmon out of the river; and high water temperatures in the summer and early fall affecting various salmon species during rearing and migration seasons. Continued loss of high quality rearing and off-channel habitat is anticipated during low flows due to sediment deposition at the mouths of tributaries.

The No-Action alternative would have no effect on the listed bird species.

4.4.4.2 Action Alternatives/Future With-Project Conditions

<u>Aspects common to both groups of action alternatives</u>

Marbled murrelets would likely only be flying high over the action area in transit between aquatic foraging areas and roosts in the upper watershed and the other listed bird species are not expected to be in the action area. None of the proposed action alternatives would be expected to affect the behaviors or habitats of the four listed bird species. Therefore, the Corps has determined that there would be **no effect** to these species.

Car Body Levee Removal Alternatives #7, 23, and 28

Construction effects to listed salmonid species may involve some turbidity during in-water construction; however, the Corps would adhere to fish work windows that are timed to protect salmon. The fish work window for the Skokomish River is 15 July to 15 September. This period may be adjusted based on consultation with the natural resource agencies such as WDFW, NMFS, and USFWS. The Car Body Levee removal will have minimal or no in-water work, and each of the increments will have an in-water work duration that will not exceed the duration of the fish work window. Construction methods would employ all best management practices to minimize turbidity.

Alternatives #7, 23, and 28 would benefit the listed salmonid species by resolving the problem of blocked spawning migration by providing a year-round connection to upstream spawning areas. Alternative #28 provides the greatest acreage of improved or reconnected riparian zones, wetlands, and aquatic habitats that would benefit all listed salmonid species. Thus, the Corps has determined there would be **no effect** to these species from this alternative.

Riverbed Excavation Alternatives #45 and 60

Increasing channel capacity to reduce the frequency of over-bank flooding is assumed to reduce the acknowledged fish-stranding problem in which adult and juvenile salmonids escape the river channel in sheet flow across roads and agricultural fields and have no pathway back to the river or other off-channel aquatic habitat. While direct mortality from stranding has been regularly observed in the Skokomish Valley during winter floods, not much has been researched regarding long-term consequences of stranding on population dynamics (Nagrodski et al. 2012).

Riverbed excavation has potential for high risks to the listed salmonids and their critical habitat. Dredging poses a risk of negative effects from turbidity and direct mortality for juvenile salmon present in the river channel during dredging. After construction, there is risk that the resulting channel morphology would not support favorable spawning conditions (Collins 1995). The sediment excavation work would need to be designed to mimic preferred spawning conditions to the greatest extent practicable. If either of these two alternatives were selected as the preferred alternative, the preliminary design would need to be refined to achieve the goal for channel capacity without creating habitat conditions that risk preventing the listed salmon species from spawning.

Due to the substantial loss of benthic invertebrates from dredging and risk of significant negative effects to spawning habitat, the Corps has determined that these alternatives would **likely adversely affect** listed species.

Cumulative Effects

Aggradation of the Skokomish River has multiple causes as described in Bureau of Reclamation (2009) and briefly summarized in Section 4.2 of this report. The extensive sediment excavation proposed for the Riverbed Excavation alternatives would have a countervailing effect in an attempt to reduce the environmental consequences of reduced channel capacity. The post-construction risk of lack of suitable spawning habitat for several years may have an additive effect to the habitat limiting factors that have reduced salmon populations in this watershed. The Car Body Levee Removal alternatives would have no significant cumulative effects.

4.5 Cultural Resources

Cultural resources are locations on the physical landscape of past human activity, occupation, or use and typically include archaeological sites such as lithic scatters, villages, procurement areas, resource extractions sites, rock shelters, rock art, shell middens; and historic era sites such as trash scatters, homesteads, railroads, ranches, logging camps, and any structures or buildings that are over 50 years old. Cultural resources include traditional cultural properties, which are aspects of the landscape that are a part of traditional lifeways and practices and are considered important to a community.

Very little cultural resource survey has occurred within the study area and no surveys have occurred as a result of the feasibility study. To compare the alternatives and identify potential impacts to cultural resources, the Corps reviewed previous inventory reports and site forms, historic maps, ethnographic literature, and did a “windshield” survey in 2009 to characterize the nature of the resources present in the basin and to determine whether there were any historic structures or other clearly visible resources that should be avoided during alternative development. The Corps requested information about cultural resource concerns from the Skokomish Tribe’s Tribal Historic Preservation Officer in a meeting in 2010 and gathered information from local residents through oral histories later that year (Montgomery and Lahren 2011). A Corps archaeologist attended the Public Scoping meeting held on October 7, 2010 and one of the informal scoping meetings discussed in section 7.1. Results of these efforts are summarized below and additional information about cultural resources in the study area appears in the Cultural Resources Appendix (D).

According to the Washington Department of Archaeology and Historic Preservation’s (DAHP) online database WISAARD (last queried October 2013), seven cultural resource inventories have occurred in the study area since 1995. The database lists all archaeological sites that have been officially recorded and sent to DAHP but does not provide a comprehensive list of inventories conducted prior to 1995. The majority of inventories known to have occurred in the study area have been small in scale, typically under three acres, or linear surveys that simply bisected the study area. Most of the inventory in the study area has clustered around Hood Canal. The study area has 17 recorded archaeological sites. Eleven of these are prehistoric sites. Shell middens and small lithic scatters are the predominant site types. Historic era sites consist of the remains of two bridges and small domestic refuse scatters without clear temporal markers.

A cursory review of information reveals that the survival of buildings and structures from the earliest settlement period is limited. Not surprisingly, extensive flooding, land clearing for logging, and later agricultural pursuits have swept away many of these properties. A “windshield” survey of the valley’s most accessible structures and buildings suggests that those that remain are products of accelerated agricultural growth in the early part of the twentieth century, the general period 1920-1940. There is also the strong possibility that some of these homes and agricultural buildings are the products of pattern books or “pre-cut and assemble” building packages selected from local hardware stores and shipped by train.

In addition to the archaeological and structural inventories, Bouchard and Kennedy (1994) completed an extensive ethnographic study of the Basin. They interviewed 22 Skokomish tribal members in 1991-1992 and identified 72 areas of tribal concern. Bouchard and Kennedy’s study built off of previous work in the area such as Dr. W.W. Elmendorf’s ethnography *The Structure of Twana Culture* (1960), Edward Curtis’s (1913) volume on the Salishan Tribes of the Coast, and T.T. Waterman’s (1920) collection of over 120 Twana place names in the vicinity of Hood Canal.

4.5.1.1 No-Action Alternative/Future Without-Project Conditions

Without an ecosystem restoration project, it is anticipated that flooding will become more frequent and the groundwater table may continue to rise, creating more wetlands, and decreasing agricultural yields. As less and less of the Valley proves suitable for agriculture, it is expected that more valley residents may be forced to move out of the Valley or abandon agriculture as their economic base. This could lead to abandonment of many historic structures especially agriculture related buildings. Vulnerable historic buildings and structures, many of wood frame construction, are subject to continued deterioration and will suffer severe damage.

To date, a small percentage of archaeological sites have been identified and recorded. Flood events pose a threat to archaeological sites by way of erosion and sloughing actions, which carry away significant cultural materials and features and thereby compromise their integrity, or bury them entirely in layers of sediment. Therefore, without the project, continued flooding cycles in the Skokomish Watershed may damage or destroy archaeological sites that have potential to yield valuable information about the history and lifeways of those who lived in the region before and after white contact.

4.5.1.2 Action Alternatives/Future With-Project Conditions

Both NEPA and the National Historic Preservation Act (NHPA) require that Federal agencies consider impacts to cultural resources; however, the NHPA specifies the process by which Federal agencies determine the significance of these resources and assess a project’s effects. The NHPA considers impacts to “historic properties” as opposed to “cultural resources”. A historic property is defined as a cultural resource that has met certain standards of age, integrity, and significance. The phrase “adverse effect” (used in the NHPA) and “significant impact” (used in NEPA) are not equivalent terms but are similar in concept. Impacts to cultural resources are typically examined in terms of how the project will impact the qualities that make the resource eligible for listing on the National Register of Historic Places (NRHP). Please see the Cultural Resources Appendix (D) for more information about the NRHP and the Act. For the purposes of this analysis, adverse effects to properties that are eligible for the National Register will be viewed as significant impacts.

Because this is a programmatic level analysis and effects on historic properties cannot be fully determined at this time, the Corps, in consultation with the State Historic Preservation Officer (SHPO), the Skokomish Tribe, Mason County, and other interested parties, would develop a Programmatic Agreement (PA) in accordance with 36CFR800.14 should an alternative become authorized. The PA would define how the consulting parties would meet their responsibilities under Section 106 of the

NHPA including defining the area of potential effect, procedures for identifying and evaluating the resources, and listing preferred strategies to avoid, minimize, or mitigate adverse effects to historic properties. The draft PA is available for review upon request and the final PA will be included with the final feasibility report/EIS. During feasibility-level design, cultural resource surveys would occur and any actions where an adverse effect finding cannot be avoided, the parties would work toward the development of mitigation or treatment options that would be implemented through a Memorandum of Agreement.

Section 304 of the NHPA prohibits Federal agencies from publicly disclosing specific information about cultural resources that could lead to their harm through vandalism or looting regardless of their eligibility. Therefore, specific site locations are not discussed in this analysis.

<u>Car Body Levee Removal Alternatives #7, 23, and 28</u>

Removal of the Car Body Levee would require three staging areas totaling 0.69 acres of ground disturbance. Ethnographic literature suggests that the confluence of the north and south forks with the mainstem has a higher potential for containing archaeological sites. Elmendorf (1960) referenced a campsite near the Car Body Levee; however, it was not in use in the 1930s and archaeological evidence has not been discovered at the junction. The staging area would be placed to avoid adversely affecting any significant cultural resources. The Car Body Levee may be over 50 years old and as such would need to be recorded as an historic resource and a determination of eligibility would need to be made prior to project development.

Cultural resources are geospatial resources that are most clearly impacted by ground disturbing activities. In general, projects that are proposed within the river channel or that have little ground disturbance have less potential for adversely affecting cultural resources. Of the eight proposed increments, the installation of LWD at RM 9 thru 11, the reconnection of the side channel between RM 4 and 5.6, and restoring the mouth of Hunter Creek have little potential to affect historic properties because there is little likelihood that sites exist within the project footprint.

The Hunter Creek side channel (included in #23 and #28) and the Weaver Creek side channel (included in #28 only) would require excavating small channels along existing swales and therefore could affect sub-surface archaeological materials adjacent to the creeks. The most likely resources to be present include short-term prehistoric and historic campsites, middens, and historic refuse areas. Due to the nature of the proposed projects, indirect impacts to surrounding historic properties are not likely.

The Grange levee setback and RM 9 levee setback (included in #23 and #28), and the Dips Road setback (included in #28 only) would involve construction of new features on the landscape, so in addition to direct impacts within the construction footprint and staging areas, the setback could indirectly adversely affect surrounding historic properties by changes in the viewshed. Other considerations include the area in front of the newly constructed features that would be more exposed to erosion and changes in soil moisture that could affect buried archaeological materials. The levees themselves and Dips Road are over 50 years old and would need to be recorded and evaluated for eligibility prior to project implementation. There are no other historic structures located between the levees and Dips Road that would be removed. Determinations of eligibility, findings of project effects and implantation of minimizing or mitigating measures would be done in consultation with the parties specified in the PA.

<u>Riverbed Excavation Alternatives #45 and 60</u>

In general, in-water work such as dredging has little likelihood of directly impacting archaeological sites or historic structures. However, changes in channel capacity and morphology could lead to changes in rates of bank erosion and flooding, which have potential to indirectly impact archaeological sites, historic structures, or important aspects of TCPs.

For Alternatives #45 and 60, sediment excavated from the river would be placed within the lower intertidal and subtidal areas of the estuary and adjacent nearshore zone. Of the 17 sites that have been recorded within the basin, ten have been recorded along the edges of Hood Canal and within the estuary. Prehistoric sites associated with the Twana, and historic era sites associated with the establishment of Nalley's Ranch, logging, and early commerce are expected to be present. Placement of dredged materials within the estuary would need to be coordinated to avoid impacts to significant cultural resources. Potential impacts associated with the eight proposed increments would be the same as discussed above.

<u>Cumulative Effects</u>

The proposed undertakings evaluated in this document would contribute to the overall restoration projects proposed by the SWAT and others and should lead to a general improvement in ecological functions. Many of the areas identified as important to the Twana were related to fishing; therefore, any improvement in fisheries would have a beneficial effect on fishing related TCPs within the area.

4.6 Social and Economic Resources

This section presents an overview of major socioeconomic characteristics and trends within the study area, including demographics and economics.

4.6.1 Indian Trust Assets

In addition to the Federal government's responsibilities under NHPA, the Federal government must consider the effects its actions may have on American Indian traditions and cultural practices. The Federal basis of a tribe's legal status rests within the context of U.S. Constitutional provisions for Federal government's powers for treaty making with other sovereign nations, and American Indian tribes' inherent sovereignty.

The Skokomish Indian Tribe, with other Tribes and bands of the Twana, Clallam, and Chimakum peoples, signed the Treaty of Point-No-Point with the Federal Government on January 26, 1855. The Skokomish Indian Reservation was formed through this treaty and required these Indians to move to the current reservation location at the mouth of the Skokomish River. The reservation boundaries were expanded by executive order in February 25, 1874 and the current location consists of 4,950 acres, with nearly 2,700 acres of residential areas and many tribal government services. Today, many tribal members continue to work within the region's fishing and logging industries. In an attempt to diversify its economy, the Tribe has purchased property for economic development (including the operation of a local casino) and resource enhancement, as well as for housing. The Tribe operates its own businesses including a tribal hatchery and a gas station/convenience store.

The priorities of the Skokomish Indian Tribe are protection of the marine, freshwater, and land resources of Hood Canal that are the backbone of the Tribal economy and spiritual beliefs. Hunting, fishing, and gathering are central to the cultural and economic existence of the Tribe and its members. Acquisition of food through hunting, fishing, and gathering is part of a complex culture that emphasizes the concept that all of life is interrelated. Fish, wildlife, and other natural resources sustain the cultural and spiritual identity of the community in addition to providing economic stability for present and future generations.

In addition to salmon, shellfish have been a mainstay of the Skokomish Nation for thousands of years. Clams, crab, and oysters were readily available for harvest year-round. The rapid decline of many western Washington salmon stocks, due in large part to habitat loss from the region's burgeoning human population, has pushed shellfish to the forefront of many tribal economies. Today, the Annas Bay estuary contains a significant shellfish resource that is used by Tribal, commercial, and recreational harvesters. However, shellfish resources have been declining due to reduced availability of suitable substrate for shellfish attachment in the estuary as well as high fecal coliform levels in Annas Bay and Hood Canal.

Along with hunting, fishing, and gathering, the intricate basketry and artwork of the Skokomish Indian Tribe is widely renowned and culturally significant. Until the 1930s, the Twana women from the Skokomish Indian Reservation harvested sweetgrass (*Scirpus americanus*) from the estuary for making baskets and other items. Industrial and agricultural development in western Washington estuaries has all but eliminated sweetgrass, and only a few remnants of the Skokomish sweetgrass were found outside of the estuary dike system by the 1970s.

4.6.1.1 No-Action Alternative/Future Without-Project Conditions

The Skokomish Indian Tribe would be affected in the future without-project condition (No Action Alternative). As salmon populations continue to decline and shellfish habitat is lost, the cultural and spiritual identity of the Tribe would be significantly impacted. U&A fishing areas will continue to degrade, jeopardizing the Federal government's trust responsibility to the Tribe.

4.6.1.2 Action Alternatives/Future With-Project Conditions

<u>Car Body Levee Removal Alternatives #7, 23, and 28</u>

Removal of the Car Body Levee will create a year-round connection from the mainstem to the North Fork and will solve the issue of the river going subsurface in the summer months. All three alternatives would benefit salmon and consequently would have a positive effect for tribal fisheries. These alternatives would have a minimal effect to other tribal trust resources such as game and sweetgrass.

<u>Riverbed Excavation Alternatives #45 and 60</u>

While both riverbed excavation alternatives would address the issue of fish stranding, the removal of sediments would have significant detrimental effects to all fish species in the Skokomish River due to its effects on benthic macroinvertebrates that serve as the primary food source as well as spawning areas. The placement of gravels within the estuary would benefit shellfish; however, placement of the gravel would need to be coordinated to avoid affecting the last stands of sweetgrass in the estuary. This alternative has a high risk of negative effects on tribal resources.

4.6.2 Transportation and Traffic

Two highways are located in the study area: US Highway 101 (US-101) and State Route 106 (SR-106). The principal arterial road, Skokomish Valley Road, runs the length of the Skokomish Valley and provides the primary access to residences and farms in the study area. Skokomish Valley Road is the most frequently flooded road, which affects access for valley residents. Public transit is limited to bus service in the Skokomish Valley. Commute times are 29 minutes for Skokomish Valley residents, which is greater than the national average of 25 minutes and most residents commute by car alone (Census 2013). Average daily traffic volume through the study area for US-101 is 5,800 and for SR-106 is 1,600 (WSDOT 2013a); US-101 is classified as a rural-principal arterial (WSDOT 2013b). US-101 is designated a Highway of Statewide Significance by the Transportation Commission (WSDOT 2009).

4.6.2.1 No-Action Alternative/Future Without-Project Conditions

In the future without-project condition, inundation of local roads in the study area will continue to be a problem. The pattern of flooding may have a slight increase in depth and frequency across the floodplain. Traffic and commute times in the study area are not expected to change substantially as US-101 is a rural-principal arterial, which provides access to rural Washington coastal communities away from urban centers. The level of service (LOS) for US-101 is Class C, or stable flow, at or near free flow (WSDOT 2010). Population in the Skokomish Valley has been declining due to a building moratorium and frequent flooding in the basin, and development and population growth is not expected to increase.

4.6.2.2 Action Alternatives/Future With-Project Conditions

For analysis of effects to transportation and traffic in the study area, the Corps used guidance from the California Environmental Quality Act (CEQA) to assist with determining levels of significance of impacts (State of California and Bureau of Land Management 2010). Under CEQA, the proposed project would have a significant impact if it would cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system; exceed, either individually or cumulatively, an LOS standard established by the regional transportation planning organizations; result in inadequate emergency access; or result in closure of a major roadway (arterial or collector classification) to through traffic as a result of construction activities with no suitable or alternative route available.

<u>Car Body Levee Removal Alternatives #7, 23, and 28</u>

Car Body Levee removal would cause temporary impacts during construction, with approximately 23 additional truck trips per day over 107 working days. Temporary traffic increases depend on the number of increments and the construction sequencing, but are assumed to range from an additional 23 truck trips for Alternative #7 to 57 truck trips for Alternative #28 work (see Table 4-4, Summary of construction components analyzed for effects to resources). Temporary traffic delays will depend on the construction sequencing, timing, and intensity. Trucks are assumed to have up to a 20-mile round-trip cycle to and from the study area. One of the project increments, Dips Road, would relocate a portion of Skokomish Valley Road and may reduce traffic delays associated with flooding. Traffic control structures may be required for restoration work along Skokomish Valley Road and US-101 for each alternative.

Residents may experience minor delays (less than 5 minutes) as they commute to and from the study area on local roads, and construction activities are not expected to cause significant increases in traffic and delay on US-101 and SR-106. These alternatives are not expected to cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the system; result in closure of a major roadway to through traffic as a result of construction activities with no suitable or alternative route available; nor meet thresholds for any of the other CEQA impact significance criteria. Given the CEQA criteria and the assumed impacts, these alternatives are not expected to cause significant temporary or long-term effects to traffic and transportation.

Riverbed Excavation Alternatives #45 and 60

Riverbed Excavation Alternatives would cause temporary impacts during construction, with approximately 300 or more truck trips per day over 631 working days for #60 and 363 working days for #45. Trucks for dredged material disposal have a shorter round-trip cycle of 10 miles, while the increments are assumed to have up to a 20-mile cycle to and from the study area. The project increment Dips Road would relocate a portion of Skokomish Valley Road and may reduce traffic delays associated with flooding. Traffic control structures may be required for restoration work along Skokomish Valley Road and US-101 for both of these alternatives.

Residents may experience longer delays (greater than 5 minutes) as they commute to and from the study area on local roads. Construction activities will increase traffic and may cause traffic delays on US-101 and SR-106 with an estimated 10 percent increase in traffic within the study area. Alternatives #45 and 60 are assumed to require periodic dredging to maintain channel capacity approximately every 20 years, or two periodic dredge cycles over the period of analysis. Periodic sediment excavation is expected to be 30 to 40 percent of the initial construction and would cause temporary traffic and transportation delays. Given the CEQA criteria and the assumed impacts, Alternatives #45 and 60 are expected to cause significant temporary effects to traffic and transportation as part of initial construction and periodic maintenance.

5. Tentatively Selected Plan - Agency Preferred Alternative

The Corps objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to NER (outputs) are increases in the net quantity and/or quality of desired ecosystem resources. The NER Plan must reasonably maximize ecosystem restoration benefits compared to costs, consistent with the Federal objective. The selected plan must be shown to be cost effective and justified to achieve the desired level of output. After analysis of all relevant environmental benefits and impacts, the Corps has identified the TSP (NER Plan) as the environmentally preferred alternative per NEPA regulations at 40 CFR 1505.2 (b).

5.1 Description of the Tentatively Selected Plan (NER Plan)

The annual costs and benefits of the TSP using planning level cost estimates are shown in Table 5-1. Features included in the TSP range from one half-acre to 107 acres with first costs ranging from approximately $200,000 to $7.5 million per feature. The total area of the proposed sites included in the TSP is approximately 330 acres, the average annual habitat units are estimated at 226.4, total annual cost using planning level estimates are estimated at $1.5 million, and the total estimated project first costs of the TSP using a more detailed cost estimate is approximately $41 million (Section 5.5 outlines the TSP first cost estimate).

Table 5-1. Tentatively Selected Plan Components

Plan ID	Plan Components	Habitat Units (In-Channel, Floodplain, and Capacity)	Habitat Units (Shellfish Substrate)	Total Habitat Units	Total Acres Restored	Total Annual Cost ($1,000s)
27	Base Alternative #3: Car Body Levee Removal	45.9	0	45.9	68	$335
	Increment 35 – Upstream LWD	82.9	0	82.9	107	144
	Increment 9 – Side Channel Restoration	25.7	0	25.7	45	138
	Increment 37 – Grange Levee Setback	18.5	0	18.5	34	146
	Increment 28 – River Mile 9 Levee Setback	13.6	0	13.6	23	105
	Increment 39 – Hunter Creek Tributary Mouth	0.5	0	0.5	0.5	9
	Increment 40 – Hunter Creek Tributary Restoration	20.1	0	20.1	29	236
	Increment 43 – Weaver Creek Tributary Restoration	19.4	0	19.4	25	339
	Totals for Tentatively Selected Plan	**226.4**	**0**	**226.4**	**331.5**	**$1462**

No costs or features (local betterments) over the NER Plan have been identified for implementation.

5.2 Design and Construction Considerations

The study team has taken a common sense and risk-based approach to the level of design developed in the feasibility phase. The information presented in the DFR/EIS includes a conceptual level of design. Appendix H, Engineering Appendix, provides the conceptual level designs developed for this stage of the study. Prior to completion of the Feasibility Phase, the Corps will develop a feasibility-level of design. The study team has identified the necessary studies and data collection to be performed in upcoming stages of the study to manage specific risks and uncertainties as well as meet the requirements outlined in ER 1110-2-1150 (Engineering and Design for Civil Works Projects; USACE 1999b). The completed feasibility-level design will be presented in the Final Feasibility Report/EIS, which will have a public comment period of 30 days.

5.2.1 Design and Construction Considerations: Car Body Levee Removal

Based on available information including a Preliminary Phase I Site Assessment, HTRW expert analysis, site visit, and experience with dissipation of pollutants after 80+ years of inundation, there are no HTRW concerns at the car body levee. At this time the cars are assumed to be solid waste that will be disposed of by the Non-Federal Sponsors at an appropriate disposal site. Additional investigation activities during feasibility-level design could include clearing vegetation for access on the levee, determining whether engines, batteries, or fuel tanks are present or intact, and possible retrieval of soil samples for chemical analysis if odors, staining, smearing, etc. are discovered during feasibility-level design analysis. If these activities confirm the need for additional analysis, additional Phase II Assessment activities will be completed to characterize the site conditions.

5.2.2 Design and Construction Considerations: Setback Levees

Two components in the TSP, the Grange Levee Setback and the River Mile 9 Levee Setback, involve modification or removal of existing levees to allow continued inundation to occur and provide controlled access to additional floodplain, shallow-water, and riparian habitat. Perpetual flowage and/or levee easements will be acquired on lands on the riverward side of the levees where natural floodplain function is restored. Setback levees will be constructed along the new margin of the floodplain to ensure that the project does not exacerbate flooding to the residents in the study area, similar to the existing and future without-project condition. The setback levees are currently designed for shallow overtopping and are expected to be approximately 4 to 6 feet in height with approximately 3H:1V side slopes with specific overtopping sections. The setback levees will not improve the level of flood risk management in the study area; they are designed to provide restoration benefits associated with a reconnected floodplain while maintaining the existing level of flood risk management (less than a 2-year level of protection) in the study area.

An analysis has not been completed to determine damages induced by project features (i.e., what damages would occur if the levees are removed or breached). Conceptual-level design assumptions and anticipated future without-project conditions for flood risk management are based on existing information and best professional judgment; this information led to formulation of alternatives that included setback levees as project features. The Corps will re-examine the justification of setting back levees during the feasibility-level design to determine the best approach for providing appropriate levels of flood risk management, including economic, environmental and engineering considerations at these sites. If the additional analysis shows that levee setbacks are not required as a feature of the Grange Levee or River Mile 9 Increments, the levees would not be included in the final recommended plan. It is possible additional flowage easements may be pursued as an alternative to setback levees.

5.3 Fish and Wildlife Coordination Act Considerations

Compliance with the Fish and Wildlife Coordination Act (FWCA) is documented in Chapter 6. The Draft Coordination Act Report includes several recommendations from USFWS for minimizing negative effects and maximizing restoration benefits. USFWS pointed out the following potential issues the Corps should address during project design:

- Any remaining sections of Car Body Levee and the other levee breach/removal increments may pose a stranding risk to fish; therefore, all of the levee material should be removed.
- LWD installations can have unintended consequences of locking a channel in place preventing natural migration.
- A planted riparian buffer is critical to the success of added productivity.
- The TSP should include effort toward returning the river to its reference condition of island-braided morphology.

The Corps is considering all of the recommendations. The design for Car Body Levee is to remove all levee material down to the natural grade at this site. The design for the other levee removal increments is to breach at strategic locations based on the direction of water flow; stranding risk will be evaluated and minimized. Regarding LWD installations, the Corps will use design assistance from technical experts to maximize benefits and avoid inappropriate design given the reach being restored. The Corps will propose riparian buffers in scale with the channels being restored at each site. Regarding a braided-island plan form, the Corps has not found clear evidence for this reference condition and will investigate this further during feasibility-level design phase.

5.4 Real Estate Considerations

At this time, real estate values are cost estimates only and are based on fee simple values. Affected parcels for each alternative including the TSP have been identified and total assessed values were determined using Mason County's Assessor data. Approximately 100 parcels of varying sizes and public/private ownership lie within the project footprint of the TSP. The total assessed real estate fee simple value for the TSP, using full parcel values, is estimated to be approximately $6.5 million.

The PDT will develop gross appraisals, real estate maps depicting the actual project lands and associated estates required, as well as a final Real Estate Plan prior to completion of the Feasibility Phase and will incorporate these into the Final Feasibility Report/EIS available for public comment. The study team has identified the necessary studies, data collection, and landowner outreach tasks to be performed in upcoming stages of the study to manage specific risks or uncertainties. Additionally, the study team and non-Federal sponsors are continuing to coordinate with landowners and other real estate representatives as the project footprint includes public and private lands.

5.5 Cost Estimate

Based on October 2015 price levels, the estimated project first cost is $40,753,000 and the fully funded cost estimate is $41,746,000. In accordance with the cost share provisions in Section 103(c) of WRDA of 1986, as amended {33 U.S.C. 2213(c)}, the Federal share of the project first cost is estimated to be $26,490,000 and the non-Federal share is estimated to be $14,264,000, which equates to 65% Federal and 35% non-Federal. The non-Federal costs include the value of lands, easements, rights of-way, relocations, and dredged or excavated material disposal areas (LERRD) estimated to be $7,574,000, or 19% of total project first costs. Acquisition is estimated to be 19% of total project first costs.

Table 5-2 outlines the project first costs of the TSP. Table 5-3 displays the cost share of the TSP.

Table 5-2. Tentatively Selected Plan Cost Estimate

Work Breakdown Structure	Project First Costs (Constant Dollar Basis; $1,000s)	Total Project Cost (Fully Funded; $1,000s)
06 Fish & Wildlife Facilities	$1,083	$1,102
09 Channels & Canals	16,124	16,460
11 Levees & Floodwalls	5,235	5,328
Subtotal Construction Cost	***$22,442***	***$22,891***
01 Lands & Damages (LERRD)	7,574	7,710
30 Planning, Engineering and Design (PED)	6,954	7,217
31 Construction Management	3,784	3,927
Total Construction Costs	**$40,753**	**$41,746**

Table 5-3. Project Cost Share of Tentatively Selected Plan

	Federal ($1,000s)	Non-Federal ($1,000s)	Total ($1,000s)
Ecosystem Restoration			
Lands & Damages		$7,574	$7,574
Fish & Wildlife Facilities	$1,083		$1,083
Channels & Canals	$16,124		$16,124
Levees & Floodwalls	$5,235		$5,235
Planning, Engineering & Design	$6,984		$6,984
Construction Management	$3,784		$3,784
Cash Contribution/Reimbursement	($5,590)	$5,590	$0
Total Project Cost Share	**$26,490**	**$14,264**	**$40,753**
Total Project Cost Share (%)	**65%**	**35%**	**100%**
Total Project Cost Share (Fully Funded)	**$27,135**	**$14,661**	**$41,746**

5.6 Monitoring and Adaptive Management

The Corps' Implementation Guidance for Section 2039 of the Water Resources Development Act (WRDA) of 2007 defines monitoring as "the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to attain project benefits" (USACE 2009a). Even the most strategically planned restoration actions can yield unexpected results. Monitoring includes documenting and diagnosing these results especially in the early, formative stages of a project, providing information useful for taking corrective action. In this way, monitoring reduces the risk of failure and enables effective, responsive management of restoration actions.

The draft Monitoring and Adaptive Management Plan (Appendix E) provides a conceptual plan for evaluating the effectiveness of proposed restoration actions and for developing corrective actions if management measures are not meeting performance metrics. At the current state of project planning, the TSP was used for the conceptual description of monitoring methods and potential adaptive management efforts. Uncertainties remain concerning the exact project features, monitoring elements, and adaptive management opportunities. Proposed monitoring protocols follow those used in monitoring other restoration projects in Puget Sound and the Pacific Northwest (Heitke et al. 2010, Crawford 2011). The plan outlines a 10-year monitoring period per WRDA 2007 guidance, with compliance monitoring occurring in years 1 and 3, and effectiveness monitoring in years 5 and 10. Compliance monitoring provides data to evaluate whether projects were built to design, and effectiveness monitoring provides data to determine whether projects are meeting project objectives. The Corps will use decision criteria to evaluate project performance for the degree of success, or for the need for corrective actions. Details and uncertainties will be addressed in the preconstruction, engineering, and design phase, and a detailed monitoring and adaptive management plan, including a detailed cost breakdown, will be drafted as a component of the Final Feasibility Report/EIS.

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

The overall cumulative effects of the TSP would be synergistic benefits to all aquatic species through process-based restoration in the lower Skokomish River. The benefits of increasing the number and size of in-channel pools, placing enough LWD to mimic quantities in nearby more natural rivers, reconnecting aquatic habitats in the adjacent floodplain, and greatly increasing the acreage of riparian zones along the river will provide significant benefits to fish and wildlife habitat, especially for salmon species. As an indicator species in Pacific Northwest ecosystems, the Corps assumes benefits to salmon would accrue for all other fish, wildlife, and plants in the study area. These benefits would combine with the more than 1,000 acres of restored estuarine habitat at the downstream end of the study area, as well as the improving forested habitat in the upper watershed; the estuarine and upper watershed restoration actions are led by other local, State, or Federal entities outside of the General Investigation Study and compliment the Corp's preferred alternative (TSP). The reach of river proposed for restoration in this feasibility study is a critical link between these habitats.

5.8 Summary of Environmental Consequences

NEPA requires disclosure of environmental consequences caused by the proposed Federal action should it be implemented. The following sections summarize the analysis provided in Chapter 4 on the potential environmental effects from implementation of the TSP (agency preferred alternative).

5.8.1 Unavoidable Adverse Environmental Effects

To facilitate the construction of all of the proposed restoration measures of the TSP, some adverse environmental effects, while only temporary, could occur within the project area. The following list summarizes adverse environmental effects that are more fully described in Chapter 4:

- Temporary, minor, and localized degradation of water quality from increases in turbidity during the estimated 141 days of in-water work.
- Greenhouse gas emissions from construction equipment would combine with the global accumulation of greenhouse gases.

- Temporary disturbance to fish and aquatic insects through increased turbidity and construction activity in the water.
- Temporary clearing of upland and riparian vegetation for access and staging areas.
- Temporary and localized disruptions to traffic cause by construction vehicle access to worksites and for proposed road relocation.

5.8.2 Irreversible and Irretrievable Commitment of Resources

NEPA requires that environmental analysis include identification of "any irreversible and irretrievable commitments of resources which would be involved in the preferred alternative should it be implemented." This clause refers to the use of nonrenewable resources and the effects that the use of these resources have on future generations. Irreversible effects primarily result from use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable period. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored because of the action (e.g., extinction of a species or the disturbance of a cultural site).

The TSP would result in an irreversible use of fossil fuels to execute the construction of the habitat restoration. Machinery types were estimated during the cost estimate work for the alternatives analysis and these are listed in Table 4-4 in Chapter 4. As an ecosystem restoration project, the proposed Federal action is designed to have little or no irreversible and irretrievable commitment of resources. All construction effects are assumed to be short-term reductions in fish, aquatic insect, and plant resources, which would recover their abundances in a relatively short period.

5.8.3 Relationship Between Short-Term Uses and Long-Term Productivity

NEPA requires that an EIS include a discussion of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. For the TSP, "short-term" refers to the temporary phase of construction of the proposed project, while "long-term" refers to the 50-year period of analysis of the proposed project and beyond. Chapter 4 of this document evaluates the direct, indirect, and cumulative effects that could result from the alternatives.

Construction of the TSP would result in short-term construction-related impacts within parts of the project area and would include to some extent interference with local traffic, minor limited air emissions, and increases in ambient noise levels, disturbance of fisheries and wildlife, and increased turbidity levels. These impacts would be temporary and would occur only during construction, and are not expected to alter the long-term productivity of the natural environment.

The TSP would assist in the long-term productivity of the Skokomish River Basin ecological community by improving the critical habitat limiting factors for salmonids. This in turn would facilitate the growth and productivity of riparian zones and wetlands and the invertebrates, fish, and wildlife that use these habitats. The TSP would enhance the long-term productivity of the natural communities throughout the study area. These long-term beneficial effects of the TSP would outweigh the impacts to the environment resulting primarily from project construction. With an increase in the acreage of riparian and wetland habitat and increase in wetland habitat quality, fish populations would experience beneficial effects. These improvements in productivity would have long-term benefits for recreational and tribal fishing in the study area.

5.8.4 Areas of Controversy and Unresolved Issues

NEPA requires disclosure of controversial issues to the decision-maker. At this time, the Corps, non-Federal sponsors, and public have no unresolved issues or areas of controversy.

5.9 Mitigation for Adverse Environmental Effects

NEPA requires that agencies identify and include in the action all relevant and reasonable mitigation measures that could reduce negative effects of the Federal action. Implementation of the TSP would involve multiple ecosystem restoration sites with construction activities in the aquatic environment and in close proximity to other ecological resources. Through the analysis of effects, certain adverse effects were identified as summarized above. Each of the proposed sites would have short-term construction related effects with varying spatial and temporal scales and degrees of intensity. Construction designs would include practices that avoid and minimize effects to affected significant resources. This section describes methods to avoid and minimize adverse construction effects of the proposed restoration sites.

Standard Practices to Mitigate Negative Effects of Construction

Specific measurable and enforceable mitigation measures would be developed for each site based on the specific effects of the project. All site designs and construction timing would include the following standard measures:

- The Corps would schedule work to occur during designated periods often referred to as fish windows as established by WDFW per Washington Administrative Code (WAC) 220-110-271.
- The Corps would schedule work outside of bird nesting season.
- Each construction contractor would be required to prepare an Environmental Protection Plan for approval by a Corps staff biologist.
- Traffic alterations would be designed to minimize impediments, with the shortest and least disruptive detours possible, and in coordination with the relevant transportation agency.

Best Management Practices to Protect Water Quality

Restoration sites would involve in-water work and areas of ground clearing. Protecting water quality from stormwater runoff requires best management practices (BMPs) to avoid excessive runoff and elevated turbidity in the receiving water body. It is important to avoid excessive pulses of sediment that are more than what the surrounding aquatic life can easily tolerate. The project would have a Stormwater Pollution Prevention Plan including a Temporary Erosion and Sedimentation Control Plan approved by a Corps staff biologist. Construction contractors would be required to obtain a Construction Stormwater Permit under Section 402 of the Clean Water Act. Standard construction stormwater BMPs can be incorporated into site designs, operational procedures, and physical measures on site. These are examples of frequently used BMPs:

- Minimize area of ground disturbance and vegetation clearing.
- Use the site’s natural contours to minimize run-off and erosion.
- Do not expose the entire site at one time; avoid bare soils during rainy months.
- Stabilize erodible surfaces with mulch, compost, seeding, or sod.

- Use features such as silt fences, gravel filter berms, silt dikes, check dams, and gravel bags for interception and dissipation of turbid runoff water.

Mitigation Measures for Effects of Greenhouse Gas Emissions

There are no legal requirements to mitigate for GHG emissions; however, BMPs are available for fuel and material conservation during construction. Such BMPs include the following:

- Maximizing use of construction materials that are reused or that have a high percentage of recycled material content, such as recycled asphalt pavement, concrete, and steel.
- Obtaining construction materials and equipment from local producers or vendors to minimize energy use for shipping.
- Encouraging construction personnel to carpool or use a crew shuttle van.
- Turning off equipment when not in use to reduce idling.
- Maintaining equipment in good working order to maximize fuel efficiency.
- Routing truck traffic through areas where the number of stops and delays would be minimized, and using off-peak travel times to maximize fuel efficiency.
- Implementing emission-control technologies for construction equipment.
- Using ultra low sulfur (for air quality) and biodiesel fuels in construction equipment.
- Using renewable energy produced onsite or offsite. For example, using solar-powered generators to supply electricity for field offices and construction lighting.

5.10 Implementation Requirements and Permits

The following sections outline the requirements for implementation of the TSP.

5.10.1 Non-Federal Sponsor

Mason County and the Skokomish Tribe are the cost-sharing non-Federal sponsors of the study. Both sponsors have provided letters of reaffirmation indicating their support of the TSP and further study phases including development of feasibility-level designs and cost estimates. The Corps will request additional letters of intent prior to the completion of the feasibility phase as well as non-Federal sponsor self-certifications of financial capability prior to execution of a project partnership agreement (PPA).

5.10.2 Institutional Requirements

The schedule for project implementation assumes authorization in the proposed Water Resources Development Act of 2016. After project authorization, the project would be eligible for construction funding. The project would be considered for inclusion in the President’s budget based on national priorities, magnitude of the Federal commitment, economic and environmental feasibility, level of local support, willingness of the non-Federal partner to fund its share of the project cost, and the budget constraints at the time of funding. Once Congress appropriates Federal construction funds, the Corps and the non-Federal partner(s) would enter into a PPA. This project partnership agreement would define the Federal and non-Federal responsibilities for implementing, operating, and maintaining the project.

5.10.3 Operation, Maintenance, Repair, Rehabilitation, and Replacement Requirements

After completion of construction and the monitoring and adaptive management period, the non-Federal sponsor(s) will assume O&M responsibility for the entire project footprint. The non-Federal sponsor is responsible for all long-term project operations, maintenance, repairs, replacements, and rehabilitations following completion of construction. O&M costs have been estimated for the base measure and increments recommended in the TSP. At this time it is assumed that the TSP will require minimal maintenance only (approximately $5,000 per year or less with O&M activities focusing on minor inspection and periodic levee maintenance activities). Detailed O&M manuals will be developed for each site during the Project Engineering and Design phase.

5.10.4 Schedule

The Corps will officially request the non-Federal partner(s) to acquire the necessary real estate immediately after the signing of the project partnership agreement. The advertisement of the construction contract will follow the certification of the real estate. The final acceptance and transfer of the project to the non-Federal partner(s) will occur after delivery of an operations and maintenance manual and as-built drawings.

5.11 Risk and Uncertainty

The PDT has used a risk and uncertainty-based strategy in their approach to formulating the project from the early stages of the study. Risks and uncertainties associated with the formulation of alternatives, development of conceptual designs and cost estimates, quantification of environmental benefits, and assumptions associated with selection of a tentatively selected plan are captured in the study's risk register. Key risks or uncertainties associated with the tentatively selected plan include the following, along with the strategy to reduce risk as the study continues:

- Future aggradation, elevation, and alignment of river channel
  - Incorporate features into feasibility-level designs that will limit channel migration and reduce riverbed instability
  - Monitor the project; implement adaptive management strategies as needed
- Landowner willingness
  - Continue formal and informal landowner outreach
  - Refine feasibility-level designs and construction footprints based on real estate needs
- Car body levee composition
  - Excavate test pits to gauge nature, extent, and condition of possible car bodies in levee

5.12 Complementary Restoration Actions for Local Implementation

There is a strong, united effort by Federal, State, and local agencies as well as the Skokomish Indian Tribe for restoration of the Skokomish River Basin. Various Federal and State agencies as well as local entities are working within their individual authorities and within specific areas of the Basin to implement restoration activities throughout the upper and lower watersheds. Section 4.2 outlines present and future actions to restore the Skokomish River Basin; these actions are compatible with the Corps' tentatively selected plan and capture synergies associated with process-based restoration.

In addition to the proposed present and future restoration projects outlined in Chapter 4, the study team, non-Federal sponsors, local and regional stakeholders, and the public identified approximately 60 specific sites within the study area where one or more measures could address unique limiting factors. As Section 3.3 describes, sites were selected based on locations of severe degradation, physical features that will provide an opportunity to improve types of degradation, access, and consideration of other complimentary proposed projects outside the range of the feasibility study. These proposed projects are generally smaller in scale and could be easily implemented by a local entity. These projects are generally compatible with the Corps' tentatively selected plan and further restore the structures, functions, and processes of the Skokomish River. Members of the Corps PDT will continue to be available to Mason County and the Skokomish Indian Tribe to ensure any proposed actions will not adversely affect the Federal investment in restoration of the Skokomish River Basin.

Finally, the TSP is one element of an integrated restoration effort in the entire Skokomish River watershed. The TSP recommends restoration of the lower Skokomish River, which is complementary to, yet independent from, restoration actions in the upper watersheds (the Upper South Fork and North Fork) and estuary. Attainment of benefits associated with the TSP is not dependent on restoration activities led by the USFS in the Upper South Fork. Similarly, implementation of proposed flow regimes at Cushman Dam, construction of fish passage facilities or hatcheries in the North Fork, or other activities required by the Cushman Settlement are independent of the Federal action, but will complement the TSP. The synergistic efforts of those involved in restoration of the entire Skokomish River watershed will produce positive, cumulative effects across the Basin.

6. Compliance with Environmental Statutes

This chapter provides documentation of how the TSP (agency preferred alternative) complies with all applicable Federal environmental laws, statutes, and executive orders.

6.1 National Environmental Policy Act

The National Environmental Policy Act (NEPA) (42 U.S.C. §4321 et seq.) commits Federal agencies to considering, documenting, and publicly disclosing the environmental effects of their actions. NEPA-required documents must provide information regarding the proposed action and alternatives, the environmental impacts of the alternatives, appropriate mitigation measures, and any adverse environmental impacts that cannot be avoided if the agency implements the proposal. Agencies are required to demonstrate that decision makers have considered these factors prior to undertaking actions, which is documented in signing a Record of Decision for Environmental Impact Statements such as this one. This Draft Feasibility Report/Environmental Impact Statement (DFR/EIS) is the primary vehicle to achieve NEPA compliance for the proposed project. Before preparing this document, the Corps published a Notice of Intent to prepare an EIS in the Federal Register on 24 September 2010, and held a public scoping meeting 7 October 2010. Following the Draft and Final versions of the DFR/EIS, the Chief of Engineers will sign a Record of Decision as well as the Corps-required Chief's Report.

6.2 Endangered Species Act of 1973

The Endangered Species Act (ESA) (16 U.S.C. §1531-1544), Section 7(a) requires that Federal agencies consult with the NMFS and USFWS, as appropriate, to ensure that proposed actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their critical habitats. The Corps is coordinating with NMFS and USFWS to ensure the protection of those threatened and endangered species under their respective jurisdictions and to anticipate potential negative effects that may result from the project. If the Corps elects to implement the preferred alternative, the study team will produce a Biological Evaluation based on the feasibility-level of design. The Corps will submit this document to NMFS and USFWS for their concurrence under Section 7 of the ESA. Results of the consultation will be reported in the Final Feasibility Report/EIS.

6.3 Clean Water Act of 1972

Section 401 – Any project that involves placing dredged or fill material in waters of the United States or wetlands, or mechanized clearing of wetlands, requires a water quality certification from the State agency as delegated by the U.S. Environmental Protection Agency (EPA). For the Skokomish River, the delegated authority is WDOE. Each site will have significant disturbance of sediments and substrates, and certain sites will have side-cast material as pilot channels are excavated. When the site-specific construction drawings and contract are prepared, the Corps will provide these and all other necessary documentation for WDOE to certify that the action will not violate established water quality standards.

Section 402 – The National Pollutant Discharge Elimination System (NPDES), controls discharges into waters of the United States. NPDES permits contain industry-specific, technology-based, and/or water-quality-based limits, and establish pollutant monitoring and reporting requirements. EPA has established a program to address stormwater discharges. These regulations require that facilities or construction sites with stormwater discharges from a site that is one acre or larger apply for an NPDES permit. Stormwater discharge permits will provide the relevant authority for discharges from restoration sites during construction.

Section 404 – The Corps administers regulations under Section 404(b)(1) of the Clean Water Act, which establishes a program to regulate the discharge of dredged and fill material into waters of the U.S., including wetlands. The Corps will evaluate potential project-induced effects subject to these regulations during feasibility-level design and provide a public notice to solicit comments on the project design and evaluation under the Section 404 of the Clean Water Act. The final DFR/EIS will include a completed 404(b)(1) evaluation in a forthcoming Appendix L: Compliance Documents.

6.4 Coastal Zone Management Act of 1972

The Coastal Zone Management Act (CZMA) of 1972 as amended (16 U.S.C. §1451-1464) requires Federal agencies to carry out their activities in a manner that is consistent to the maximum extent practicable with the enforceable policies of the approved State Coastal Zone Management Program. The aim of the act is to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." The delegated authority for review of consistency in Washington State is WDOE. In compliance with State law, Mason County has developed its own Shoreline Master Program under the State Shoreline Management Act. The Corps expects to be fully consistent with the enforceable polices of Mason County's Shoreline Master Program. The Corps will prepare a CZMA Consistency Determination during feasibility-level design phase according to the relevant county code and will submit this consistency determination to WDOE for their review and concurrence. The Final Feasibility Report/EIS will include any concurrence letter the Corps receives regarding the consistency determination.

6.5 Clean Air Act of 1972

The Clean Air Act (CAA) as Amended (42 U.S.C. §7401, et seq.) prohibits Federal agencies from approving any action that does not conform to an approved State or Federal implementation plan. Three agencies have jurisdiction over air quality in the project area: EPA, WDOE, and the Olympic Region Clean Air Agency. The EPA sets standards for concentrations of pollutants in outdoor air and the State establishes regulations that govern contaminant emissions from air pollution sources. Construction activities associated with the proposal will create air emissions, but the emissions are not expected to affect implementation of Washington's CAA implementation plan.

6.6 National Historic Preservation Act of 1966

The National Historic Preservation Act (NHPA) and its implementing regulations 36 CFR §800 provides a regulatory framework for the identification, documentation, and evaluation of cultural resources that may be affected by federal undertakings. Under the Act, Federal agencies must take into account the effects of their undertakings on historic properties (cultural resources that have been found to be eligible for listing in the National Register of Historic Places) and afford the Advisory Council a reasonable opportunity to comment on such undertaking. Additionally, a Federal agency shall consult with any tribe that attaches religious and cultural significance to such properties.

To meet the Agency's responsibilities under NHPA, the Corps is in the process of executing a Programmatic Agreement with the Advisory Council, SHPO, and the Skokomish Tribe, which will set forth the means by which the Corps will comply with the Act. Programmatic Agreements are prepared when effects on historic properties cannot be fully determined prior to approval of an undertaking (36CFR800.14). The Final Feasibility Report/EIS will include a copy of the signed Programmatic Agreement.

6.7 Federal Trust Responsibility

The Federal trust responsibility to Native American Tribes is a protection and preservation of land and certain rights for them. Treaties with the Tribes are the supreme law of the land, superior to State laws, and equal to Federal laws. The trust responsibility is derived from the special relationship between the U.S. and Native American Indian Tribes, first defined by U.S. Supreme Court Chief Justice John Marshall in Cherokee Nation v. Georgia, 30 U.S. 1 (5 Pet.) (1831). Later, in Seminole Nation v. United States, 316 U.S. §286 (1942), the Supreme Court noted that the U.S. "has charged itself with moral obligations of the highest responsibility and trust" toward Native American Indian Tribes. The scope of the Federal trust responsibility is broad and incumbent upon all Federal agencies. The U.S. government has an obligation to protect tribal land, assets, resources, and rights, as well as a duty to carry out the mandates of Federal law with respect to Indian Tribes.

Federal agencies have a trust responsibility to preserve and rebuild fisheries in Washington State within tribes' usual and accustomed fishing areas and to do so in consultation and coordination with the federally recognized tribes. The Skokomish Tribe has had representation in this feasibility study planning phase as one of the two non-Federal sponsors. The study team anticipates that the proposed ecosystem restoration would have significant benefits to ecosystem and fisheries resources, which are of economic and cultural value to the Tribe, and is consistent with the Tribe's treaty rights.

6.8 Executive Order 13175 Consultation and Coordination with Indian Tribal Governments

Executive Order 13175 reaffirmed the Federal government's commitment to a government-to-government relationship with Indian Tribes, and directed Federal agencies to establish procedures to consult and collaborate with tribal governments when new agency regulations would have tribal implications. The Corps has a government-to-government consultation policy to facilitate the interchange between decision makers to obtain mutually acceptable decisions. In accordance with this Executive Order, the Corps has engaged in regular and meaningful consultation and collaboration with the Skokomish Tribe throughout the course of the study.

6.9 Bald and Golden Eagle Act of 1940

The Bald and Golden Eagle Protection Act (16 U.S.C. §668-668c) applies to Corps civil works projects through the protection of bald and golden eagles from disturbance. Construction activities associated with the proposed actions have potential to disturb bald and golden eagles due to the presence of heavy machinery and elevated noise levels. The Corps will develop an eagle monitoring plan, and will minimize construction effects by surveying each site for nests and roosts prior to and during construction, and, if nests and/or roosts are nearby, will coordinate with USFWS.

6.10 Fish and Wildlife Coordination Act of 1934

The Fish and Wildlife Coordination Act (FWCA) of 1934 as amended (16 U.S.C. §661-667e) provides authority for the USFWS involvement in evaluating effects to fish and wildlife from proposed water resource development projects. It requires that fish and wildlife resources receive equal consideration to other project features. It requires Federal agencies that construct, license, or permit water resource development projects to consult with the USFWS, NMFS, and State resource agencies regarding the effects to fish and wildlife resources and measures to mitigate these effects. Section 2(b) requires the USFWS to produce a Coordination Act Report that describes fish and wildlife resources in a project area, potential negative effects of a proposed project, and recommendations for a project. The draft report includes the USFWS positions and recommendations. This draft document and a planning aid letter pursuant to FWCA are in Appendix L.

6.11 Magnuson-Stevens Fishery Conservation and Management Act of 1976

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §1801 et. seq.) requires Federal agencies to consult with NMFS on activities that may adversely affect Essential Fish Habitat (EFH). The objective of an EFH assessment is to determine whether the proposed action(s) "may adversely affect" designated EFH for relevant commercial, federally managed fisheries species within the proposed action area. EFH includes those waters and substrate necessary for fish spawning, breeding, feeding, or growth to maturity. The assessment describes conservation measures proposed to avoid, minimize, or otherwise offset potential adverse effects to designated EFH resulting from the proposed action. During feasibility-level design phase, the Corps would prepare an effects analysis addressing EFH, which would be provided to USFWS and NMFS within the Biological Evaluation required under ESA Section 7. Although habitat disturbance may have temporary adverse effects to designated EFH, the conservation measures that the Corps will include as part of the proposed site design to address ESA concerns should be adequate to avoid, minimize, or otherwise offset potential adverse effects to the EFH. The proposed restoration sites would result in long-term benefits to salmonids, but are not anticipated to have any effect on EFH of the coastal pelagic species or groundfish.

6.12 Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. §1361-1407) restricts harassment of marine mammals and requires interagency consultation in conjunction with the ESA consultation for Federal activities. The preferred alternative would have no effect to marine mammals. In the event that an alternative is selected that would affect marine mammals, the Corps would consult with NMFS on effects to marine mammals in conjunction with the ESA Section 7 consultation. The Corps would implement all practicable conservation measures and adhere to a marine mammal monitoring plan.

6.13 Migratory Bird Treaty Act of 1918 and Executive Order 13186 Migratory Bird Habitat Protection

The Migratory Bird Treaty Act (16 U.S.C. §703-712) as amended protects over 800 bird species and their habitat, and commits that the U.S. will take measures to protect identified ecosystems of special importance to migratory birds against pollution, detrimental alterations, and other environmental degradations. EO 13186 directs Federal agencies to evaluate the effects of their actions on migratory birds, with emphasis on species of concern, and inform the USFWS of potential negative effects to migratory birds. If the Corps elects to implement the preferred alternative, migratory bird habitat will be investigated during feasibility-level design phase to determine whether any negative effects will occur and will coordinate appropriate mitigation with USFWS.

6.14 Wild and Scenic Rivers Act of 1968

The Wild and Scenic Rivers Act (Public Law 90-542; 16 U.S.C. 1271 et seq.) establishes a National Wild and Scenic Rivers System to preserve, protect, and enhance the wilderness qualities, scenic beauties, and ecological regimes of rivers and streams. Any construction within 100 feet of a scenic stream requires a scenic streams permit. Four sections of the South Fork Skokomish River are designated as “wild”, “scenic”, or “recreational”. All of the proposed restoration work would occur in the lower mainstem Skokomish River and would not affect the protected reaches.

6.15 Executive Order 12898 Environmental Justice

Executive Order 12898 directs Federal agencies to take the appropriate steps to identify and address any disproportionately high and adverse human health or environmental effects of Federal programs, policies, and activities on minority and low-income populations. The Corps has analyzed the potential effects of the alternatives on communities in the Skokomish Valley and found that there would be no disproportionately high and adverse human health impacts to any environmental justice communities. Further, the Tribe as a community protected under this Executive Order has been actively engaged in the study and environmental review process.

6.16 Executive Order 11990 Protection of Wetlands

The purpose of Executive Order 11990 is to "minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands". To meet these objectives, the order requires Federal agencies, in planning their actions, to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided. The preferred alternative would have the overall effect of enhancing wetlands and increasing their total area in the Skokomish Valley.

6.17 Farmland Protection Policy Act

Congress passed the Farmland Protection Policy Act (FPPA) because of substantial decreases in farmland acreage. The purpose of the Act is to minimize the extent to which Federal actions contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. Projects are subject to FPPA requirements if they may irreversibly convert farmland (directly or indirectly) to nonagricultural use and are completed by a Federal agency or with assistance from a Federal agency. The Skokomish Valley has no designated prime and unique farmland that would be converted to other uses.

7. Public Involvement, Review, and Consultation

Stakeholders, agencies, and the public are integral in providing input for defining restoration opportunities, objectives, constraints, and for developing restoration strategies that support development of the range of alternatives to be analyzed for feasibility and environmental compliance. Public involvement activities and agency coordination are summarized in this chapter.

7.1 Public Involvement Process

Corps Planning Policy and NEPA emphasize public involvement in government actions affecting the environment by requiring that the benefits and risks associated with the proposed actions be assessed and publicly disclosed. In accordance with NEPA public involvement requirements (40 CFR 1506.6) and Corps Planning Policy (ER 1105-2-100), opportunities were presented for the public to provide oral or written comments on potentially affected resources, environmental issues to be considered, and the agency's approach to the analysis. Efforts to involve the public included a public scoping meeting, soliciting relevant information from the public, holding a number of informal public meetings, and explaining procedures of how interested parties can get information on the planning process.

7.1.1 Public Scoping Meeting

Scoping is a critical component of the overall public involvement program to solicit input from affected Federal, State, and local agencies; tribes; and interested stakeholders. The scoping process provides early and open means of determining the scope of issues (problems, needs, and opportunities) to be identified and addressed in the DFR/EIS. The Skokomish scoping process was conducted jointly with Mason County and the Skokomish Indian Tribe.

To announce the start of the feasibility phase, a Federal notice of intent (NOI) was issued to residents, Federal, State and local agencies, Tribal governments, and interested groups and was published in the Federal Register on September 24, 2010. The recipients were invited to comment on the results of the earlier completed reconnaissance study and to provide input to the feasibility study, including the scoping of the environmental issues that should be addressed throughout the study. The NOI announced a public scoping meeting, which was held on October 7, 2010 at Mason County Public Works, 100 West Public Works Drive, Shelton, Washington. An open house ran from 4:00 p.m. to 7:00 p.m., with a presentation and opportunity for formal public comment at 5:30 p.m. The public scoping meeting aimed to provide an overview of the Skokomish feasibility study, identify project purpose and need, identify preliminary measures, and describe the NEPA process.

During the comment period, the Corps received 28 comments; three comment forms and one photo were submitted during the scoping meeting, nine verbal comments were given during the scoping meeting, eight letters were mailed, and eight email messages were submitted. Comments included several themes, primarily agriculture, aquatic ecosystem restoration/channel restoration, Cushman Dam, flooding, habitat (specific organisms or animals), and sediment management. A complete list of public comments from the scoping period is contained in Appendix M.

7.1.2 Draft Feasibility Report / EIS Public Review

The public comment period, during which any person or organization may comment on the DFR/EIS, is mandated by State and Federal laws. For the Skokomish study, the draft FR/EIS public comment period will formally run for 45 days beginning in February 2014 and ending in April 2014. The Corps will consider all comments received during the comment period. The complete list of comments regarding the draft FR/EIS and the Corps' responses will be included as an appendix to the Final FR/EIS.

The Study Team will host one public hearing in the study area in March 2014. In addition to accepting comments during the public hearings, comments will be accepted via mail, fax, or email.

7.2 Agency and Tribal Government Consultation and Coordination Process

Preparation of this DFR/EIS is being coordinated with appropriate Federal, State, and local interests as well as environmental groups and other interested parties.

7.2.1 Federal Agencies

Several Federal agencies participated in early study activities, particularly in the process of identifying problems and opportunities in the basin. The Bureau of Reclamation has provided information critical to understanding the geomorphology and sediment transport processes of the river. The Corps has briefed the NMFS Restoration Center Northwest on the study as NMFS continues to express interest in the study's progress. The Corps contracted a baseline study through USFWS to conduct biological sampling throughout the study area. Additionally, the Corps is coordinating with USFWS in compliance with the FWCA. The Council for Environmental Quality regulations for implementing NEPA encourage agencies to formally agree to "cooperating agency" status, thus ensuring their expertise will be applied when formulating feasible alternative plans. Prior to the Feasibility Scoping Meeting, NMFS and USFWS expressed willingness to consider a cooperating agency role; although they declined upon formal invitation, both agencies remain actively involved in the study.

7.2.2 State Agencies

The Corps has coordinated with the WDFW to seek input on potential restoration projects and has sought information regarding shellfish and eelgrass habitat from the WDNR. Further consultation with WDFW will occur through briefing this agency on the final array of alternatives and seeking their input on impacts and benefits of the proposed actions.

7.2.3 Indian Tribes

The Corps has engaged in formal and informal coordination with the Skokomish Indian Tribe throughout the feasibility phase. The Skokomish Tribe has had a critical role throughout the feasibility study as one of the two non-Federal sponsors (Mason County is the other). Tribal coordination will continue throughout the feasibility phase, preconstruction engineering and design, and construction in accordance with Executive Order 13175 Consultation and Coordination with Indian Tribal Governments.

7.3 Additional Coordination and Consultation

The following Federal and State agencies, tribal partners, and non-governmental organizations have been involved during the feasibility study:

- National Marine Fisheries Service
- U.S. Fish and Wildlife Service
- U.S. Bureau of Reclamation
- Washington Department of Fish and Wildlife
- Washington Department of Natural Resources
- Puget Sound Partnership
- Washington Salmon Recovery Funding Board
- Northwest Indian Fisheries Commission
- Skokomish Watershed Action Team
- Hood Canal Coordinating Council
- Taylor Shellfish Company
- Green Diamond Resource Company
- Tacoma Public Utilities

7.4 Peer Review Process

In 2011, the PDT developed the Review Plan for the Feasibility Study of the Skokomish River Basin, Mason County, Washington (Peer Review Plan; USACE 2011), which the Corps Ecosystem Restoration Planning Center of Expertise (ECO-PCX) approved. Peer review was designed to meet all pertinent Corps policies (e.g. Engineering Circulars [EC] including EC 1165-2-214; USACE 2012). This plan requires external review of the project's technical reports as well as the draft and final feasibility report/EIS. The Skokomish study has adhered to this guidance and completed multiple rounds of District Quality Control (DQC) and Agency Technical Review (ATR) on feasibility phase deliverables. This Draft Feasibility Report/Environmental Impact Statement (DFR/EIS) will undergo DQC, ATR, and Independent External Peer Review (IEPR). Once complete, DQC, ATR, and IEPR reports will be submitted with the Final Feasibility Report/EIS. The IEPR report will also be posted for public access and transmitted to Congressional committee.

In accordance with guidelines set by the Corps for planning and ecosystem output models (e.g., ER 1165-2-501 and EC 1105-2-412, Seattle District requested approval for one-time use of a planning model. The model review plan was submitted to the ECO-PCX in March 2013. The complete model documentation report (Appendix F) has undergone peer review by the ECO-PCX and was approved for one-time use on October 8, 2013.

8. Recommendations

The following language outlines the Corps' recommendations for project approval and authorization for implementation.

I recommend that the tentatively selected plan for ecosystem restoration for the Skokomish River Basin project area as generally described in this report be authorized for implementation as a Federal project, with such modifications thereof as in the discretion of the Commander, USACE may be advisable. The estimated first cost of the recommended plan is $40,753,000. Minimal (less than $5,000 per year) operations, maintenance, repair, rehabilitation, and replacement (OMRR&R) expenses are expected at this time. The Federal portion of the estimated first cost is $26,490,000. The non-Federal sponsors' portion of the required 35% cost share of total project first costs is $14,264,000. The non-Federal partners shall, prior to implementation, agree to perform the following items of local cooperation:

Provide 35 percent of total project costs as further specified below:

1. Enter into an agreement, which provides, prior to execution of the project partnership agreement, 35 percent of design costs;
2. Provide, during construction, any additional funds needed to cover the non-Federal share of design costs;
3. Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;
4. Provide, during construction, any additional costs as necessary to make its total contribution equal to 35 percent of the total project costs allocated to the project;

   a. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project;
   b. Not use funds provided by a Federal agency under any other Federal program to satisfy, in whole or in part, the non-Federal share of the cost of the project unless the Federal agency that provides the funds determines that the funds are authorized to be used to carry out the study or project;
   c. Not use project or lands, easements, and rights-of-way required for the project as a wetlands bank or mitigation credit for any other project;
   d. For as long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the project, or functional portion of the project, including mitigation, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;
   e. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing,

replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the non-Federal sponsor of responsibility to meet the non-Federal sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

f. Hold and save the Government free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

g. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal partner shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government;

h. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

i. Agree that, as between the Federal Government and the non-Federal partner, the non-Federal partner shall be considered the operator of the project for the purpose of CERCLA liability, and, to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

j. Prevent obstructions of or encroachment on the project (including prescribing and enforcing regulations to prevent such obstruction or encroachments) that might reduce ecosystem restoration benefits, hinder operation and maintenance, or interfere with the project's proper function, such as any new developments on project lands or the addition of facilities that would degrade the benefits of the project;

k. Keep up and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of three years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as would properly reflect total costs of construction of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

l. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal partner has entered into a written agreement to furnish its required cooperation for the project or separable element.

m. Comply with all applicable Federal and State laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and all applicable Federal labor standards and requirements, including but not limited to 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying, and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.); and

n. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

The recommendations contained herein reflect the information available at this time and current departmental policies governing the formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of the national civil works construction program or the perspective of higher levels within the executive branch. Consequently, the recommendations may be modified before they are transmitted to Congress for authorization and/or implementation funding. However, prior to transmittal to Congress, the State of Washington, interested Federal agencies, and other parties will be advised of any significant modifications in the recommendations and will be afforded an opportunity to comment further.

BRUCE A. ESTOK
Colonel, Corps of Engineers
District Commander

9. List of Preparers

The following individuals participated in the preparation of this integrated Feasibility Report and Environmental Impact Statement:

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