Final Environmental Assessment

Stillaguamish River Ecosystem Restoration
Puget Sound and Adjacent Waters Authority

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Final Environmental Assessment
Stillaguamish River Ecosystem Restoration

Lead Agencies:
U.S. Army Corps of Engineers, Seattle District and Snohomish County, Washington

Abstract:
Since settlement, the Stillaguamish River has been extensively altered by industry, urbanization, agriculture, and historic forest practices. Partial filling of the estuary, revetment and channelization projects by the Corps of Engineers in the 1930s, levee construction, and timber harvest has led to the degradation of fish and wildlife habitat throughout the basin. Despite this history, there are numerous opportunities for ecosystem restoration work in the watershed.

The proposed Ecosystem Restoration Plan recommends restoration features throughout the Stillaguamish River—from the tidal estuaries to the spawning and wildlife areas of the upper basin. The Plan includes proposed restoration features at 13 sites; these projects would restore and re-establish stream, riparian, wetland, and tidal habitats, providing critical habitat for salmonids.

The Ecosystem Restoration Plan was developed with the full coordination of interested federal, state, and local agencies as well as the project sponsor, Snohomish County. The recommended plan also has the support of the Stillaguamish and the Tulalip Indian Tribes, the Washington State Department of Fish and Wildlife, the U.S. Fish and Wildlife Service, the Stillaguamish Implementation Review Committee, and other interested parties.

The following document is the Environmental Assessment (EA), pursuant to the National Environmental Policy Act (NEPA), for the recommended basin-wide restoration plan. It is also anticipated that this document could be adopted under Washington State's Environmental Policy Act (SEPA) at a later date. The purpose of this document is to evaluate what types of approaches to habitat restoration have been considered under the Ecosystem Restoration Plan, and then actual projects that are the outcome of the preferred restoration methodology. Snohomish County may adopt this NEPA EA under the appropriate Washington State Environmental Policy Act (SEPA) procedures; it is anticipated that separate SEPA documents will be prepared for site specific actions.

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ACRONYMS

BA	biological assessment
BAJ	bar apex log jam
BMPs	best management practices
CCC	Civilian Conservation Corps
cfs	cubic feet per second
CO	carbon monoxide
Corps	U.S. Army Corps of Engineers
CZM	Coastal Zone Management
dB	decibels
dbh	diameter at breast height
DNR	Washington Department of Natural Resources
DO	dissolved oxygen
Ecology	Washington Department of Ecology
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ERS	Ecosystem Restoration Study
ESA	Endangered Species Act
ESU	evolutionarily significant unit
GIS	geographic information system
HPA	Hydraulic Project Approval
HTRW	Hazardous, Toxic, And Radiological Wastes

JARPA	Joint Aquatic Resources Permit Application
LWD	large woody debris
MOA	Memorandum of Agreement
MLLW	mean lower low water
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO2	nitrogen dioxide
NOx	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWP	Nationwide Permit
O3	ozone
OHW	Ordinary High Water
PHS	Priority Habitats and Species
ppm	parts per million
RER	restoration effectiveness rating
RCW	Revised Code of Washington
RM	river mile
SASSI	Salmon and Steelhead Stock Inventory
SCPW	Snohomish County Public Works

SEPA	State Environmental Policy Act
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SMA	Washington Shoreline Management Act
SO2	sulfur dioxide
TCP	Traditional Cultural Properties
USC	U.S. Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOCs	volatile organic compounds
WAC	Washington Administrative Code
WDF	Washington Department of Fisheries (precursor to WDFW)
WDFW	Washington Department of Fish and Wildlife
WRDA	Water Resource Development Act
WRIA	Water Resource Inventory Area
WSCC	Washington State Conservation Commission
WWTIT	Western Washington Treaty Indian Tribes

1. BACKGROUND

The Puget Sound drainage basin is faced with increasing environmental resource problems that have wide ranging impacts. The Stillaguamish River watershed, within the Puget Sound basin, contributes to these problems in important ways. Over time, the effects of industry, urbanization, agriculture, and historic forest practices have resulted in vast changes throughout the Stillaguamish River watershed. Partial filling of the estuary, construction of a series of revetment and channelization projects by the Corps of Engineers in the 1930s, construction of an extensive system of levees, and harvesting of timber in the upper watershed have led to significant fish and wildlife degradation in the basin. Summer/fall chinook salmon and bull trout have been listed as threatened, and coho and sea run cutthroat trout are candidate species for listing under the Endangered Species Act. Although much of the watershed’s natural habitats for these nationally significant species have been destroyed or degraded, there are numerous opportunities for ecosystem restoration.

1.1 Project Authority

The Stillaguamish River Basin Restoration Study is authorized by, Section 209 of the Flood Control Act of 1962 (Public Law 87-874), which authorizes the Corps to conduct a comprehensive study of the Puget Sound and Adjacent Waters in western Washington. The Puget Sound and Adjacent Waters authority does not explicitly mention ecosystem restoration, but later interpretations judged that restoration is an appropriate use of the authority. Funding for the reconnaissance study was provided in the 1995 Energy and Water Appropriations Bill. In 1998, the reconnaissance phase was completed and the Feasibility Cost-Sharing Agreement with Snohomish County was signed. The feasibility phase of study was initiated in 1999, which resulted in a Feasibility Report and this Environmental Assessment (EA).

1.2 Project Purpose and Scope

The overall objective of this plan is to restore critical landscape processes, functions and structures to a more natural condition in order to support native anadromous salmonids, while providing some wildlife benefits. The primary planning goal was to formulate projects that addressed critical habitat restoration needs throughout the Stillaguamish watershed—from rearing areas in the tidal estuaries to spawning habitat in the upper basin.

The restoration activities considered in this Environmental Assessment (EA) are being conducted under a Corps of Engineers program called Ecosystem Restoration, which is one of the primary missions of the Corps Civil Works program. This restoration study has involved a comprehensive evaluation of the problems contributing to system degradation and development of alternative solutions. This report documents consideration of alternative restoration strategies, identifies a preferred restoration approach, and evaluates a number of restoration projects using various criteria. Thirteen proposed projects are evaluated in depth. Snohomish County may adopt this NEPA EA under the appropriate Washington State Environmental Policy Act (SEPA) procedures; it is anticipated that separate SEPA documents will be prepared for site specific actions.

Due do a variety of factors (i.e., funding, real-estate availability, and technical feasibility), not all of the restoration projects may be constructed. If successful in obtaining the necessary lands and funding for the restoration program, the construction of projects would be phased over a ten-year period starting in 2001. Adaptive management principles will be applied to this restoration program; results (e.g., stability, functionality) of the initial projects will be monitored so that the design and implementation of the remaining projects will incorporate "lessons learned" from previously constructed projects. While this document is intended to cover the requirements under NEPA at this time, if there is a notable changes to the basin-wide restoration effort or if an individual project changes substantially, additional NEPA evaluation will need to occur.

1.3 Project History

The Ecosystem Restoration Study is being conducted under a Corps study process called General Investigation. A General Investigation (G.I.) study is usually conducted in three phases: reconnaissance, feasibility and, if congressional authorization is obtained, construction. Each phase of the G.I. is increasingly more complex and provides further layers of detail building on the previous study phase.

A Reconnaissance Study for this restoration program, entitled *Stillaguamish River Ecosystem Restoration General Investigation*, was completed in December 1997. The purpose of this document was to examine the need for ecosystem restoration in the Stillaguamish Basin, to identify potential projects, to determine the federal interest in planning for such projects, and to assess the level of interest and support of non-federal sponsors in the identified projects.

Projects that were considered appropriate for possible inclusion in the program were recommended for further evaluation under a Feasibility Phase Study. The objective of this Feasibility Study is to formulate a plan that will be recommended for implementation. Feasibility Phase analyses of project costs and environmental outputs are more detailed and quantitative than those developed for the Reconnaissance Study.

This Environmental Assessment is being developed concurrently with the Feasibility Study. It is a companion report which documents the environmental planning process as required by National Environmental Policy Act (NEPA) and forms the basis for environmental coordination of the study. It is anticipated that Snohomish County (the lead SEPA agency) may adopt this NEPA document at a later date.

1.4 Resource Problems

Over the past century, a variety of conditions and activities have contributed to the degradation of fish and wildlife habitat in the Stillaguamish River Basin. Some of these problems do not lend themselves to corrective action through Corps program and are addressed through other programs, such as Forest Service management plans. Major changes in ecological processes and patterns that can potentially be addressed through Water Resources Development Act (WRDA) ecosystem restoration projects include:

1.4.1. Hydrology and Geomorphology

There have been significant changes in the way water moves through and within the Stillaguamish basin, the morphology and distribution of channels, and the recruitment, movement, and storage of sediments. The complex interrelationships among these factors, and the influence of human activities and changes in plant/animal populations, are currently the subject of a major study on patterns of historic change in the Stillaguamish Basin (Collins 1997.). Some of the major anthropogenic changes to basin hydrology and geomorphology are discussed below.

Channel condition has changed significantly in some places (Collins 1997). Both aggradation and degradation have been observed in various locations, channel widths and the occurrence of in-stream islands have been modified, and certain channel segments and tributaries have been substantially re-aligned or structurally modified. Major structural intervention has included the extensive diking of the lower mainstem, numerous revetment projects, and the installation of a weir across the mouth of Cook Slough in 1939. Each of these actions was designed specifically to modify the way water moves and is stored within the channel system and floodplain. Diking of the tidally-influenced portion of the mainstem eliminated an extensive network of tidal blind channels, and other mainstem diking and bank work effectively isolated floodplains and sloughs from the river at all flows except major flood events. Loss of large woody debris had a major influence on in-channel processes. In addition to having direct effects on terrestrial and aquatic habitat condition and availability, splash-damming, channel snagging, and riparian logging may have contributed to channel downcutting (Collins 1997).

Sediment recruitment, storage, and movement are a particularly complex issue. Gravel mining within basin channels has had direct effects, along with probable indirect influences offsite. Sediment inputs are naturally high in many areas due to the inherent instability of soils and lacustrine parent materials on steep slopes. However, some major slides appear to be related to land management actions. Major slide areas and sediment sources in recent decades include the DeForest Creek slide in the Deer Creek basin on the North Fork, the Hazel slide on the North Fork, and the Gold Basin slide on the South Fork.

The changes in hydrology, channel behavior, and sediment movement described above have differentially influenced various portions of the basin. However, the lower mainstem reaches and its associated floodplain have undergone the most dramatic alterations. The fundamental dynamic nature of the lower river has been largely arrested, particularly with regard to hydrologic connectivity between the channel and floodplain, and with regard to channel migration. This simplification and stabilization of the system, in turn, has had direct and indirect adverse consequences for native plant communities and fish and wildlife habitats (Collins 1997).

1.4.2. Vegetation Composition, Structure, and Distribution

Plant community changes also have been most dramatic in the lower mainstem portion of the basin. The original complex of distributary channels and blind tidal channels produced a mosaic of dynamic vegetation types that included salt and brackish marshes, freshwater marshes and shrub swamps, and tidal freshwater swamps integrated with riparian and floodplain forests. The floodplain forests contained extensive relic channels, active sloughs, and side channels connected to the river at higher flows. Periodic movement of the main channel and tributary creeks, as well as beaver activity, produced a pattern of interspersion of various successional stages and transitional communities within the matrix of ancient forest stands.

With the arrival of European settlers, the mainstem floodplain was logged and, along with the intertidal zone, hydrologically altered through channel modification, ditching, and diking. Original forest cover was removed, beavers were largely eradicated, and the system of distributary and side channels was greatly simplified. These changes altered the dynamic nature of the natural vegetation cover, and eliminated much of the mosaic pattern created by interspersion of plant communities of various types and successional stages. The modern landscape of the lower valley is agricultural, and the principal forested areas are relatively small stands dominated by hardwoods. Streamside vegetation consists primarily of narrow, discontinuous bands of hardwoods. Freshwater marshes are very limited in extent. Salt marshes are currently present in a fairly narrow area outside the dike system, as the intertidal blind channel system was largely eliminated.

The valley bottoms of the North Fork, lower South Fork, and major tributaries originally supported forest mosaics reflecting beaver activity and channel movement similar to the forests of the mainstem floodplain, but more limited in extent (Pess et. al. 1999). This system interspersed with and transitioned into upland forest types. Mosaic patterns in upland areas and riparian zones in steep terrain were maintained by fire or by snow and debris avalanches. Early mining and railroad construction activities required large amounts of wood, which was initially taken from mainstem riparian areas. Subsequent logging of tributary basins and slopes often involved highly destructive practices, such as splash-damming, which not only altered the condition of the logged areas but also often had detrimental impacts on stream channels elsewhere in the basin (USFS 1995, ODFW 1995, and Sedell 1988). As large-scale logging accelerated in this century, the pattern of forest cover and processes affecting it, such as fire and landslides, changed dramatically. Fire return intervals in the pre-settlement system were on the order of centuries, while fires occurred more commonly during the period of intensive exploitation. Slides initiated in cut-over and road areas also occurred more frequently than normal rates. All of these changes have resulted in a basin characterized by a patchwork of early-to-mid seral forest stands and very little old-growth forest. In addition, the large woody debris component of both forest and stream ecosystems is assumed to have been substantially depleted and altered in character (Pollock 1998).

Forest Service management objectives in the basin are generally geared toward increasing the proportion of federal lands in a late-seral condition, with a special emphasis on protecting riparian areas (USFS 1994). However, recovery of late-successional characteristics is a slow process, and natural disturbances (fire, avalanche, etc.) will continue to operate to create early-successional patches. Forest Service projections of future trends in the basin indicate that increasing population growth and relatively short timber rotations on non-federal lands will preclude any significant increase in late-seral vegetation outside of the federal landholdings (USFS 1995). Therefore, while the patchy nature of the forest may gradually be improved within the upper basin, forest cover in the lower Forks, the mainstem, and many tributary basins is likely to remain fragmented and discontinuous.

1.4.3. Fish and Wildlife Habitat

The fundamental changes in basic ecosystem structure and processes described above have had significant impacts on the condition and function of habitats for fish and wildlife within the basin. The principal changes can be categorized as follows:

Loss and fragmentation of habitat area. Conversion of forest lands and intertidal wetlands to pasture, urban areas, and other uses has dramatically altered the character and structure of terrestrial and aquatic habitats, particularly in the former floodplains associated with the lower forks and Mainstem. The formerly extensive tracts of intertidal habitat and forest in those areas are reduced to discontinuous fringes along watercourses and the edge of the Bay. The few remaining “blocks” of habitat are relatively small and are generally isolated within an agricultural landscape. Within the upper basin there remain extensive areas that are largely forested; however, logging, fire, road building, and other influences over the past century have changed the pattern of forest cover. The modern forest is broken into relatively small patches of various ages, rather than the much larger patch sizes that formerly characterized the landscape (US Forest Service 1995, 1996).

This general pattern of habitat loss and fragmentation has adverse consequences for wildlife species that require large contiguous blocks of habitat and continuity of corridors among habitats. Species with large home ranges (such as bears) and migratory species that require diverse food resources, cover, and lack of disturbance (such as waterfowl) can be severely affected by habitat reduction and fragmentation.

Differential loss of particular habitat types. The general loss and fragmentation of habitats within the basin has had differential impacts. Certain habitat types have been particularly depleted. Low-elevation floodplain and intertidal wetlands have suffered a disproportionate impact relative to upland areas and higher-elevation wetlands. For example, much of the drainage and land-reclamation activity in the lower basin has been directed specifically at converting wetlands to farmland. Similarly, although forest cover has been largely retained in the upper basin, there has been a major shift in age class distribution such that late-seral systems are relatively rare.

The result of these differential losses of certain habitats has been to significantly impact fish and wildlife species that depend on those systems to complete all or some of their life requirements. Species such as the northern spotted owl and the marbled murrelet, which are dependent on late-seral forests, have become a major focus of management attention on federal lands within the upper basin. Habitat appropriate for such species has been largely eliminated from the lower basin. Many aquatic species, including the salmonid species that are local and regional management priorities, have critical dependence on the distribution and quality of wetlands and other off-channel habitats. Such habitats have been decimated in the lower portions of the basin.

Changes in habitat-forming processes. Fish and wildlife habitats within the Stillaguamish basin are tied to dynamic ecosystem processes. Fire, disease and avalanches formerly maintained Forest mosaics. In the floodplains of the lower forks and Mainstem, channel migration and avulsion were constant forces in forming new bars, abandoned channel segments, side channels, and depressional wetlands. Beaver activity throughout the basin had major effects with respect to the distribution and characteristics of wetlands, many of which were ephemeral on the scale of decades or centuries. The influence of terrestrial plant communities on aquatic systems was significant, in terms of shading and organic inputs. Inputs of large woody debris, in particular, had effects on habitat structure, sediment storage, and nutrient processing within channel systems.

Changes in land use, hydrologic controls, and resource exploitation in the period since European settlement have dramatically altered all of these habitat-forming processes. As noted above, natural patterns of forest disruption and regeneration have been largely superceded by harvest patterns and related fire and road impacts. Channel migration has been arrested by bank stabilization efforts, particularly in the lower mainstem, and other channel characteristics have been influenced by downcutting and meander cutoffs. Some of these changes were specific projects undertaken to stabilize the river and reduce flooding, while others were indirect effects of activities such as gravel mining.

1.4.4. Relationship of these Problems to Federal Interest in Restoration

The preceding analysis documents the history of changes to the hydrology, channel characteristics, and sediment transport patterns in the Stillaguamish basin. Various governmental agencies have participated in constructing bank works, weirs, drainage systems, flood protection levees, and cuttoffs in the Mainstem reaches of the river. In recent decades, the Corps has taken general responsibility for managing these combined works as a single "project," particularly with regard to flood protection. Corps efforts have included repairs and modifications to levees, the main-channel weir, and various permitting activities within the channel and in basin wetlands. Overall, the federal involvement in the "project" that incorporates the many channel and floodplain modifications within the lower basin is no longer separable from most of the non-federal actions that have taken place.

The major changes to ecosystem characteristics and processes outlined above are directly related to the various alterations to channel and floodplain characteristics, and are therefore at least partly attributable to Corps' activities. Floodplain clearing, diking, and channel stabilization are clearly related to the overall "project" that has been directed toward flood reduction and land reclamation in the lower basin. However, some changes in habitat quality and habitat-forming processes have been more directly related to land management activities (principally logging) on federal and private lands in the upper basin. These activities have no significant relationship to the past actions and current responsibilities of the Corps. Therefore, most of the restoration actions considered here involve the mainstem portion of the river. Several proposed actions concern tributaries to the North and South Forks, but they are clearly related to hydrologic issues traditionally within the purview of the Corps.

1.5 Prior Studies and Reports

A variety of resources were consulted in order to identify potential projects suitable for inclusion in the General Investigation. These include general reviews of processes that determine habitat integrity in forested river basins (e.g. Abbe and Montgomery 1996, Bilby and Ward 1989, Bilby et al. 1996, Bisson et al. 1987, Everest et al. 1987, Gregory et al. 1991, Jorgensen 1990, Jorgensen and Mitsch 1989, Montgomery and Buffington 1993, Rosgen 1994, Schlosser 1991, Sedell et al 1990, Swanson et al. 1988), regional scientific studies of critical factors influencing habitat quality in the river basins and estuaries of western Washington (e.g. Beechie et al. 1994, Beechie et al. 1996, Simenstad et al. 1991, Simenstad and Wissmar 1996), and studies specific to the Stillaguamish basin (e.g. Benda et al. 1992, Collins et al. 1994, Pess et. al. 1999, Collins 1997, Polloch 1998 and Pollach and Pess 1998)). Where information from these studies and reports is used herein, they are included by reference.

In addition, a number of studies and analyses have been initiated in recent years specifically to characterize the condition of the Stillaguamish Basin. These reports identify factors limiting ecosystem function, and isolate potential restoration actions that might substantially improve particular problem areas or deficiencies. The materials discussed below served as a starting point for project identification.

Puget Sound Wetland Restoration Program (Stillaguamish Basin Project)
This project is being conducted by the Washington State Department of Ecology, with support from EPA, the Puget Sound Water Quality Action Team, and NOAA, and with the participation of various governmental agencies, tribes, groups, and individuals. The project consists of a large-scale watershed analysis intended to identify and prioritize wetland restoration opportunities based on their potential to address losses of critical wetland functions and related problems such as flooding, depressed salmon populations, degraded water quality, and loss of wildlife habitat. Resources incorporated into the project Geographic Information System include soils, wetland inventory, surficial geology, and similar attributes. The project database includes approximately 1600 specific candidate restoration sites and associated characteristics suitable for use in developing analyses of restoration potential, functional potential, and rankings of sites within specific areas or to meet specific functional restoration objectives.

Stillaguamish Implementation Review Committee, Restoration Subcommittee
The Stillaguamish Implementation Review Committee (SIRC) is a group of citizens and agency representatives responsible for coordinating implementation of water quality improvement actions recommended in a Watershed Action Plan developed in 1990. The Restoration Subcommittee developed a draft set of sub-basin condition summaries and

restoration strategies that focused on salmon and trout habitat in 13 Stillaguamish sub-basins (SIRC 1995). The draft document is considered a work in progress that continues to be refined and modified as the planning process proceeds.

Snohomish County and Tribal Resource Inventory and Planning Documents
Snohomish County Surface Water Management, the Stillaguamish Tribe, and Tulalip Tribe have developed various resource inventory materials that have been used to isolate problems and restoration opportunities within the Stillaguamish basin or sub-sections of the basin. These include aquatic habitat mapping, culvert inventories, stream inventories, and riparian corridor mapping, in addition to direct monitoring of fish use.

Forest Service studies
The U.S. Forest Service has conducted a Stillaguamish River Assessment (1994) and watershed analyses on the Upper and Lower South Fork of the Stillaguamish River and Canyon Creek (U.S. Forest Service Darrington Ranger District 1995, 1996). These documents thoroughly review conditions within the study areas, including aquatic habitats, seral and landscape patterns of terrestrial vegetation, fish and wildlife populations, including species considered endangered or in peril, and patterns of human use. They include identification of restoration priorities as well as management issues. The Forest Service has also published a review of restoration activities in the Deer Creek watershed between 1984-1994 (Movassaghi et al. 1996), which includes an assessment of the effectiveness of particular actions and recommendations for future initiatives.

Washington State Conservation Commission Limiting Factors Report
This report is an assessment of the habitat factors limiting the production of salmon in the Stillaguamish watershed, also known as Water Resource Inventory Area (WRIA) 5
This document focuses on all Stillaguamish stocks identified in the 1992 *Washington State Salmon and Steelhead Stock Inventory* (SASSI): chinook, coho, chum, and pink salmon, steelhead, and bull trout. Searun cutthroat and sockeye salmon are also discussed. The SASSI currently lists the Stillaguamish summer and fall chinook and Stillaguamish coho as depressed stocks. The Deer Creek summer steelhead is listed as critical. In March 1999, the Puget Sound chinook stocks were designated as threatened under the federal Endangered Species Act. Additionally the US Fish and Wildlife Service (USFWS) has listed the Puget Sound bull trout as threatened.

Corps of Engineers Vegetation Mapping and Resource Inventory Compilation
The Seattle District, Corps of Engineers has assembled various resource map coverages within a Geographic Information System specifically to support this study. Existing coverages of wetland distribution, soils, surficial geology, stream inventories, stream blockages, priority species habitats, and similar resources have been adopted directly from their primary sources. Existing coverages include the Washington Rivers Information System (Hudson and Knutson 1993), along with modifications and improvements developed in the course of studies conducted by the Department of Ecology, Snohomish County, Stillaguamish Tribe, and Tulalip Tribe, as described above. In addition, the GIS contains a coverage called "Land Cover," which depicts vegetation and land use over the entire basin (Pacific Meridian 1997). The Land Cover mapping was commissioned specifically to support the Corps' 1997 Reconnaissance Study.

Technical Assessment For Chinook Salmon Recovery in the Stillaguamish Watershed. DRAFT REPORT (July 12, 2000).
This report was developed by the Stillaguamish Technical Advisory Group, which includes The Stillaguamish Tribe and Snohomish County. The report includes an evaluation of historic chinook salmon resource conditions, changes to the resource that have caused a threatened chinook status, restoration goals in the Stillaguamish for chinook, modifications in hatchery, harvest and habitat and a restoration strategy. There are figures in the report that depict current chinook distribution, wetlands in the basin and a landslide inventory.

Other studies
Various studies have been initiated specifically to investigate conditions influencing salmonids within the basin. Embry (1987) and Toth (1991) conducted hydrologic studies. The Deer Creek drainage has been the subject of several studies, including a watershed assessment and restoration strategy commissioned by the Stillaguamish Tribe (Collins et al. 1994). This latter study identified salmonid habitat-forming processes in Deer Creek, the causes of changes in those processes over the past half-century, and how those changes affected steelhead habitats over that period. This historical analysis approach was used to develop a watershed assessment and restoration plan for the Deer Creek basin (Beechie et al. 1996). Historic channel conditions and aquatic habitat distribution in the Stillaguamish basin are the subjects of completed studies (Pess et.al 1999).

2. EXISTING CONDITIONS

2.1 Physical Characteristics

The Stillaguamish River Basin is the fifth largest tributary to Puget Sound, draining a 684 square mile watershed with more than 975 miles of rivers and tributaries. The basin has an east-west orientation with the upper basin on the west slope of the Cascades Mountain Range and the lower basin within the Puget Sound Trough.

For planning and orientation purposes, watershed can be divided into three large sub-basins: the North Fork, the South Fork, and the lower basin. The North and South Forks converge at the town of Arlington. In the lower basin, the resulting mainstem branches into both channels and sloughs. These channels and sloughs converge west of Silvana and the Stillaguamish is again one river for three miles, until two distributary channels are formed near the town of Stanwood. Hat Slough enters Port Susan, and the old Stillaguamish channel drains into Skagit Bay via West Pass and Port Susan via South Slough. Refer to Figure 1 for a location map.

The Stillaguamish Basin's headwaters are in the North Cascades, a topographically diverse area characterized by peaks and valleys shaped by glacial activity. The South Fork drainage begins at Three Fingers Peak (6,854 feet). Above the town of Silverton, the South Fork loses about 2000 feet in elevation in 3 miles, then opens up to a valley floor. The River then flows 26 miles through this gradually widening valley, which is bordered by high mountains and ridges. Elevation drops 1,000 feet to the head of Robe Canyon, then another 600 feet in the 8 miles to the mouth of Canyon Creek. Below Canyon Creek, the South Fork flows an additional 12 miles northwesterly through a canyon and then over Granite Falls. The South Fork continues an additional four miles through a narrow floodplain to its confluence with the North Fork.

The North Fork headwaters form at an elevation of about 4,550 feet. The first 16 miles of the North Fork, including the major tributaries of Squire, Boulder, and Deer Creeks, flow through narrow valleys with steep gradients. Near the city of Darrington, the North Fork emerges from the higher mountains and enters a wide valley characterized by braided channels, back channel sloughs, and oxbow lakes. Its confluence with the South Fork occurs at an elevation of 52 feet. The mainstem gradually slopes downward as it meanders through a wide, fertile floodplain towards Port Susan where it meets the waters of Puget Sound.

2.1.1. Geology

The Stillaguamish Basin, like other river basins arising in the Cascade Range along Puget Sound, has been shaped by a number of geologic processes and events. The two major geologic processes along the Pacific Northwest Coast are the movement of tectonic plates, which is manifested by seismic activity and volcanism, and glaciation. The Cascade Mountain Range is the result of several periods of tectonic uplift and volcanic eruptions. High volcanic peaks such as Mount Rainier, Mt. St. Helens, and Mount Baker continue to build in modern times (Kruckeberg 1991).

FIGURE 1.

Not available electronically.

Throughout much of the Quaternary Period, the basin underwent continental glaciation. The ice was typically several thousand feet thick and caused tremendous scouring and compaction of the volcanic material. Each advance of the ice left behind lateral moraines of unconsolidated materials and compacted till from underneath the ice. The Stillaguamish Basin is composed of various lithologies that include Jurassic Period metamorphic rock in the western portion, and Tertiary Period sedimentary and volcanic rock in the east.

The most recent period of Washington's glaciation, the Vashon Stage, occurred approximately 15,000 years ago. During this period, a mile-thick cordilleran ice sheet extended just south of the present-day city of Olympia. It completely retreated approximately 13,000 years ago, and left behind the deposits of gravels and compacted till material seen today in most soils and surface formations (Kruckeberg 1991). Ice dams formed glacial lakes in many of the river valleys and left behind lacustrine silts and clay in the lower elevation valleys. Other surficial deposits include talus (rockfall) and alluvial and/or debris fans at mouths of tributary valleys. These glacial-lacustrine clays and silts have been the main source of the significant sediment production of the basin. Glacial sediments, especially in steeper slopes, are extremely prone to mass wasting and erosion.

2.1.2. Climate

The Stillaguamish Basin's climate is typically maritime, with cool wet winters and mild summers. Average rainfall ranges from 30 inches in the western lowlands to over 140 inches in the forested eastern region. Approximately 75% of the basin's precipitation falls between October and March. At elevations greater than 3000 feet, much of this precipitation falls as snow. Major winter and spring flooding can occur when abrupt warming results in rain-on-snow events. Spring snowmelt runoff generally peaks in May. The lowest streamflows occur during dry summer months, typically July through September.

2.1.3. Hydrology

The pre-settlement morphology of the Stillaguamish River was typical of recently de-glaciated western Cascade rivers. Headwater streams were steep and set in either bedrock or boulders, while the lower reaches contained mostly low gradient, alluvial streams. The area was, and still is, naturally sediment rich with several distributary channels in the valley bottoms. Tidal effects reach upstream to river mile 7, just above the confluence with Cook Slough.

The South Fork drainage area covers about 255 square miles, while the North Fork drainage covers about 284 square miles. Below are descriptions of the major tributaries to the Stillaguamish, which include brief discussions of the physical factors limiting salmonid production. This section then turns to more a generalized description of the Basin's hydrologic characteristics; particularly those altered during the past century.

Northern Tributaries to the Mainstem
Church Creek Many years of agricultural land use have resulted in the removal of most of the riparian vegetation in the lower reaches (Jorgenson Slough). Church Creek provides habitat primarily for cutthroat and coho, with fewer chum (mostly planted) and steelhead. It is the best cutthroat stream in the Stillaguamish system, with annual smolt production about equal to that of coho.

Pilchuck Creek Resource experts have assumed that summer low flows in the Pilchuck, with associated high temperatures, are limiting factors for salmon production. Factors that have contributed to reduced summer flows include wetland loss, increased bedload from disruptive land use practices, upstream water withdrawals, and blocked or restricted culverts. Some of the same factors contribute to "flashy" high flows in the winter.

Harvey/Armstrong Creek Agricultural run-off, high sediment loading, "flashy" winter flows and low summer flows, lack of riparian vegetation, and a general lack of instream channel rearing/holding/spawn habitats are limiting factors for salmonids in this tributary. Coho, cutthroat and steelhead can be found in Harvey/Armstrong Creek and its accessible tributaries.

Southern Tributaries to the Mainstem
Tributary 30 This system has low flow problems in late summer and fall, as its main source of water is springs. Although there are some excellent reaches of rearing and/or spawning habitat, low summer flow is a limiting factor.

Portage Creek Much of Portage Creek system has been ditched and straightened. Past and present agricultural activities have caused the loss of many of the systems wetlands and riparian zones.

Fish Creek Although Fish Creek is adversely effect by agricultural runoff and land clearing for home-building, there is significant coho spawning in the upper reaches and in the supporting tributaries. This is due to the presence of highest quality coho spawning habitat of all the southern Stillaguamish mainstem tributaries.

South Fork Stillaguamish
Lower South Fork Spawning habitat in this portion of the system is fair, as high sediment loads from the Upper South Fork often bury spawning gravels. Monitoring near Granite Falls in 1991/92 found the lower South Fork to have some of the highest levels of total suspended solids in the entire watershed. In its lowermost reaches, the floodplain of the South Fork widens into a broad valley and floodplain. This reach has high winter rearing use by coho and steelhead. There are extensive wall-base channels in the floodplain and draining the terraces.

Canyon Creek In this sub-basin, winter steelhead are present throughout the mainstem. Summer steelhead are present in the upper reaches of the mainstem, and in the lower north and south forks. High sediment loading can be a problem, because soils are generally unstable, gradients are steep, and rainfall is high. The creek beds also experience rapid down- and bank cutting, which also increases sedimentation. Nevertheless, resource experts believe that there is a potential to increase production.

Upper South Fork In 1954, a fishway was built on Granite Falls to allow anadromous salmonids access to spawning grounds above the natural falls. Steelhead, chinook, pink, and coho gained access to the Upper South Fork as a result, but passage is sometimes impeded by gravels blocking the structure or low flows. There are resident bull trout in this portion of the river as well.

North Fork Stillaguamish
Deer Creek Deer Creek and its tributaries have undergone dramatic changes since the onset of logging. Peak flows, mass wasting of sediment, channel incision and scour are have changed channel morphology in this geologically unstable area. Even so, Deer Creek is still important to breeding populations of coho and steelhead.

North Fork Stillaguamish Due to intense logging in this watershed, erosion and deposition patterns have changed drastically and adversely affected the ability of the system to support salmonid populations. In addition to changes in habitat quality (i.e., loss of riparian vegetation), sediments have buried spawning areas and high flows have removed LWD. The North Fork is the main producer of most anadromous species and races, although numbers are dramatically reduced (especially for coho and chinook) from historic record.

Flows. Peak streamflows generally occur in the late autumn and winter, typically from rain-on-snow events. More that one-third of the Stillaguamish Basin is located in elevations prone to rain-on-snow events, between 305 and 914 m in elevation. Ten to 14 of the largest peak flow events on record have occurred in past 20 years (Pess and Benda 1994).   From 1978-1987 these high flows resulted in a 4- to 5- fold increase in hill-slope sediment input from upper North Fork (above RM 34.5). This input changed channel morphology in several ways. Particular reaches have widened over 100%, and aggraded or degraded up to two meters in 11 years. This has resulted in the “perching” of many tributaries above the mainstem and the shallowing of channels, which causes the filling in of pools, rising temperatures, and low flow problems (Pess and Benda 1994).

Excessively high stream flows can be detrimental to salmon when they cause scouring in gravel beds containing salmon eggs. Also, the scoured substrate may be redeposited over downstream salmon redds, smothering the eggs. High flows can also flush large woody debris out of stream channels.

Flood flows have been higher and flashier than patterns recorded earlier. Resource experts attribute this to rain-on-snow events in the heavily logged upper watershed. This is well demonstrated by the unusual number of large flows have occurred in the last 10 years. These flows have cut new channels and contributed to channel instability, scouring of redds and fish strandings.

Low summer flows allow salinity intrusion to move upstream further than historic conditions, when summer flows were above 200 cfs. Low flows can also contribute to a decrease in rearing space, a decrease in dissolved oxygen, and an increase in water temperature. Please reference the hydrographs in Figures 2 and 3. Note that these figures are for the North Fork. Similar discharge is expected out of the South Fork, as both Basins are about the same size and their discharge near Arlington is nearly the same, therefore the sum total (below Arlington) is double the North Fork values.

Physical Alterations. Splash dams, which were constructed on small tributaries of both forks, were some of the first anthropomorphic blockages to fish migration in the basin. They were used in historic logging operations to transport harvested logs from upland harvest areas to the mainstem river. They were constructed by building a log crib dam on a stream, then filling the pool that formed behind it with logs. The dam was then breached, which violently flushed the logs downstream where they could be transported to a mill. In addition to migration interference, splash dams caused serious long-term destruction to aquatic and riparian habitat when the impounded water and logs were sluiced down river. The characteristics of the main basin, however, remain relatively unchanged from pre-settlement conditions in that there are no dams or other artificial impoundments. Water withdrawals for irrigation and city water supplies are minor. Major changes have come from the development practices for both logging and agriculture, both of which dramatically altered channel dynamics on the river and its tributaries. Several small hydropower facilities were associated with early mining and logging operations; only one licensed household-sized hydroelectric project remains today, and it is located on a stream without trout or salmon.

Logging operations routinely cleared large woody debris (LWD) from waterways to facilitate log transport. LWD provided structure that maintained a high degree of habitat diversity (instream cover, off-channel overwintering habitat, etc.) and controlled channel morphology by creating pools and trapping spawning gravel. Agricultural practices resulted in the channelization of many streams for flood control. Farmers cleared and drained a high percentage of the wetlands for either pasture or production. Other alterations such as creating small dams and stream diversions changed wetland hydrology. In many cases, these actions resulted in either a simplification of habitat or complete loss of the wetland.

The estuary’s flow regime has been altered dramatically. Prior to 1920, most of the river flowed via the North Channel to Skagit Bay. In the early 1900s, steamboats would navigate up the North Channel and continue upstream to Silvana. Hat Slough was a small narrow backwater carrying water only during high flow events. A settler by the name of Hat widened and deepened the slough, presumably for log storage. Floods in the early 1900s expanded the slough until a flood in the 1920s caused the main river channel to shift to Hat Slough. Re-routing of the high flows from the Stillaguamish Channel to Hat Slough has severely degraded the water quality in the Stillaguamish Channel.

FIGURE 2.

Not available electronically.

FIGURE 3.

Not available electronically.

Historically, the flows in this channel were larger and the river was deeper. Less sediment was deposited in the stream, the water temperature was lower and dissolved oxygen concentrations were higher because of this swifter, deeper stream flow.

Sediment Load. The Stillaguamish has a naturally heavy sediment load because of the inherent instability of the glacial lacustrine sediments. Clearcutting vast areas of forest increased sediment loading and exacerbated natural mass wasting events. Pess et. al (1999) identified sediment choking of the streams as one of the major limiting factors in salmonid production. Sediment reduces inter-gravel water flow within the salmon redd, which decreases dissolved-oxygen levels and interrupts the removal of metabolic wastes. Sediment accumulations in spawning gravels can also prevent fry from emerging (WSCC 1999).

Bortleson (1980) noted one interesting aspect of sediment dynamics on the Stillaguamish River: maps indicate that the delta outside of the sea-dikes has grown significantly since 1886. The most dramatic increase has occurred in the southern part of the delta near Hat Slough, where several inter-distributary islands have formed. Bortleson attributes this progradation to rapid sediment accumulation, caused by shifts in the sediment load from distributary channels in the lower mainstem. Bortleson theorized that the relative sizes of the former channels indicated most of the streamflow went through West Pass and South Pass. Hat Slough appeared to be a minor distributary at the time of the 1886 mapping. Today the primary flow of the Stillaguamish River—and, therefore, the greatest sediment load—is through Hat Slough. The other distributaries have since narrowed because of sediment loading in the channels.

The progradation of the marsh is not surprising given the naturally high and unrestricted sediment loads of the Stillaguamish River. In addition, anthropogenic increases in the sediment load may also have contributed to the progradation (Bortleson 1980). Bortleson attributes possible increased sediment rates to farming, land clearing, logging, and/or dredging upstream.

Flood Control. Extensive river modifications occurred in the mainstem below Arlington, and at the estuary. Beginning in the 1860s, several private and public entities constructed flood control levees and dredged channels, for purposes of both flood control and the conversion wetlands to agriculture. Private individuals also built sea-dikes around salt marshes mainly for agricultural conversion. Some flood control projects were also constructed on the North and South Forks. These efforts resulted in cutting off many of the back channels associated with the original riverway.

The Corps had two authorized projects downstream of Arlington, only one of which was built. In 1939, the Corps was authorized to provide works to reduce bank erosion and channel changes on the mainstem between Arlington and Hat Slough, a distance of 15 miles. The project included revetments at 26 places on the river and Cook Slough; a 275 foot long control weir at the mouth of Cook Slough that limited flow through the slough; and two cut-off channels, each about 900 feet long, to limit sharp bends in Cook Slough. As a result, most flow was channeled via North Slough. The Corps modified the weir in

1991 to allow fish passage during low flows. A river bar has built up at the entrance to the Stillaguamish Channel and, during flood events, the river over-tops the bar and increases sediment load in the Stillaguamish Channel. Levees have also been built along portions of the Stillaguamish Channel near Stanwood, and along Hat Slough, to restrict the river's natural tendency of changing course. Lower flows result in less gravel cleansing and shifting in the river, which reduce the number of salmonid spawning areas. Environmental Assessments for periodic maintenance of the weir and levees are available from the Seattle District office of the Corps of Engineers.

2.1.4. Water Quality

Water quality in the Stillaguamish Basin varies with land use and topography. The Washington Department of Ecology rates water quality as Class AA (extraordinary) upstream of the confluence of Squire Creek in the North Fork and the confluence of Canyon Creek in the South Fork. In 1989, the Department of Ecology identified the lower Stillaguamish as an impaired waterbody because of water quality problems (WDOE 1989). A Tulalip Fisheries Department study (Paulsen et al. 1991) of the lower Stillaguamish found that the mainstem generally met Class A standards, while tributaries met Class B standards. Marine sites (Warm and Juniper Beaches) met Class B standards. The number of reported water quality violations are increasing, as indicated by the growing number of "303(d)" listings in the Stillaguamish drainage. As defined in the federal Clean Water Act, a water body listed on a state's 303(d) list is not expected to attain water-quality standards after implementation of technology-based pollution controls.

Nonpoint source pollution is a major cause of deteriorating water quality in the Stillaguamish Basin; different types of nonpoint source pollution are associated with different land uses. High sediment loads come from land development, tree harvesting and erosion. High nutrient levels are from fertilizers, failing septic systems and animal manure. Bacterial contamination results from septic systems and animal waste. Fecal coliform levels appear to be influenced by manure spreading, overflow of manure lagoons, and seasonal livestock access to streams.

Nonpoint sources in the Stillaguamish watershed include onsite sewage disposal on rural residential land, commercial and non-commercial (hobby farm) agricultural practices, and forestry practices. These non-point sources are expected to increase with continued development of the watershed. In the lower watershed, river reaches that contained hobby farms had the greatest alteration in water quality while the commercial agricultural sites had less impact. Hobby farm owners generally practice poorer pasture management. The US Soil Conservation Service estimates there are about 1,060 agricultural operating units in the Stillaguamish watershed (SCPW 1989).

Temperature. Human-caused increases in stream temperatures are attributed to removal of streamside vegetation and channel widening as a result of high sediment loads. High temperatures often result in areas where there has been a loss of deep pools and where the stream is shallow. Removal of large wood debris, increased sediment supply, and increased peak flows are generally implicated in causing such conditions.

Low water temperatures are an important habitat characteristic for salmonids. The optimal temperature range for salmon is 12-14°C, with lower temperatures preferred for spawning. Temperatures in the range of 20-25°C are lethal for adults. Increased water temperatures may give non-native warmwater species a competitive advantage over native salmonids. A temperature study was conducted by the Stillaguamish Tribe, Tulalip tribe, and Snohomish County from June to September 1996. This study showed that temperatures in the mainstem Stillaguamish and select tributaries fell into stressful ranges (above 13°C) during a high percentage of the study period (Thornburgh 1999, as cited by Washington State Conservation Commission 1999).

Dissolved Oxygen. At dissolved oxygen levels of 8 mg/l or less, salmon eggs are moderately impaired, while adult salmon are affected at or below 5 mg/l. Monthly monitoring data, collected by the Stillaguamish Tribe and Snohomish County during a 1991-1998 survey period, indicate that dissolved oxygen concentrations in the mainstem Stillaguamish usually fall within the preferred ranges, while concentrations in the tributaries usually meet or exceed the standard of 8 mg/l (WSCC 1999). However, in areas such as Portage Creek dissolved oxygen concentrations are generally lower.

Fecal Coliform. Historically, cattle were not present in the river so fecal coliform levels would have been extremely low, similar to those found in the upper watershed today. During storm events, bacteria levels tend to be highest in the tributaries. Approximately 56 commercial dairy farms are currently operating in the watershed, which support about 10,800 cows that produce 235,000 tons of manure per year (SCPW 1989). Commercial shellfish harvesting is restricted throughout much of Port Susan as a result of bacterial contamination, (Nelson, Thornburgh, and Halpin 1991). In fact, in 1986 one third of the tideflats of Port Susan were closed to commercial shellfish harvesting due to fecal coliform counts of the meat of eastern softshell clams (SCPW 1989). In addition, high levels of fecal coliform are generally associated with nutrients such as nitrate and phosphorus. High concentrations of these nutrients can lead to algae blooms which in turn can lead to a decrease in dissolved oxygen levels.

2.1.5. Air Quality

Air quality in the Stillaguamish Basin is generally good. In the lower valley towns with high-density housing, some air quality problems occasionally occur. Motor vehicles are the largest source of air pollutants in Snohomish County, although wood-burning stoves also contribute. Problems generally occur during the dry late summer when minimal wind conditions persist for long periods of time, or during mid-winter thermal inversions. Particulates, sulfur dioxide, ozone, and carbon monoxide are the pollutants of concern.

2.1.6. Noise

Noise is not considered a significant problem in the Basin. Major areas that can produce noise include the Cities of Stanwood, Arlington, Darrington and Granite Falls. Vehicular traffic along the I-5 corridor is a constant low level source. Other intermittent sources include equipment noise from farming operations, logging and construction equipment.

2.2 Natural Resources

2.2.1. Vegetation

Forests. Since the retreat of the last glaciers, coniferous trees have dominated forests of the upper basins. The landscape is characterized by three major coniferous zones, which are caused by differences in elevation, aspect and moisture. The Western Hemlock zone predominates the lower elevations (up to 2,000 ft.), while the Silver Fir zone (2,000 to 3,200 ft.) occupies higher elevations, and the Mountain Hemlock zone (3,000 to 4,400 ft.) (USFS 1992). The autecology of these species includes fire and disturbance adaptation, which tended to perpetuate them as the dominant species. Other trees present in the landscape include western red cedar (*Thuja plicata*) and Sitka spruce (*Picea sitchensis*), however, they are not dominant except in a few isolated areas (Weinmann, pers. comm.). While the historic vegetation composition in the North and South Forks has been stable since retreat of the last glaciers, distribution has varied as a result of changes in regional weather patterns and major fires.

At settlement, the forests consisted of large stands of mixed confers between 200 and 400 years old; this stand age is consistent the predicted fire frequency for the area. Some older forest stands were estimated to be up to 1,000 years old, but these were limited in area and distribution (Weinmann, pers. comm.). Hardwood tree species were not common and usually restricted to specialized habitats. Red alder (*Alnus rubra*) and/or vine maple (*Acer circinatum*) colonized and dominated newly burned or newly opened areas. Black cottonwood (*Populus balsamifera*) dominated the well-drained riparian areas (e.g., braided channels). Big leaf maple (*Acer macrophylum*) and red alder dominated the poorly drained riparian zones (e.g., back channels). Oregon ash (*Fraxinus latifolia*) grew on relatively stable lake margins or adjacent to bogs (Weinmann, pers. comm.). Open prairies or other habitats dominated by herbaceous species were not common.

At the turn of the century logging practices were a major cause of forest fires, which were started in the log yards or by the locomotive engines used for transport. Although Northwest forests were adapted to regenerating fires, logging radically altered the pre-settlement patterns of major fires every 200 to 400 years (USFS 1996). Out-of-control slash burns and railroad sparks started major fires with alarming frequency, sometimes as often as every 4-5 years (USFS 1996). These frequent large-scale fires resulted in a shift of forest-stand age from older mature forests to younger, fragmented tree ‘patches’ or plantations. Most of the remaining forest today contains forests patches of a relatively young age.

Logging practices also dramatically altered the vegetation present in the Stillaguamish Basin. Loggers cut almost all of the larger, mature stands of western hemlock, Douglas fir, and silver fir. After logging, forest managers either allowed the clearcuts to naturally colonize or they were planted. This resulted in a change from fairly continuous, equally aged forest stands to a series of varying-aged forest patches. The edge effect of such a ‘staggered-setting’ system of clearcutting has indirectly affected additional habitat. This form of forest fragmentation shifts the landscape into a spatial and temporal mosaic that results in disruption of habitat corridors and the creation of habitat islands, both of which can decrease wildlife use and productivity. Timber harvest has also resulted in a reduction of snags and downed-wood habitats. Today, only about 12% of the basin currently contains mature stands and there are virtually no continuous forests stands of any significant size. Please reference Figure 4.

Given time, evergreen trees will eventually dominate a disturbed northwest forest stand. However, after logging, there is a long period of colonization by deciduous trees such as red alder and, in some cases, vine maple. Prior to settlement in the Stillaguamish Basin, deciduous forests were fairly isolated and were usually in areas disturbed by fire, avalanche, flooding, or other natural phenomena. Today, deciduous forests make up a significant portion of the forest component—approximately 18-20% of the total forest cover. Another major change in vegetation composition has been a shift from forest to open areas dominated by herbaceous vegetation, usually grasses. Open grasslands would have been a fairly rare component of the post-glacial landscape where emergent wetlands or recently burned areas were usually the only open areas. Agricultural clearing and urban development have changed thousands of forested acres into open grasslands, which currently cover about 10% of the current landscape. Although this may appear to be an increase in habitat diversity, it actually further fragments forest cover and thus increases the “patchy” nature of the landscape.

The most dramatic changes in vegetation composition have occurred in riparian areas. By 1909 mature cedars, Douglas firs, spruces, pines, hemlocks and deciduous trees in most of the basin’s riparian zones had been removed (Collins 1997). The majority of the present riparian zones is either entirely devoid of trees or dominated by young stands of dense red alder or second-growth conifers. The young deciduous and evergreen trees lack the capability of adding any significant levels of LWD to the stream systems now or in the near future.

Wetlands and Riparian Areas. Habitat in the lower Stillaguamish River Basin historically consisted of extensive salt water and brackish marsh, freshwater wetlands, and riparian habitats. In intertidal areas, bullrush (*Scirpus maritimus*), Lyngby’s sedge (*Carex lyngbyei*) and seaside arrowgrass (*Triglochin maritimum)* dominated (Bortleson 1980). Significant inputs of large woody debris to the delta area enhanced fish and wildlife habitat. This, combined with the variety of estuarine habitat types, would have provided niches for an extremely diverse benthic flora and fauna. Just beyond the extent of tidal inundation, the valley floor was largely comprised of groves of Sitka spruce and western red cedar. These trees grew to substantial size and were long lived. One account in the 1880’s describes a tree 13-½ ft in diameter that scaled 50,000 feet of lumber.

Many of the Basin’s emergent and forested wetlands have been converted into agricultural lands or urbanized. This occurred through the placement of fill, the building dikes and levees, and the construction of drains, ditches and other methods to remove or depress surface and ground water. Prior to European settlement, there was approximately 18 km^2 of salt marsh habitat. Between 1870 and 1968, about 85% of the Stillaguamish

FIGURE 4.

Not available electronically.

estuary's tidal marsh was converted to agriculture; two-thirds of this conversion occurred between 1870 and 1886 (Collins 1997).

Although logging the upper watershed had dramatic effects on the patterns and distribution of vegetation, the resulting vegetation has some resemblance to past conditions. In the lower watershed, however, agricultural and urban development completely altered pre-settlement habitats. Loggers, farmers, and urban settlers removed almost all of the native vegetation. Upland and wetland forests were converted to open pastures, agricultural fields, and urban/rural settlements. Farmers drained emergent wetlands and diked most of the salt marshes. Many delta distributaries were filled for agricultural purposes and protected from river flooding by a series of levees, and from tidal flooding by sea dikes. These actions have destroyed the majority of intertidal habitat in the lower basin. In addition, a navigation channel from South Pass to Stanwood was constructed by the Corps in 1945 and maintained until 1986. Figure 4 shows the intertidal habitat that remains on the exterior of the sea dikes around Port Susan (indicated by the wetlands-emergent category).

2.2.2. Fisheries

The Stillaguamish watershed supports five species of Pacific salmon: chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), pink (*O. gorbuscha*), chum (*O. keta*), and a small population of sockeye (*O. nerka*). Two species of anadromous trout, steelhead (*O. mykiss*) and searun cutthroat (*O. clarki clarki*), two species of native char, bull trout (*Salvelinus confluentus*) and Dolly Varden (*S. malma*), and several non-commercial resident species are also present in the Basin. Three of these species are listed or are candidates for listing under the Endangered Species Act. Both chinook and bull trout are listed as threatened, while coho is a candidate species.

Historically the Stillaguamish basin acted as a series of interconnected habitats that supplied all of the life history needs of these fish. The once large estuary, with its blind sloughs and off channel habitats, provided excellent rearing areas. The extensive well-buffered, cool, stream system in the upper watershed contained all the channel attributes that salmon and other cold water species require. The numbers of salmon and trout formerly associated with the Stillaguamish is not well chronicled. All we have are anecdotal references and that several Native Americans resided in close proximity to their traditional harvest areas and there were many such villages that used fish traps along the lower part of the river (Lane 1973). One recent report estimated that historic coho production alone accounted for 1.5 to 2.5 million smolts per year (Pess et al. 1999).

By the 1940's (Collins 1997) some of the larger landscape changes were starting to occur throughout the basin. Agriculture had dominated much of the lower valley and timber production was well underway. Salmon production information from 1956-1965 shows the Stillaguamish River to still be a very productive system (Table 1). Consistent with current populations of anadromous fish, changes in ocean and baitfish population could have made large differences in population size and health. Catastrophic events such as fires, earthquakes, landslides, and floods would have also resulted in large fluctuations in fish populations.

Table 1. Stillaguamish River average annual natural anadromous production by species 1956-1965 (in thousands)

	Chinook	*Coho*	*Chum*	*Pink*	*Sea run Trout*	*Steelhead*
Range	0.64-43.5	33.9-312.7	11.0-258.6	375-1920	58.2-120.7	26.8-60
Average	19.7	100.6	16.97	806.2	79.2	39.5

Notes: Production values include harvest and escapement. Steelhead and Sea-run Trout production values include hatchery and natural production. Pink salmon production values are for odd-years only.
Source: Puget Sound Task Force, 1970 and USFS 1995

The Stillaguamish River supports both wild and hatchery stocks. Various State and Tribal hatcheries have supplemented the wild runs of summer chinook, chum, and coho since 1939. Recent data on the anadromous fish production in the Stillaguamish Basin is limited. However, most recent information indicates a far lower productivity than described between 1956 and 1965 (WDF 1975; SASSI 1992).

A 1992 salmon and steelhead stock inventory, conducted by the Washington Department of Fish and Wildlife (WDFW) and the Western Washington Treaty Indian Tribes (WWTIT) designated the summer/fall chinook stock as depressed (WDFW and WWTIT 1994; hereafter referred to as the “SASSI”). They based this designation upon chronically low escapement estimates. The SASSI defines depressed stock as a stock whose production is below expected levels but above the level where permanent damage to the stock is likely. The SASSI’s average escapement goal of 2,000 has been met only twice since 1968.

Stillaguamish and the adjacent Skagit river are managed differently than most Puget Sound tributaries, as they are managed on a wild stock basis for coho and chinook. This means that wild coho and chinook are considered the “driver stock.” Harvest rates and times are set to project these wild stocks, and harvest is limited by projections based upon return numbers. Escapements for both Stillaguamish coho and chinook have been up and down over the last few years. Several factors need to be considered in the erratic number of returns over the years including ocean conditions in the rearing grounds, harvest, and degradation of habitat (pers. com. Cris Dietrich WDFW 6-2-97).

Salmon and trout migrate, spawn and rear in over 61 miles of mainstem and 65 miles of South Fork Stillaguamish River and its tributaries. They also use 36 miles of the North Fork Stillaguamish and 93 miles of its tributaries (WDF, 1975). Salmon and trout use the mainstem primarily for transportation and rearing. Spawning takes place mostly in the North and South Forks and its tributaries. Rearing areas are located in the Straight of Juan de Fuca and the western part of Vancouver Island

The following is a brief overview of the more important species that utilize the Stillaguamish Basin and some information on their ecology.

Anadromous Fish

Chinook Salmon Fishery experts consider the summer and fall chinook found in the Stillaguamish River as two distinct stocks within a single population. Chinook populations enter the river beginning in mid-July and spawn from mid-August through October. The summer stock generally spawns in September in the North Fork, while the fall stock usually spawns in October in the mainstem and South Fork (WDFW and WWTIT 1994). Juvenile chinook rear throughout the river system. Fry spend from one to five months in fresh water before migrating to the estuary. Outmigration for both stocks occurs from mid-March through June, though a small percentage (less than 10%), of stream type chinook rear for one year (WSCC 1999). Stillaguamish chinook stocks, along with all of the Puget Sound chinook stocks, were designated as threatened under the Endangered Species Act in March 1999.

Coho Salmon Two distinct coho stocks are present in the Stillaguamish Basin: Stillaguamish and Deer Creek (WDFW and WWTIT 1994). The former is considered a mixture of native and non-native fish because of releases of hatchery coho from the early 1950s to 1981; the later is a native stock. Coho return to the Stillaguamish in September and October, and generally spawn in smaller streams with stable streamflow and gravel-sized substrate from mid-November through January. Coho fry emerge in March and April, and spend a full year in the watershed before migrating as smolts to salt water. Juvenile coho rear throughout the watershed, preferring quiet waters such as side channels, stream margins, and beaver ponds (WSCC 1999). Stillaguamish coho stocks, along with all of the Puget Sound/Strait of Georgia coho stocks, were designated as a candidate species under the Endangered Species Act in March 1999.

Chum Salmon The SASSI divides Stillaguamish River chum salmon into North Fork and South Fork stocks. Stillaguamish chum are believed to be native in origin, however Grays Harbor chum were introduced in 1916. Chum enter the river from September through December, with the most movement occurring in early to mid-November. Spawning occurs from mid-October through December. Chum prefer to spawn in the upper North Fork, lower South Fork, in side channels, and in larger tributary streams. Chum fry emerge in March through May, then leave the freshwater system almost immediately. Juvenile chum may linger in the estuary for up to three months before migrating into Puget Sound. The 1992 SASSI classified this stock as healthy.

Pink Salmon Stillaguamish pink salmon are also divided into North and South Fork stocks by the SASSI. These stocks are considered to be native; there is no record of hatchery introductions. Pinks enter the river from early August to early October, with a peak run in the South Fork in September. Spawning begins in late September and continues through October, peaking in mid-October. Pinks spawn throughout the entire North Fork, on the South Fork as far as Granite Falls, and in the larger tributaries in odd years. Even year returns of pink salmon are negligible. The SASSI considers the pink salmon to be native to the Stillaguamish and has recorded no hatchery interactions. The 1992 SASSI classified pink stocks as healthy, however, a consistent decline in the stocks' body size has been noted.

Sockeye Salmon

There is a small population of sockeye salmon inhabiting the Stillaguamish (WSCC 1999). It is not known if this stock are strays from other watersheds or a genetically distinct stock. Stillaguamish sockeye are not listed in the SASSI, and there are no published reports of escapement data. They are known to spawn in the upper North Fork, and in several tributaries. Sockeye generally enter the river from July through September, and spawn from August through October. Smolts migrate out of the river from March through June.

Steelhead Trout Four steelhead stocks have been identified in the Stillaguamish watershed, including one winter run and three summer runs. The summer-run steelhead stocks include the mixed wild/hatchery Canyon Creek stock, the non-native South Fork stock, and a wild Deer Creek stock. Some consider the wild stock found above Granite Falls to be a distinct fourth summer-run stock. Summer-run steelhead enter the Stillaguamish River from March through October, peaking at the end of June. Summer-run steelhead spawn from mid-February to mid-May, with a peak in mid- to late March. The 1992 SASSI did not inventory the present status of summer-run steelhead, but it was considered stable and healthy. Winter-run steelhead enter the river from early November through April, and spawning occurs mainly in the North and South Forks. Winter-run steelhead are wild stock, and were classified as healthy in the 1992 SASSI. The pools of small quite streams are important for steelhead fry, but as they grow in size they are able to use higher energy stream habitat. Juvenile steelhead rear for one to three years in freshwater before outmigrating to Puget Sound. Smolts migrate out of the river from March through late June.

Cutthroat Trout Sea-run and resident stocks of cutthroat trout are found throughout the Stillaguamish watershed, though there has been no systematic inventory of their populations (WSCC 1999). Sea-run cutthroats are known to be present in the mainstem, North Fork, and South Fork below Granite Falls. Resident rainbow trout are believed to replace cutthroat as the predominant species in tributaries. Sea-run cutthroats enter the river beginning in late July with peak movement in September. Spawning occurs from mid-February to mid-May. Young fish rear for two to four years in freshwater before migrating to the ocean, where they spend about five months before returning to the Stillaguamish Basin.

Resident Fishes

Dolly Varden and Bull Trout Two species of native char are present in the Stillaguamish Basin, bull trout and Dolly Varden. Although sometimes anadromous, it is likely that the majority of Stillaguamish char are resident. Some hybridization between Dolly Varden and bull trout is likely due to habitat overlap within the basin. Spawning occurs primarily in the headwaters of the North and South Forks. The 1992 SASSI stock status was listed as unknown. In October 1999, the Coastal/Puget Sound population segment of bull trout was listed as a threatened species under the Endangered Species Act.

<u>Resident Trout</u> Non-native char, such as the brook trout (*Salvelinus fontinalis*), are present in many upper-watershed lakes. WDFW introduced brook trout into the basin to provide sports fishing opportunity; they are now in several outlet streams associated with these lakes. Native resident trout spawn and rear in almost all Basin stream and lake waters. Rainbow and cutthroat trout occur throughout the mainstem, and the North and South Forks. Resident trout are also above Granite Falls, however, fishery experts do not know whether rainbow trout were present above Granite Falls prior to the construction of the fish ladder. Some stocking of cutthroat and rainbow trout has occurred throughout the basin.

<u>Other Resident Fishes</u> Native non-game species found in the Stillaguamish Basin include large-scale sucker (*Cataostomus macrocheilus*); torrent, coast range, shorthead, and prickly sculpins (*Cottus* spp); pacific, river and western brook lamprey (*Lampetra* spp.); peamouth (*Mylocheilus caurinus*); three-spine stickleback (*Gasterosteus aculeatus*); mountain whitefish (*Prosopium williamsoni*); speckled dace (*Rhinichthys osculus*); and redside shiner (*Richardsoni balteatus*). Exotic species within the basin likely include the largemouth and smallmouth bass (*Micropterus* spp.), yellow perch (*Perca flavescens*), and brown bullhead (*Ictalurus nebulosus*). WDFW does not have specific population estimates for either native or exotic non-game species.

2.2.3. Wildlife

Historically, the extensive stands of mature forest in the Stillaguamish Basin supported many species of wildlife, including those predators with large home range requirements, such as the grizzly bear (*Ursus chelan*), black bear (*Euarctos americanus*), gray wolf (*Canis lupus*), and cougar (*Felis concolor*). Other mammals found throughout the basin included Roosevelt elk (*Cervus elaphus*), black-tailed deer (*Odocoileus hemionus columbianus*), beaver (*Castor canadensis*), California wolverine (*Gulo gulo*), Townsend’s bat (*Corynorhinus townsendii*) and small mammals such as Townsend chipmunk (*Eutamias townsendi*), martin (*Martes americana*), chickaree (*Tamiasciurus douglasi*), redback voles (*Clethrionomys gapperi*) and deer mice (*Peromyscus maniculatus*). Beaver played a very large role in creating complex systems of pools and wetlands in the smaller tributaries and back channels.

Avifauna historically associated with the Basin’s forest stands included bald eagles (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), spotted owls (*Strix occidentalis*), marbled murrelets (*Brachyramphus marmoratus*), and other species of passerine birds and raptors. The marshlands and eelgrass beds of the Stillaguamish estuary supported a great variety of shorebirds and waterfowl. The estuary is on the Pacific flyway and provided important resting and feeding habitat for migratory birds such as black brant (*Branta nigricans*) and harlequin duck (*Histrionicus histrionicus*). It also provided overwintering habitat for northern migrant species such as snow geese (*Chen hyperborea*) and tundra swan (*Cygnus columbianus*). In addition, the mild winters allowed for large resident populations of some species to stay in and around the estuary all year. Resident species included the great blue heron (*Ardea herodias*), pintail duck (*Anas acuta*) and gadwall (*Anas strepera*).

Common furbearers, usually associated with the riparian areas, were mink (*Mustela vison*), muskrat (*Ondatra zibethica*), weasels (*Mustela* spp.), raccoon (*Procyon lotor*), and snowshoe hare (*Lepus americanus*). Several amphibian species occurred in the basin, including Cascade frogs (*Rana cascadae*) and red-legged frogs (*R. aurora*). Historic marine mammal usage in the Port Susan estuary probably included sea otter (*Enhydra lutris*), California sea lion (*Zalophus californianus*), harbor seals (*Phoca vitulina*), porpoises (*Phocoena phocoena, Phocoenoides dalli*), and orcas (*Orcinus orca*).

Several wildlife species are no longer present within the Stillaguamish Basin, or their populations are so low that they have been listed under the Endangered Species Act. However, species that are more commonly in edge (or early seral) habitats are now more abundant. Species that have been eliminated are the gray wolf, grizzly bear, and sea otter. All are top of the food change predators, and were subject to hunting or active eradication efforts. Species whose populations have been diminished include the spotted owl, marbled murrelet, martin, California wolverine, Townsend's bat and beaver. Many of these species require a large home range and are typically associated with large patches of mature forests. In general, much of the species diversity associated with the historic conditions in the basin remain; what has changed over time is the abundance and distribution of these species.

There are several reasons for changes in distribution and abundance of wildlife in the Stillaguamish Basin. The fragmentation of forests from over a century of logging has resulted in fewer habitats available to forest-dependent species. It also has greatly reduced habitat connectivity, which is crucial for many species. Connectivity of habitat allows species to migrate seasonally, disperses individuals, and allows the overlap of territories of potential breeding pairs of ranging animals. In addition, smaller forest patches have different microclimate conditions, less ability to buffer weather extremes, and a greater amount of edge. Increased edge reduces interior habitat available for species associated with late-successional and old-growth forests. As fragmentation increases, the species associated with late-successional forest decline (U.S. Fish and Wildlife Service 1995).

Loss of wetlands throughout the basin has reduced the available habitat for waterfowl and shorebirds, with a resultant drop in populations. Logging, agricultural practices and rural-urban development has fragmented riparian zones in much of the Stillaguamish basin. This fragmentation has diminished the value of riparian zones as travel corridors for wide-ranging species. As beaver have been actively trapped and eradicated during the last 70 years, their role in wetland augmentation and creation of off-channel rearing habitat for salmon has been greatly curtailed. The under-appreciated function that beaver provide in habitat forming processes within landscape are just now beginning to be understood (Pollock and Pess 1998).

2.3 Threatened and Endangered Species

The types of habitat degradation discussed above have led to population declines of numerous fish and wildlife species. Several species under the jurisdiction of the Federal

Endangered Species Act potentially occur in the Stillaguamish Basin. Based upon correspondences with U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), Table 2 was compiled to list the species of concern in the Stillaguamish River Basin.

Table 2. Endangered, Threatened, and Candidate Species in Project Vicinities

Species	Listing Status	Projects	Agency with Jurisdiction
Chinook Salmon *Oncorhynchus tshawytscha*	Listed Threatened	All	NMFS
Bull Trout *Salvelinus confluentus*	Listed Threatened	All	USFWS
Bald Eagle *Haliaeetus leucocephalus*	Listed Threatened {proposed for de-listing in July 1999}	All	USFWS
Marbled Murrelet *Brachyramphus marmoratus*	Listed Threatened	Hazel Slide and Gold Basin Slide	USFWS
Northern Spotted Owl *Strix occidentalis*	Listed Threatened	Hazel Slide and Gold Basin Slide	USFWS
Coho Salmon *Oncorhynchus kisutch*	Candidate	All	NMFS

<u>Sources</u>: Species List Letter from USFWS dated 12/17/99 (Ref. #1-3-00-SP-0103 through 0111), and the National Marine Fisheries Service Northwest Region web site (*http://www.nwr.noaa.gov/1habcon/habweb/listnwr.htm)*

Below are brief descriptions of the life history requirements of these protected species. Projected impacts of the proposed projects on threatened and endangered species are addressed briefly in Sections 4.3 and 6.3, while a more in-depth review is being prepared in a separate Biological Evaluation for the USFWS and NMFS.

2.3.1. Chinook Salmon

The Puget Sound Evolutionarily Significant Unit (ESU) chinook salmon was listed as a threatened species under the Endangered Species Act of 1973, as amended (64 FR 16397), on March 24, 1999. The Stillaguamish Basin is included in this ESU.

Chinook adults migrate from the ocean into the freshwater streams and rivers of their birth to spawn and die. Within this general life history strategy, however, chinook display a broad array of tactics that include variation in age at seaward migration, variation in length of freshwater, estuarine, and oceanic residence, variation in ocean distribution and ocean migratory patterns, and variation in age and season of spawning migration. In an extensive review of the literature, Healey (1991) used differences in life history patterns to divide eastern Pacific chinook salmon into two broad races: "stream-type" and "ocean-type."

Like all other Puget Sound chinook, those observed in the Stillaguamish Basin are of the ocean-type race (NMFS 1998). Ocean-type chinook migrate to sea during their first year of life, normally within three months after emergence from spawning gravel. Growth and development to adulthood occurs primarily in estuarine and coastal waters (NMFS 1998). Ocean-type chinook return to their natal river in the fall, though actual adult run and spawning timing is in response to the local temperature and water flow regimes (Myers et al. 1998). After spawning, females remain on the redd from 4 to 26 days until they die or become too weak to hold in the current (Neilson and Banford 1983). During this period, females will vigorously defend the redd against the spawning activity of newly arriving fish. Duration of incubation varies, depending on location of redds, but is generally completed by the end of February. Young chinook reside in stream gravels for 2 to 3 weeks after hatching (Wydoski and Whitney 1979) before moving to lateral stream habitats (e.g., sloughs, side channels, and pools) for refugia and food during their migration downstream and out to Puget Sound. Peak emigration occurs from March to June.

Chinook have been have been highly valued by indigenous peoples since time immemorial, and commercially harvested since the mid-nineteenth century. Several anthropogenic factors have contributed to the decline of Puget Sound chinook stocks. Agricultural diking and the removal of large woody debris along with sources of its recruitment are most often implicated as the primary causes of habitat degradation in the Stillaguamish Basin (NMFS 1998, WDFW and Washington Treaty Tribes 1994).

Designated critical habitat for the Puget Sound ESU Chinook includes all marine, estuarine and river reaches accessible to the species in Puget Sound (NMFS 2000). Critical habitat consists of the water, substrate, and the adjacent riparian zone of accessible estuarine and riverine reaches. Excluded are areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 13,761 mi^2 of Washington.

2.3.2. Bull Trout

The Coastal/Puget Sound bull trout population segment was listed as a threatened species under the Endangered Species Act of 1973, as amended (64 FR 16397), in October 1999.

Bull trout is a western North American char in the family Salmonidae. Bull trout populations have declined through much of the species' range; some local populations are extinct, and many other stocks are isolated and may be at risk (Rieman and McIntyre 1993). Bull trout characteristically occupy high quality habitat, often in the less disturbed portions of a drainage. Necessary key habitat features include channel stability, clean spawning substrate, abundant and complex cover, cold temperatures, and lack of barriers inhibiting movement/habitat connectivity (Reiman and McIntyre, 1993). A combination of factors including habitat degradation, expansion of non-native species, and over-harvest are thought to have contributed to the decline and fragmentation of indigenous bull trout populations.

Bull trout are known to exhibit four types of life history strategies. The three freshwater forms are: (1) adfluvial, which migrate between lakes and streams, (2) fluvial, which migrate within river systems, and (3) resident, which are non-migratory. The fourth strategy, anadromy, occurs when the fish spawn in fresh water after rearing for some portion of their life in the ocean.

Bull trout spawn during the fall, potentially from late August to mid-November. Initiation of breeding appears to be related to declining water temperatures. In Washington, Wydoski and Whitney (1979) reported spawning activity was most intense at 5 to 6^{o}C. Spawning occurs primarily at night. Groundwater influence and proximity to cover are reported as important factors in spawning site selection. The period from egg deposition to emergence from the gravel may take as long as 220+ days; development is temperature dependent. Juvenile bull trout, particularly young of year, have very specific habitat requirements. Small bull trout are primarily bottom-dwellers, occupying positions above, on, or below the stream bottom. Bull trout fry are found in shallow, slow backwater side channels or eddies. Migratory bull trout rear in tributary streams for several years before migrating downstream into a larger river or lake to mature (Rieman and McIntyre 1993). The adult bull trout, like its young, is a bottom dweller, showing preference for deep pools of cold water rivers, lakes and reservoirs (Moyle 1976).

2.3.3. Coho Salmon

The Puget Sound/Strait of Georgia ESU coho salmon was declared a candidate species under the Endangered Species Act of 1973, as amended (64 FR 16397), in July 1995. The Stillaguamish Basin is located in this ESU.

The life history and habitat requirements of coho are similar to chinook, except that coho typically spawn in shallow tributary streams and usually spend more time rearing in fresh water. After 1 or 2 years in ocean waters, adult coho return to their parent rivers beginning in August, and begin to spawn in late October. Coho larvae spend 2 to 3 weeks absorbing the yolk sac in the gravels of the redd before they emerge. Juvenile coho salmon then rear in freshwater for approximately 15 to 18 months prior to migrating downstream to the ocean. Newly emergent fry usually congregate in schools in pools of their natal stream. As coho grow they move into riffle habitat and aggressively defend their territory, resulting in the displacement of excess juveniles downstream to less favorable habitat (Wydoski and Whitney 1979). This aggressive behavior may be an important factor maintaining the numbers of juveniles within the carrying capacity of the stream, and distributing juveniles more widely downstream. As territories are established, individuals rear in selected areas of the stream and feed on drifting benthic organisms and terrestrial insects. Territories expand as juveniles grow. Feeding and growth slow considerably in the fall and winter, as food production and fish metabolisms slow. Outmigration timings are quite variable, but peak outmigration of coho smolts typically occurs between late April and late May. Juveniles generally spend two years in the ocean before beginning their spawning migration back to natal streams. Some precocious males, called “jacks,” return to spawn after only 6 months at sea.

2.3.4. Bald Eagle

The Washington State bald eagle population was listed as threatened under the Endangered Species Act of 1973, as amended (64 FR 16397), in February 1978. Since DDT was banned in 1972, bald eagle populations have rebounded. The bald eagle was proposed for de-listing in July 1999.

The bald eagle is found only in North America and ranges over much of the continent, from the northern reaches of Alaska and Canada to northern Mexico. Bald eagles in Washington State are most commonly found along lakes, rivers, marshes, or other wetland areas west of the Cascades, with an occasional occurrence along major rivers in eastern Washington.

The bald eagle wintering season extends from October 31 through March 31. Food is recognized as the essential habitat requirement affecting winter numbers and distribution of bald eagles. Other wintering habitat considerations are communal night roosts and perches. Generally large, tall, and decadent stands of trees on slopes with northerly exposures are used for roosting; eagles tend to roost in older trees with broken crowns and open branching (WDFW 1998a). Bald eagles select perches on the basis of exposure, and proximity to food sources. Trees are preferred over other types of perches, which may include pilings, fence posts, powerline poles, the ground, rock outcrops, and logs (Steenhof 1978).

Bald eagles nest between early January and mid-August. The characteristic features of bald eagle breeding habitat are nest sites, perch trees, and available prey. Bald eagles primarily nest in uneven-aged, multi-storied stands with old-growth components. Factors such as tree height, diameter, tree species, position on the surrounding topography, distance from water, and distance from disturbance also influence nest selection. Bald eagles normally lay two to three eggs once a year, which hatch after about 35 days. Snags, trees with exposed lateral branches, or trees with dead tops are often present in nesting territories and are critical to eagle perching, movement to and from the nest, and as points of defense of their territory.

2.3.5. Marbled Murrelet

The marbled murrelet (*Brachyramphus marmoratus*) was listed as a threatened species under the Endangered Species Act of 1973, as amended (64 FR 16397), in October 1992. The subspecies occurring in North America ranges from Alaska’s Aleutian Archipelago to central California. Primary causes of population decline include the loss of nesting habitat, and direct mortality from gillnet fisheries and oil spills.

Marbled murrelets spend most of their lives in the marine environment, where they forage in areas 0.3 to 2 km from shore. Murrelets often aggregate near localized food sources, resulting in a clumped distribution. Prey species include herring, sand lance, anchovy, osmerids, seaperch, sardines, rockfish, capelin, smelt, as well as euphasiids, mysids, and gammarid amphipods. Marbled murrelets also aggregate, loaf, preen, and exihibit wing-stretching behaviors on the water.

Marbled murrelets nest in inland old-growth low-elevation coniferous forests with multi-layered canopies. Murrelets select large-diameter [>81cm diameter at breast height (dbh)] trees with horizontal branches of at least seven inches in diameter and heavy moss growth. Characteristic habitat attributes of nesting sites include the presence of nesting platforms (e.g., forked limbs, dwarf mistletoe infections, witches' brooms, deformities), adequate canopy cover over the nest, and close proximity (<84km) to the marine environment (Hamer and Nelson 1995a). These structures are typically found in old-growth and mature forests, but may be found in a variety of forest types including younger forests containing remnant large trees. General landscape conditions may influence the degree to which marbled murrelets nest in an area. In Washington, marbled murrelet detections increased when old-growth/mature forests comprised more than 30 percent of the landscape, and decreased when more than 25 percent of the landscape was clear-cuts and meadows (Hamer and Cummins 1990).

Of 95 murrelet nests in North America during 1995, nine were located in Washington. Nesting occurs over an extended period from late March to late September; however in Washington, murrelets generally nest between 26 May and 27 August (USFWS 1999). Marbled murrelets have been observed at some inland sites during all months of the year. Attendance at breeding sites during the non-breeding season may enhance pair bond maintenance, facilitate earlier breeding, or reinforce familiarity with flight paths to breeding sites (O'Donnell *et al.* 1995).

During the breeding period, the female marbled murrelet lays a single egg in a tree containing a suitable nesting platform. Both sexes incubate the egg in alternating 24-hour shifts for approximately 30 days, and the young fledge after 27 to 40 days. Chicks are fed at least once a day. Adults feeding young fly from marine feeding areas to nest sites at all times of the day, but most often at dusk and dawn (Nelson and Hamer 1995b). Before leaving the nest, the young molt into a distinctive juvenile plumage. A fledgling's first flight is from the nest directly to the marine environment (Hamer and Cummins 1990).

Critical habitat was designated for the marbled murrelet on May 24, 1996 (USFWS 1996). 32 critical habitat units in Washington, Oregon, and California, encompassing approximately 1,573,340 hectares of Federal and non-Federal lands, were designated at this time. Two primary constituent elements considered essential for successful reproduction were identified: (1) individual trees with potential nesting platforms, and (2) forested areas within 0.5 mile of individual trees with potential nesting platforms and a canopy height of at least one-half the site potential tree height. Within the boundaries of designated critical habitat, only those areas that contain one or both primary constituent elements are, by definition, critical habitat. Areas without either primary constituent element are excluded by definition.

2.3.6. Northern Spotted Owl

The northern spotted owl (*Strix occidentalis caurina*) was federally listed as a threatened species throughout its range on June 26, 1990. The primary reason for this listing was the reduction and fragmentation of habitat that was projected to continue under the forest practices utilized at the time of listing.

Three subspecies of Spotted owls occur in North America: the northern spotted owl, the California spotted owl (*S. o. occidentalis*), and the Mexican spotted owl (*S. o. lucida*). The current range of the northern spotted owl is from southwestern British Columbia, through western Washington, western Oregon, and northern California south to San Francisco Bay (USFWS 1990). In Washington, the northern spotted owl occurs on the Olympic Peninsula, in the western lowlands, and in the Cascades, generally below elevations of 1280m.

Spotted owls are primarily nocturnal perch-and-pounce predators, and thus they possess exceptional eyesight and hearing, as well as feathers modified to facilitate silent flight. Although spotted owls are nocturnal, during the day they forage opportunistically and may move short distances to change roosting position in response to changes in ambient temperature or exposure to direct sunlight. Spotted owls prey on a broad array of species, such as insects, birds, and small mammals; however, primary prey items are woodrats (*Neotoma fuscipes* and *N. cinerea*) and flying squirrels.

Habitat for the spotted owl can be divided into two basic categories: nesting, roosting and foraging (NRF habitat), and dispersal habitat. Spotted owl NRF habitat is characterized by: (1) a multilayered, multispecies canopy dominated by large [>76 cm diameter at breast height (dbh)] conifer overstory trees, and an understory of shade-tolerant conifers or hardwoods; (2) a moderate to high (60-80%) canopy closure with an understory that is open enough to allow spotted owls to fly within and beneath it; (3) substantial decadence in the form of large, live coniferous trees with deformities such as cavities, broken tops, and dwarf mistletoe (*Arceuthobium* spp.) infestations allowing formation of the contiguous habitat for nesting; and numerous large snags, and ground cover consisting of large accumulations of logs and other woody debris (Thomas et al. 1990).

The northern spotted owl nests in tree cavities, on debris platforms, and in the old nests of other large birds. Spotted owls normally lay one or two eggs, although three or four egg clutches are not uncommon. The female incubates the eggs for approximately 30 days. Once the eggs hatch the owlets are fed by their parents until they leave the nest 3 to 5 weeks after hatching. In Washington, nesting occurs between March 1 and July 31, and fledging occurs between August 1 and September 30 (USFWS 1999).

Dispersal of juvenile owls begins in the early fall. Usually juveniles move from their natal area to a breeding site, and occasionally adults move from one breeding site to another. Without successful dispersal, replacement of individuals that are lost from the breeding population through death or emigration will not occur, and the population will decline. Dispersing spotted owls have a greater chance of survival if forest conditions between designated areas are suitable for foraging and roosting. Thomas et al. (1990) defined a stand of timber capable of providing for dispersal has trees having a dbh of at least 28 cm and a canopy closure of more than 40%.

2.4 Cultural Resources

Cultural resources can be the tangible, physical remains of past human activity (e.g., archaeological sites, buildings, structures, districts, objects, and landscapes) or traditional cultural properties (TCPs) associated with the cultural practices or beliefs of a living community. The age of these resources in the greater project area ranges from thousands of years to recent times. The term historic properties refers to those tangible cultural resources that are eligible for listing on the National Register of Historic Places (NRHP) regardless of cultural affiliation or age, although the upper limit for classification as "historical" is generally at least 50 years old. Also eligible for listing on the NRHP, TCPs are rooted in the community's history and important in maintaining the community's cultural identity. Particularly important to tribal members are sacred landforms, ceremonial sites, rock art, cairns, certain animal and plant resources, and locations prominent in mythology and tribal history. Also, the treatment of cemeteries and isolated interments, regardless of cultural affiliation, must be addressed with respect and dignity.

Ecosystem Changes. The distribution of historic properties and TCPs within the Stillaguamish River Basin is the result of past environments and the prehistoric and historic use of the region's resources. The earliest inhabitants of the region were dependent on the abundance of plant and animals for survival and historic development was dependent on extractive industries like logging and mining. The availability and distribution of necessary food, plant, stone, and other resources structured the mobility and settlement of early groups as timber, ore, and fertile land influenced the economy and placement of Euroamerican immigrants. In addition, environmental conditions such as fluvial deposition, tectonic activity, and recent human impacts such as logging and construction have all affected the condition and delectability of remaining archaeological sites.

Two factors, changing climate and changing landscape, have had the greatest influence in determining where and how native people lived in the Stillaguamish River Basin for the last 12,000 years.

Climate. The climate and vegetation of the Puget Lowlands changed substantially during the late Pleistocene and early to middle Holocene. Since that time the climate has been relatively stable while vegetation has undergone major changes associated with historic disturbance. Based on pollen studies, it appears pioneer and early successional species such as lodgepole pine, bracken fern, and alder colonized the newly deglaciated landscape of western Washington 15,000 years ago, followed by Douglas fir. Between c. 10,000 and 6,000-5,000 years ago, summer temperatures were higher and precipitation rates lower, conditions which were marked by the expansion of prairies in the Puget Lowlands, northward spread of oak and hazel from the Willamette Valley, and increases of grasses, bracken fern, Douglas fir, and red alder. The abundance of Douglas fir and alder and higher densities of charcoal in sediments suggest that fire was a factor in maintaining the prairie and forest associations during this period. Cedar and hemlock began to increase after c. 7,000 years ago, becoming dominant in lowland western Washington by about 5,000 years ago. Prairies shrank and wetlands expanded at that time. These changes marked the onset of cooler, moister conditions and the development of closed climax forests. After 5,000 years ago, no major changes are evident in the pollen record until the historic period, when native vegetation was disrupted by land clearance. Douglas fir has remained a significant element of western Washington forests for these 5,000 years, probably due to continued periodic catastrophic fires, and the establishment of old growth cedar-hemlock forests has been cited as an important factor in the development of the Northwest Coast culture seen during the ethnographic period.

Landscape. The post-glacial adjustment of sea levels, tectonic instability, and the abruptly changed hydrology of the lower Stillaguamish River have important implications for site location and discovery. The end of the Pleistocene witnessed great fluctuations in relative sea level as world-wide warming contributed vast amounts of melt water to the seas and the newly exposed land rose as it cast off the weight of the glacial ice. Relative sea levels dropped several hundred feet below present levels, then rose more than 300 ft higher than current levels for a brief period between c. 12,500 and 11,000 years ago, and finally stabilized to today's levels about 5,000 years ago.

In addition to isostatic and eustatic sea level changes, other processes affected the Stillaguamish River Basin and bear on the distribution, integrity, and detectability of archaeological sites. During the early Holocene, rivers and streams cut valleys through the drift left behind by retreating glaciers and occupied outwash channels, depositing alluvium over outwash sediments. Colluvial sediments were deposited on valley slopes and floors and the Stillaguamish delta prograded, leaving former marine shorelines far inland. Formation of prominent volcanic peaks of the North Cascades also occurred during eruptions at the end of the Pleistocene. Glacier Peak tephras were redeposited in the basin by rivers draining its flanks (Miss and Campbell 1991). In addition, some topographic changes resulted from tectonic activity, which recent studies suggest has been fairly common in the Puget Lowlands. One earthquake occurred between 1,100 and 1,700 years ago along a fault extending from south Bainbridge Island to Lake Sammamish. This event caused rapid uplift south of the fault and subsidence to its north, landslides into lakes Washington and Sammamish, and a *tsunami* in Puget Sound. Sites may have been buried and, in the case of the marine shoreline that existed at the time of the event, recorded archaeological sites are known to have subsided below the current sea level during this earthquake. Historic changes, such as river diversions and channelization have also significantly affected the Stillaguamish River system and pre-existing cultural resources.

Miss and Campbell (1991) summarize the geologic changes and their implications for the archaeological record of the project area as follows:

> Most level areas in [Snohomish County], excluding the lowest river floodplains and terraces, consist of outwash plain or glacial till. They are post-glacial surfaces with little Holocene sediment accumulation. Archaeological sites on these landforms may be of any age and are not deeply buried.
>
> If humans were in the region during the brief marine transgression between 12,500 and 11,000 years ago, some of their activities may have been associated with shorelines higher than today's. [The 500 ft (150 m) contour of project area topographic maps provides an approximation of such a shoreline.] Old terraces may be found at the foot of the mountains and on the margins of a few prominent glacial till features.
>
> Marine shorelines dating from 5,000 to 9,000 years ago are presently submerged, probably eliminating a significant portion of the prehistoric record. Sites associated with the present shoreline are likely to be younger than 5,000 years. Older marine sites may be found along shorelines backed by steep glacial landforms formed by till and outwash. Marine terraces may also be found inland among the major river valleys where sea water preceded valley fill.

Alluvial accumulation in the Stillaguamish and Snohomish valley bottoms is extensive but the rate of progradation is unknown. Ages of sites in this setting should decrease toward the river mouth. Sites also have the potential to be deeply buried, and if waterlogged, to contain well preserved organic artifacts.

Prehistory. Use of the Stillaguamish River Basin by humans is believed to have occurred soon after the retreat of the Pleistocene glaciers around 12,000 years ago. The earliest regional evidence of human occupation consists of a small number of fluted Clovis or Clovis-like projectile points characteristic of the period between 12,000-11,000 years ago, and Olcott sites, thought to represent a period of occupation prior to development of marine-oriented Northwest cultures. The Olcott Site (45SN14), located on an old Stillaguamish terrace, serves as the type site for a basalt tool industry believed by some to date between 8,000 and 5,000 years ago. Olcott assemblages are characterized by tools manufactured from locally obtained cobbles, including large leaf-shaped and stemmed points, and cobble and flake tools. Features are rarely encountered at these sites and, due to poor preservation conditions, plant and animal remains have not been found. The interpretation of the Olcott Phase as representative of early settlement in western Washington is not universally accepted because researchers have yet to associate absolute dates (e.g., carbon-14 samples) with the Olcott assemblages. The early dates assigned to Olcott sites are based on their location on old landforms and the fact that Olcott-type artifacts have been dated at between 8,000 and 5,000 years ago when located in stratified sites near Canada's Fraser River. Some, however, have pointed out that Olcott-style artifacts have been located at datable younger sites and the assemblages may have a functional derivation and thus are not temporally distinctive.

Questions surround the Olcott sites in addition to chronological questions. Some have argued that early residents of the Puget Sound lowlands relied on a subsistence strategy based on terrestrial mammals (some now extinct) because salmon and shellfish were scarce before c. 5,000 years ago. Low productivity of these marine resources was likely due to instability of river regimes and intertidal zones associated with isostatic rebound and sea level rise. Sea level rise between 9,000 and 4,500 years ago, however, inundated coastal sites that contained additional information from this early period. Therefore, rather than being a manifestation of an independent big game hunting society, the so-called Olcott Phase may be no more than the upland component of a complex economic system that has had its marine-oriented portion "removed" from view by sea level rise. The Olcott Phase is an important area of further research that may be advanced by information held in the archaeological record of the Stillaguamish River Basin.

As the various environments evolved within the post-glacial Stillaguamish River Basin, its inhabitants adapted to the changes. Fishing, hunting, and plant gathering became more specialized as these groups gained experience in regional and seasonal resource exploitation. After about 5,000 years ago, larger populations organized in more complex ways exploited a wide range of locally available resources, including shellfish, salmon, small mammals, berries, roots, and bulbs. Shell middens are numerous on saltwater shorelines; the apparent lack of earlier shell midden sites is due to inundation of earlier shoreline sites by rising sea levels, which did not attain near-modern levels until c. 5,000 years ago. Ground stone, bone, antler, and shell tools, associated with fishing, marine mammal hunting, and plant processing, became increasingly more common and diversified. Emphasis on salmon exploitation grew over time as large-scale fishing, processing, and storage technologies were developed.

Evidence of a well-developed massive woodworking technology, cedar plank houses, and semi-permanent villages appears in the archaeological record by c. 3,500 years ago. Materials imported from east of the mountains to the project area for lithic tool manufacture evidence increased contact and trade with groups in eastern Washington. Resource specialization, increased population, improved food storage methods, and establishments of larger villages were all signs of a more sedentary lifestyle after approximately 2,500 years ago.

Full scale development of marine-oriented cultures on the coast and inland hunting, gathering, and riverine fishing traditions as represented in the ethnographic record is apparent after c. 2,500 years ago. A wide variety of ground and chipped stone and bone artifacts made of both local and imported materials occur, representing complex and diversified technologies for fishing and sea mammal hunting, processing, and storage. Large-scale woodworking and cedar plank houses occupied by a large semi-sedentary population are also well represented. Wood artifacts, including fishhooks, wedges, cordage, and basketry, have been recovered from sites exhibiting good preservation environments.

It is anticipated that the greater project area contains a variety of cultural resources ranging from prehistoric campsites, specialized resource procurement sites, village sites, and early historic period sites. Prehistoric site types may consist of inundated occupation areas (e.g., sites dating between 9,000 and 5,000 years ago), fishing sites (e.g., weirs), coastal shell middens, inland wet sites, lithic scatters, and rock shelters. In addition, TCPs and burials are located in the project area. Historic structures and/or historic archaeological sites occurring within the basin may be associated with early industry (e.g., timber or mining), homesteading, communication, transportation, and flood control

Ethnography and Ethnohistory. The historic period is marked by dramatic changes in native populations and community composition resulting from the introduction of epidemic diseases and Euroamerican goods and settlement. By the time most ethnographies were written in the late nineteenth and early twentieth centuries, these changes had already significantly altered native cultures. The introduction and transmission of smallpox and other epidemic diseases, which infected some Native American groups before direct contact with Euroamericans, resulted in a minimum estimated loss of over two-thirds of the Native American population on the southern Northwest coast in the first century after contact. The introduction of Euroamerican guns, iron, blankets, foods, and livestock, which began with the fur trade, also altered native economies.

Among the groups in and immediately surrounding the Stillaguamish River Basin, there were close similarities in languages (Salish), political organization, lifestyle, and religious beliefs. Kinship ties, shared subsistence areas, dynamic trade networks, and topographic continuity linked groups, provided the basis for sustained relationships, and generally blurred the political boundaries that were later delineated by whites. Accordingly, ethnographers differ somewhat in their interpretation of limited early information from the area and a degree of uncertainty exists as to territorial boundaries within the project area (Baenen 1981). According to some early ethnographers (Gibbs 1877) and later researchers, the mouth and estuary area of the lower Stillaguamish River were not occupied by ancestors of the Stillaguamish Tribe. Rather, the *Stoluck-wha-mish*, or 'River People', occupied the Arlington area and upriver (primarily on the North Fork) where the Kwa'dsakbiuk (Quadsak), a subgroup affiliated with what would later become the Swinomish Tribe, occupied the mouth (Swanton 1952). According to Bruseth (1949), he "had several times visited the ancient camp site on the Leque place near Stanwood, Tsalbilts home---Quadsak headquarters; seen the enormous pile of old clam shells." This site is probably archaeological site 45SN1 on Leque Peninsula. Others interpret the available information and conclude that the mouth was seasonally occupied by the Stillaguamish (Tweddell 1953) while still others flatly state that permanent Stillaguamish villages existed at or near around Stanwood and Hat Slough (Bryan 1955; Dorsey 1927). For the purposes of this report, and because it seems likely that the Stillaguamish occupied the estuary area at least on a seasonal basis (possibly in common use with other groups), the Stillaguamish territory is considered to encompass the entire project area.

Many details recorded about other tribes by anthropologists near the turn of the century, such as village sites, are lacking for the Stillaguamish because they were not well studied prior to Indian Claims Commission litigation in the 1950s. On the other hand, according to Lane (1975), "Because many of the Stillaguamish remained on the ancestral lands and continued their traditional modes of getting a living, local and traditional knowledge was retained to a greater degree than would have been the case among descendents raised on a reservation in the territory of another people." It is known that the North Fork was the location for most villages, although people probably used the South Fork for hunting; archeologists have found evidence of a fish site below Granite Falls (Miss and Campbell, 1991). Like other Northwest Coast groups, the Stillaguamish River Basin people spent winters in permanent villages consisting of from one to several large cedar plank houses, each of which typically housed several families. The villages were located on rivers at tributary confluences, on lakes, and on sheltered shorelines (Bruseth 1949; Dorsey 1927). During the spring, summer, and fall, the village occupants split up into smaller groups and moved to seasonal camps and resource locations to fish, hunt, and collect a variety of resources as they became available. Temporary wood frame and mat shelters were commonly used at these seasonal occupation sites. Although overland trails supplemented travel between villages, camps, and resource locations, the river and its tributaries provided efficient transportation routes through the densely forested territory. Early accounts noted the skill with which the Stillaguamish poled dugout canoes upriver and shot rapids on the return trip (Lane 1975).

Salmon was the most important element of the subsistence economy, but the Stillaguamish exploited a wide variety of fish, shellfish, roots, bulbs and berries, and mammals for use or trade (Nelson 1994). The Stillaguamish constructed fish weirs at various places in the rivers to create a barrier and trapped, speared, or netted the fish as they returned to spawning streams. According to James Dorsey (Quil-Que-Kadam), a tribal member who was born around 1850 and lived his entire life on the Stillaguamish River, fish traps were located at most of the occupation sites along the river (Dorsey 1927). Marshy shores, meadows, and prairies provided habitat for large and small game and contained edible roots, bulbs, and berries. Many of the prairies in the Puget Lowlands noted by early settlers and shown on old maps, including some in the Stillaguamish River Valley, were likely created and maintained by burning. Prehistoric and historic tribal land use within the basin included cultivation of native plants such as wild onion, Indian carrot, wapato, and possibly camas at Kent Prairie near Arlington. The Stillaguamish, along with other tribes in the Puget Sound region, also cultivated potatoes after they were introduced by the Hudson's Bay Company and before the arrival of most white settlers (Lane 1975). The Stillaguamish people also gathered edible roots at Sauk Prairies in the Territory of the Sauk-Suiattle Indians.

Although early explorers estimated the locations of several villages in Stillaguamish territory, the most complete and accurate inventory of occupation sites within the general project area comes from James Dorsey's affidavit submitted to the Indian Claims Commission in 1927. According to Dorsey, a large village was located south of Stanwood on present day Leque Peninsula (45SN1); two more on either side of the river near Florence; one between Florence and Silvana; another south of the delta at Warm

Beach; another on Hat Slough; another at confluence of the North and South Forks at Arlington; other near Oso and Hazel; and Dorsey recalled a large hunting and processing camp at Mt. Higgins. Some of the sites were meeting places shared by neighboring groups who came to trade or exploit nearby resources. Dorsey also stated that some cemeteries were associated with village sites, while other burial grounds and individual plots stood alone. Most of these interments had been desecrated by white settlers by the time of Dorsey's affidavit (Dorsey 1927). The following passage from Alice Essex's *The Stanwood Story* (1971) is indicative of the settler's attitudes toward the remains of the native peoples.

Another pioneer tale says Charles Mann discovered an Indian cemetery while exploring the woods near his store at Fir. Hundreds of Indian remains were found hanging in the trees, some only skeletons. Owls and crows were circling around and upon receiving word of this discovery, the settlers rushed into the woods and set fire to the ghastly scene.

The Tulalip Tribes are the successors in interest to the Skykomish, Snohomish, Sauk-Suiattle tribes, and other signatory tribes to the Treaty of Point Elliott. Close tribal ties may have led Territorial Governor Stevens to consider the signature of Pat-Kanim (Chief of the Snoqualmie, Snohomish ,and other tribes) to be adequate representation for the Stillaguamish (Hollenbeck, 1987). The Federal Government eventually assigned the Stillaguamish people to the Tulalip Reservation but few people actually relocated permanently to the reservation. Many of the Stillaguamish people and their descendants continue to live within the Stillaguamish River basin (Hollenbeck, 1987).

The Stillaguamish Tribe gained federal recognition in 1976. Since then, the tribe acquired nearly 100 acres of land within the Stillaguamish basin. The Stillaguamish Tribe has a current population of approximately 200 members. Fishing, hunting, gathering of native plant material, and access to the river, wetlands, and forests of the basin provide essential economic and spiritual sustenance to the Tulalip and Stillaguamish people.

History. The last 150 years of Euro-American settlement and development in the Stillaguamish River basin has fundamentally shaped the conditions found today within the basin. The initial Euro-American settlement and subsequent development of the basin was integrally related to logging, mining, railroad construction, and agriculture. The purpose of this section is to discuss the development history of the basin after Euroamerican settlement.

Fur trading expeditions of the British first brought frontiersmen and traders through the Stillaguamish River Valley as the Hudson's Bay Company expanded its network of posts in the Columbia region. Euroamerican settlement of the Stillaguamish began in the late 1840s and 1850s. The Donation Land Act of 1850 entitled every single white male to a quarter section (160 acres) if they resided upon and cultivated the quarter section for four consecutive years. If married, the individual could receive half of a section (320 acres). By 1853, Donation land claims had been filed in Seattle, along the Duwamish, Stillaguamish, and White rivers. By 1855, there were 1,018 land claims in widely scattered locations in Washington. In addition, the 1855 Treaties of Medicine Creek and Point Elliott called for the resident Indians to cede their traditionally occupied lands in exchange for reserved lands. This opened up many thousands of acres to Euroamerican settlement, which occurred fairly rapidly. More settlers arrived with the opening of the rail-lines across the Cascades (late 1880s and early 1900s). A pattern of settlement similar to all western Washington basins also occurred on the Stillaguamish (Hollenbeck, 1987).

Loggers first established camps around Stanwood (then known as Centerville) in the 1860s. The primary purpose of the camps was to supply the California boomtowns of the 1849 gold rush. People built sawmills all along the coastlines of Puget Sound to process the abundant timber that blanketed the entire region. The logging industry began to move eastward as lowland timber disappeared. There were virtually no roads so loggers floated most of the timber down the Stillaguamish River to Stanwood and its mills. Eventually the timber interests built roadways and established railroad connections. This included a branch line of the Great Northern Railway up the River from Arlington that hauled timber from the upper Stillaguamish and Sauk River basins. Logging continued to increase during both world wars because of the high demand for timber. As technologies changed, timber removal became more efficient and operators were able to reach even the most remote locations. Trucks became more important than railroads for transporting timber in the 1930s that also opened up logging in more areas (Hollenbeck, 1987).

In the early 1870s, settlers constructed the first sea-dikes on the estuary near the present City of Stanwood. This converted some 800 acres of tidelands to agricultural fields. By the 1886, most of the estuary had been diked and drained (Bortleson, et al., 1980). Flood control opened the way for industrial, commercial, and residential development.

Mining was an important industry within the basin, especially around the turn of the century. The first mining locations were near the town of Silverton on the South Fork (established in 1892). Miners also formed a community at Monte Christo near Barlow Pass, above the headwaters of the South Fork. A severe flood on the River in 1898 damaged the railroads and caused the mines to close. Fear of starvation during the coming winter caused the residents to move down towards Granite Falls and abandoned the town site. After the 1920s, mining operations eventually died out or the companies scaled back to minimal operations due to the low quantity of gold and falling prices for other minerals (Hollenbeck, 1987).

Previous Cultural Resources Work. According to Miss and Campbell (1991), archaeological work in Snohomish County can be grouped into three periods with are distinguished by geographic and theoretical focus. The first archaeological investigation in the county, and the project area specifically, was conducted on coastal and riverine shell middens by Harlan I. Smith of the American Museum of Natural History. In 1899, Smith interviewed local collectors, recorded “shell-heaps” along the lower Stillaguamish reach and north of Stanwood and conducted excavations at some of them, and recovered artifacts for the museum’s collections. Between the 1940s and 1970s, various schools conducted surveys for academic research around Puget Sound. Concentrating on easily identifiable shoreline middens, these surveys often focused on ethnographically recorded village sites (Miss and Campbell 1991). Researchers recorded some of the sites originally visited by Harlan Smith around Stanwood and the lower Stillaguamish. During this time, the lithic assemblage discovered by Leo Olcott on an old glacial outwash terrace (45SN14) generated much interest in the “Olcott” or “Old Cordilleran” complex described by Butler (1960). This prompted professional and amateur surveys to locate more Olcott-type sites throughout the Puget Sound region and the list of sites recorded in the early 1960s, especially in Snohomish County, reflects this bias. Since the 1970s and the implementation of federal historic preservation mandates, professional archaeologists have conducted numerous, but limited, project-related cultural resources assessments in Snohomish County. The vast majority of these were small project and covered specific APEs outside the current project area. Although no systematic cultural resources survey has been conducted in the project area, Northwest Archaeological Associates, Inc. (NWAA) undertook an overview of prehistoric cultural resources within Snohomish County and attempted to relocate 98 previously recorded prehistoric sites (Miss and Campbell 1991). Unfortunately, two-thirds of the sites could not be relocated. In the current project area, NWAA personnel attempted to revisit 45SN1 (Harlan Smith’s Shell-heap #1 and the village site noted by Dorsey and Bruseth) on Leque Peninsula south of Stanwood but were refused access by the land owner. The NWAA team also visited and re-recorded badly disturbed 45SN2 (Smith’s Shell-heap #2) and relatively intact midden 45SN3, both north of Stanwood (Stenholm 1991a); 45SN308 near the confluence of Pilchuck Creek and the Stillaguamish (Campbell 1991); 45SN65 north of the river east of Arlington (Stenholm 1991b); 45SN33, a potential Olcott site east of the Stillaguamish and Jim Creek confluence; and 45SN63, east of Arlington. Due to their focus on prehistoric sites, Chris and Campbell did not examine historic sites associated with the Hempel Creek homesite, sawmill and log flume, and Gold Basin town site around Gold Basin Campground. Because landslide consolidation is being considered across the river from the campground, these are the closest recorded sites to any of the proposed non-levee restoration areas.

2.5 Socio-Economic Resources

2.5.1. Land and Shoreline Use

Please refer to Figure 4 for a land use/vegetation map of the Stillaguamish Basin. Land along the mainstem and tributaries below Arlington is primarily in agricultural production or urban development. In the larger population centers, industrial, commercial, and residential land uses are common. The majority of this land is privately owned. However, timber production can also be important in the larger tributaries (such as Pilchuck Creek).

Most land along the South Fork and its tributaries, from Granite Falls to Arlington, is also privately owned. This area is primarily agricultural, with a growing rural ‘hobby-farm’ population. The largest exception is the Jim Creek tributary which is almost entirely within the Naval Reserve Station. On the South Fork above Granite Falls, timber production is the most prevalent land use. The majority of the area is within the Mt. Baker-Snoqualmie National Forest, which is in U.S. Forest Service ownership. The remainder of the upper South Fork basin is in large land holdings by timber companies or small private holdings.

The land along the North Fork mainstem and many of its tributaries is primarily in private ownership, although some State-owned lands are present. Agriculture is the dominant land use along the mainstem, while timber production by large land-holding companies is prevalent along the tributaries. The upper reaches of the North Fork and its major tributaries are within the boundaries of the Mt. Baker-Snoqualmie National Forest.

2.5.2. Recreation

The major recreational areas within the Stillaguamish watershed are concentrated in the upland forested areas or along the River. Snohomish County, local municipalities, and state/federal agencies are currently involved in improving a trail system along the Stillaguamish River. Existing facilities include numerous municipal parks, golf courses, and picnic facilities near the Stillaguamish River. Considerable water recreation occurs in the river during the summer months, while fishing occurs year around. Many portions of the Basin are in the Mt. Baker-Snoqualmie National Forest, which contains several campgrounds and trail heads. Much of the Basin's recreation is centered around the town of Darrington, where the mountain loop highway provides access to hikers, berry pickers and the occasional gold miner.

2.5.3. Population

Most of the Stillaguamish Basin's current population lives in or around the Cities of Arlington (at the Forks), Granite Falls (on the South Fork), and Stanwood (at the mouth). Although there is some suburban encroachment, most of the area remains in agricultural or timber production. Agricultural areas are located along the valley bottoms of the tributaries, the Forks, and mainstem. Timber production occurs in the eastern portions of the basin and along the upper tributaries. The number of hobby farms is also increasing along the South Fork, west of Granite Falls. In 1995, the population of was estimated at 90,000, and was expected to grow by about 2% a year.

2.5.4. Public Service and Utilities

The Basin has a well-developed infrastructure with a compliment of police, fire, hospitals and emergency medical services associated with the major population centers. Public schools are distributed throughout the basin as well. Wastewater treatment facilities can be found in Stanwood, Arlington, Granite Falls and Darrington, the rest of the Basin is typically on septic systems. Potable water is available from a variety of providers including public utility districts, water districts, community water associations and individual wells. Electricity is also available from a few different providers including local utility districts and larger power companies.

2.6 Hazardous and Toxic Wastes

Land surrounding the Stillaguamish river and its tributaries is used for major agricultural activities. All agricultural areas are suspect for herbicide, pesticide, and insecticide contamination of soil and water. Because of the long agricultural history of the area of interest, the presence of background concentrations of these contaminants and their degradation products is likely.

A preliminary site-specific evaluation of potential hazardous waste issues for proposed restoration activities can be found in Section 6.6 of this document.

3. ALTERNATIVES

3.1 Overview

In this section of the EA, we examine the types of approaches the Corps could use to restore habitat in the project area. Then we will compare and contrast the different alternatives, describing the environmental consequences of these various restoration approaches (Section 4.). This evaluation will identify the best way to proceed with choosing specific restoration projects. We will then identify a range of project types that would occur under the preferred alternative and describe how individual projects were selected (Section 5.). The last step is to evaluate the environmental consequences of the specific projects (Section 6.).

Three major alternatives on how to approach habitat restoration in the Stillaguamish River Basin were identified for analysis in this EA through the planning process. They are:

Alternative 1 - no action
Alternative 2 - the multi-species (i.e., fish and wildlife) approach
Alternative 3 - the single threatened fish species approach.

3.2 Alternative 1: No Action

The No Action Alternative would consist of the continuation of a variety of restoration activities under existing regulations and tribal, agency, and non-governmental organization restoration programs. Current independent management of the river basin by various agencies would continue, implementing activities under existing policies.

The goals of this alternative are to continue the implementation of project-by-project restoration activities through the current agency-based programs. The goals and objectives for restoration would be tied to those defined for each separate agency program rather than to the overarching goals of the watershed-based program. Additionally, under No Action, the geographic focus and how the restorations will be implemented will also be tied to the individual programs.

The No Action Alternative assumes that efforts to improve habitat conditions throughout the Stillaguamish River Basin would continue, but as a fragmented, noncohesive program with limited funding opportunities. Restorations that do occur would most likely be as a part of single-jurisdiction actions based on location and funding opportunities rather than comprehensive resource need. Restoration aspects of No Action could include continued project-by-project restorations that would incrementally reduce barriers to fish passage, connect potential habitat and potential major spawning and rearing areas with the mainstem river, increase estuarine habitat, and increase streamside vegetation.

The geographic focus of this alternative would continue to be scattered throughout the Basin, in much the same way as past projects.

This alternative would be implemented through the current ongoing agency/sponsor programs, funding sources and jurisdictions. Examples of current restoration programs include the Washington Department of Fish and Wildlife SHEER program (an inventory of anadromous fish blockages on streams within the state of Washington), restorations occurring as a part of the local Conservation District, the Tribes and programs initiated by Snohomish County.

Monitoring of restorations and restoration success would continue to be fragmented or non-existent because there is no mechanism to evaluate project successes, shortcomings, limitations, and contribution to ecosystem improvement.

The project evaluation criteria (i.e., rationale for selecting the locations and types of restorations) would be based on the wide range of factors currently used by the various agencies and groups involved in restoration in the Basin. These evaluation criteria include such factors as available funding and manpower, site availability, site access, and ease of accomplishing the restoration.

3.3 Alternative 2: Multi-Species Approach (Preferred Alternative)

The Preferred Alternative would be a program to restore ecological resources and processes that would benefit multiple fish, riparian and riverine-associated wildlife species. This alternative would focus on implementing a balance of activities that would not be at the expense of maintaining or improving successful populations of other species. This approach assumes restoration of larger areas of aquatic environment and riparian corridors, and providing connections to existing productive habitat that might otherwise not occur under the No Action Alternative. The emphasis of this alternative is ecosystem based and focuses on maintaining or restoring watershed processes that salmonid species are dependent upon. Implementing this approach would result in improved habitats for a group of species, thereby resulting in improved populations of other species as part of a balanced natural ecosystem.

The objective of this alternative is to restore critical landscape processes, functions and structures to a more natural condition in order to support native anadromous salmonids, while providing some wildlife benefits.

Under this alternative, the geographic focus will be at the watershed level (this includes the mainstem, north and south forks and major tributaries), with the intent to manage restoration based on the total resource need rather than through individual programs as would be the case under the No Action Alternative.

Examples of activities that might be conducted as part of Alternative 2 could include:

- Reducing barriers to fish passage – for example, construction of a new fish ladder at the Stillaguamish weir that would facilitate upstream fish passage during low river flows.

- Improving estuarine habitat – intertidal habitat could be increased by removing or breaching levees and allowing tidal inundation into areas that were formally blocked. A variety of species could use these habitats for rearing.

- Reconnecting former river meanders back to the mainstem to provide off-channel-rearing habitat.

- Moving the river away from on-going landslides.

- Increasing streamside vegetation - through planting along tributaries, especially the Portage Creek area.

This alternative would be implemented through the Stillaguamish Ecosystem Restoration Program administered jointly by the Corps of Engineers and Snohomish County. Snohomish County would be the local sponsor for various Corps projects. Candidate projects would be identified and evaluated by a panel of biologists and other technical staff using evaluation criteria (i.e., an objective rationale for selecting the locations and types of restorations). All projects would also be subject to an incremental cost analysis to provide the economic justification for the proposed project. The timing of construction of projects under this alternative would occur over a ten-year period. This alternative would rely upon willing landowners; real estate actions would be accomplished through easements and fee simple purchase. Under this alternative, monitoring of restorations and restoration success would be accomplished from a watershed (ecosystem) approach, utilizing the monitoring protocol and GIS database program developed as a part of the Reconnaissance Study.

3.4 Alternative 3: Single-Species Restoration

This alternative focuses on restoring fish habitat to benefit a single species—ESA-listed chinook salmon or bull trout, for example—rather than a multi-species restoration approach.

Over the past several decades, effort has been focused on improving specific plant and animal species populations and habitats under the Endangered Species Act (ESA). Recovery plans have been developed and implemented for such ESA-listed species such as the bald eagle, grizzly bear, northern spotted owl, and marbled murrelet. In March 1999, NMFS listed the chinook salmon as threatened. As a result, programs are currently underway to address the restoration of the species under ESA. This species would likely be the one selected as the target species for a Federal restoration program.

The single-species alternative is not meant to comply with all legal implications associated with recovery under the ESA, but rather address the actions that could be accomplished under a voluntary restoration effort focusing on habitat improvements that benefit chinook salmon. The program would not address all of the chinook recovery needs but would make a significant improvement over current conditions.

The goals of this alternative are to implement capital improvement projects that would assist in increasing chinook populations in the Stillaguamish Basin in a manner consistent with regulatory requirements. These capital improvements would focus on improving life cycle requirements for the salmon within the Stillaguamish River Watershed and Port Susan Estuary. Restoration activities would be designed to increase the critical spawning and rearing habitat for and the number and/or distribution of chinook salmon.

Under this alternative, resource information on Stillaguamish River chinook salmon (historic condition, current distribution and population, life history, habitat needs and population genetics) would continue to be gathered to further improve the restoration projects.

This alternative would be implemented through the Stillaguamish River Ecosystem Restoration Program administered jointly by the Corps of Engineers and Snohomish County. Snohomish County would be the local sponsor for various Corps projects. The public, local, state, federal and tribal groups would be solicited to identify potential projects. A technical committee would use the project selection criteria to evaluate projects submitted by the various agencies and groups. After evaluation and ranking of projects, a feasibility analysis of the top-rated projects would be conducted. The feasibility analysis would include design, cost, permitting, access, and land purchase factors. All projects would also have to go through an incremental cost analysis to provide the economic justification for the proposed project.

Under this alternative, the geographic focus will be at the north and south forks, the lower mainstem and Port Susan, with the intent to manage restoration based on the total resource need rather than through individual programs as would be the case under the No Action Alternative.

Examples of activities that might be conducted as part of Alternative 3 could include:

- Constructing artificial spawning channels by excavating new channels at various places along the north and south forks.
- Construction of hatcheries for chinook salmon.
- Levee removal and construction intertidal sloughs in Port Susan Bay.
- Construction of off-channel rearing areas for chinook smolts along the mainstem.

Under this alternative, monitoring of restorations and restoration success would be accomplished from a watershed (ecosystem) approach, and utilizing the monitoring protocol and GIS database program developed as a part of the Reconnaissance Study. The monitoring plan would be based on the program goals and objectives, chinook use at the project sites, overall chinook population trends in the Stillaguamish Basin, and measurable improvements to chinook habitat components at the project sites. The timing of construction of projects under this alternative would occur over a ten-year period.

This alternative also relies upon willing landowners; real estate actions would be accomplished through easements and fee simple purchase.

3.5 Alternatives Considered but Eliminated from Detailed Study

The Corps and Snohomish County considered evaluating one other alternative—return to historic conditions—in this EA. This alternative was eliminated from detailed evaluation because it was not considered to be politically, socially, or economically feasible. The intent of the Historic Conditions Alternative would be to restore the basin as closely as possible to its original condition, as described in the study area history of the basin in Section 2. This alternative would have included, individually or in combination, the following components, several of which would be necessary to approach re-establishing historic conditions:

- Completely remove the existing dike system that fronts Port Susan Bay to restore tidal inundation to historic estuarine marsh habitat.

- Remove the Stillaguamish weir to restore historic water distribution in the lower river.

- Completely remove revetments along the lower mainstem to restore back channels, wetlands, and the floodplain.

None of these components are evaluated in this EA.

Whichever restoration approach is pursued, the resultant projects will have to go through an incremental cost analysis as part of the Corps feasibility process.

4. ENVIRONMENTAL CONSEQUENCES OF THE VARIOUS APPROACHES TO HABITAT RESTORATION

In this section the different approaches to restoration presented in Section 3 will be evaluated for their environmental consequences. These different approaches will be compared and contrasted to determine which method would produce the most positive environmental effects while minimizing adverse impacts.

4.1 Physical Characteristics

One of the intents of restoration activities for the Stillaguamish system is to change the existing channel and bank characteristics to be more representative of natural conditions. Soils and stream morphology, both dynamic conditions in riverine systems, would be modified along the River as a result of these changes. These modifications would occur for all alternatives including No Action.

4.1.1. Geology

Under all alternatives, short-term impacts to soils resulting from the proposed restoration activities would occur from construction. Construction impacts would result from the movement and use of construction equipment at the restoration sites. The level of impact would vary from site to site depending on location, current level of disturbance, soils type, presence of hard-surfaced roads for site access, and other factors. Construction activities would result in temporary disturbance to soils at the construction site, soil compaction, and removal or modification of coarse channel deposits and/or finer overbank alluvium. This material would either be repositioned on the restoration site or taken off-site for disposal. For this discussion it is assumed that alternatives 2 and 3 would have the greatest short term impacts since the frequency and location of projects under the no-action alternative would be difficult to estimate. Under alternative 2 (multi-species approach) project location sites would be throughout the basin. While under alternative three (focuses on chinook) most project sites would be located along the mainstem and in the estuary.

4.1.2. Climate

Due to the scale and timeframe of the proposed restoration alternatives, none of the alternatives are likely to affect local climatic conditions.

4.1.3. Hydrology

All of the restoration alternatives would modify surface and groundwater conditions to some extent, with the intent to improve conditions for salmonid and riparian resources. The differences between the alternatives are one of scale, location and timeframe. Under the no-action, it is difficult to predict where changes to hydrology would occur since detailed plans for restoration outside of this program are not available. For alternatives 2 and 3, the stated objectives are to improve the hydrologic condition. Both of these have similar time frames (construction would occur over a ten-year period). Again, alternative 2 (multi-species approach) could occur over a wider area. All proposed restoration alternatives will, to some degree, affect surface water conditions within the Stillaguamish

River Basin. Construction impacts to surface water would be minor since construction activities are not expected to alter surface water patterns or quantities.

Typical activities under all alternatives include placement of large woody debris (LWD), excavation, re-vegetation, and alteration of in-stream structures. While these activities are common to all three alternatives, the degree of impacts varies among the different alternatives. For alternative 1 (no-action), these activities could occur throughout the basin but probably infrequently. For alternative 2 (multi-species), these activities would occur along the mainstem, in the estuary and some tributaries over the next ten years. For alternative 3 (single species), the activities would occur just along the mainstem and estuary over a ten-year timeframe. The increases in streamside vegetation along tributaries and the mainstem from re-vegetation activities are not expected to result in seasonal modifications in surface water. The additional vegetation could result in a higher use of groundwater during the growing season, however.

In-depth evaluation of project-specific impacts would occur as a part of the environmental review for individual restoration projects.

Groundwater

Short-term impacts to groundwater could occur from construction of elements of alternatives 2 and 3. The level of impact would vary from site to site depending on location, current level of disturbance, soils type, presence of hard-surfaced roads for site access, and other factors.

Long-term impacts to groundwater would include an increase in recharge from additional length of channel under alternatives 2 or 3. Again, it would be the extent of change, where alternative two encompasses a wider area where the work would be accomplished. While this activity would be beneficial, the overall effect of this contribution to groundwater is expected to be minor relative to the amount of impervious surface area in the watershed and the degree to which patterns of groundwater recharge have been modified.

4.1.4. Water Quality

In the short term water quality would be negatively impacted under any of the proposed alternatives. This is expected since restoration activities entail moving of soil and the placement of material adjacent to the mainstem, tributaries and the estuary. Potential short term impacts of the various alternatives differ on the basis of scale, location and timing. Given the little information we have on the no-action alternative, we could assume that this alternative would have the least impact. The short-term impacts under alternative 2 would be distributed throughout the basin over a ten-year period. Alternative 3's short-term impacts would be confined to the mainstem and estuary.

Water quality would be expected to improve in the long term as the function of the restoration projects increases, particularly for those activities designed to increase streamside vegetation, bank stability, and to improve the control of sediment from landslides. Streamside planting and protection of riparian zones would further provide filtration of overland (particularly sheet flow) surface water movement and water quality protection, as well as improvements to stream temperatures due to increased shading. Again, it is the scale and location that produces differences between the alternatives. In the short term, the no-action alternative would have fewer positive impacts since projects would occur at a slower pace. Both alternatives 2 and 3 have the potential for long term water quality benefits as well as short-term impacts. Since the construction period for either alternative is expected over ten years, the short-term impacts with proper best management practices would be slight.

In-depth evaluation of project-specific impacts would occur as a part of the environmental review for individual restoration projects.

4.1.5. Air Quality

Similar to water quality, air quality could be diminished under any of the alternatives on a short-term basis. Impacts from construction would include particulate suspension from the moving of soil and emissions of construction-related motorized equipment. Fugitive dust emissions are expected to contribute an insignificant burden to the ambient air contaminant load and are not expected to exceed ambient air quality standards. In the long term, air quality may be slightly improved as vegetation plantings associated with restoration activities matures.

4.1.6. Noise

Under all of the alternatives, there would be a temporary increase in sound levels due to the use of heavy equipment and the hauling of materials during construction. The increase in sound levels would depend on the type of equipment being used and the amount of time it is in use. The types of equipment used for these types of projects will typically generate noise levels between 80 and 90 dBA at a distance of 50 feet while the equipment is operating. The sound level impacts resulting from construction would be short-term and temporary. Depending on location, background noise from existing sources and noise from other nearby commercial and agricultural activities would mask construction noise. Construction noise levels would not be continuous and would generally be restricted to daytime hours. Again the types of equipment would not differ among the alternatives, but the frequency of occurrence, the locations and timing could be vary.

Overall, the long-term noise impacts of any restoration projects are expected to be far less than other types of developments such as new roads, or other heavy industrial and commercial use activities.

4.2 Natural Resources

4.2.1. Vegetation

The proposed alternatives for restoration would require modifications to existing vegetation during construction, but would improve vegetation resources in the long term. Under alternatives 2 and 3, short-term impacts to riparian resources would occur during the construction phase of restoration activities. Vegetation may need to be removed for equipment to gain access to the restoration sites. This could result in the temporary reduction of woody vegetation (shrubs and trees) along stream and riverbanks. Given the types of restoration activities, vegetation changes would occur primarily in riparian areas adjacent to the Stillaguamish River and its tributaries.

In the long term, riparian vegetation would increase as a result of streamside plantings. The species, location, and density of vegetation for planting would vary based on site-specific conditions. Again, the differences between alternatives are a matter of scale, location, and timing. Alternative 2 (multi-species) may offer the best long-term benefit to riparian vegetation. Native plants would be placed in the riparian corridor along tributaries and the mainstem. In time this vegetation would mature, providing multi-canopied cover for the streams and river. Streamside vegetation would also be available for recruitment to the system through bankline erosion or other mechanisms. Monitoring for invasive species that could establish in the newly constructed projects will need to occur. If species such as reed canary grass, tansy ragwort, false bamboo, or another of a number of weedy species impact they new habitats, they will need to be controlled in the appropriate manner.

Impacts to wetlands would depend on the location and type of restoration activity. Activities under any of the alternatives could affect wetlands in two ways: during construction of restoration projects, and as an element of the restoration (i.e., restoration of degraded wetlands).

As a part of subsequent environmental reviews for individual projects, site-specific impact analyses would: (1) identify the type of wetlands involved, (2) describe the impacts to the wetlands, (3) evaluate alternatives to avoid or improve these wetlands, and (4) identify practicable methods and measures to minimize harm to the wetlands.

During construction, mitigation measures will be employed, including the enhancement of existing wetlands, creation of new wetlands, erosion control, and bridging if an important wetland would be influenced by surface water flow.

4.2.2. Fisheries

The overall purpose of the restoration plan is to improve the health of the Stillaguamish River ecosystem for fish and wildlife by restoring the amount/quality of spawning and rearing habitat, as well as water flow and quality. All of the alternatives discussed so far have some potential for doing this. Under the no-action alternative, the assumption is that fisheries enhancement would still be pursued by a variety of entities and agencies but at a smaller scale and would be less organized. Alternative 2 looks to enhance fisheries habitat for a variety of species (but predominantly salmonids). Alternative 2 also places emphasis on a ecosystem based approach that focuses on maintaining or restoring watershed processes that salmonid species are dependent upon. Alternative 3 looks to improve habitat for chinook through a variety of ways, such as artificial production and habitat improvements.

Most recent literature points out the need to take an ecosystem approach and to consider the role of watershed dynamics in choosing how to accomplish restoration (Kondoff 2000, Spence et al. 1996). This is certainly the intent of the preferred alternative (No. 2). Alternative 2 would improve fish habitat by increasing use by the wide variety of fish species in the tributaries and mainstem, albeit with a focus on improving habitat for salmonids. Actions in the estuary (e.g., creating deltaic habitat, restoring wetlands) would also benefit a variety of estuarine intertidal fish species.

Restoration activities such as removing barriers, modifying channel profiles, adding LWD and creating habitat structures are recognized benefits to salmonids (Washington Department of Fish and Wildlife 1998; USFWS unpub; Spence et al. 1996). The level of benefit to be achieved through implementation of these activities will be based on project location, existing riparian vegetation, and proximity to other habitat, stream channel profile, velocity, and a variety of other factors.

Implementation of alternative 3 would result in similar benefits, but with a focus on mainstem chinook habitat improvements. The impacts/benefits of these alternatives on fish would be the same as defined for alternatives 1 and 2, but restoration activities would not occur in the tributaries.

4.2.3. Wildlife

The focus of the project alternatives will be to improve fish and wildlife habitat in the Stillaguamish basin. During the construction phase, proposed restoration activities will temporarily impact wildlife habitat elements. Short-term impacts would generally be from disturbance caused by construct activities. These impacts will include noise from equipment and removal of vegetation to gain access to the restoration sites.

In the long term, restoration activities would result in some improvement to wildlife habitat. The activities of greatest benefit to wildlife would include importing and placing LWD, planting vegetation along tributaries and mainstem, increasing floodplain habitat and wetlands, and protecting floodplain and wetland habitat. Alternative 2 has the best chance for long term improvements for wildlife since restoration activities will occur throughout the basin.

4.3 Threatened and Endangered Species

As required under the Endangered Species Act, a programmatic Biological Assessment (BA) evaluating project impacts on the species listed in Section 2.3 will be prepared for the preferred alternative of this restoration plan. This BA will follow the USFWS and NMFS assessment guidelines for effect determinations at the watershed scale.

Generally speaking, a number of salmonid habitat indicators in the Stillaguamish Basin are currently considered to be “at risk” or “not properly functioning.” The proposed projects have been designed specifically to improve a number of these indicators (e.g., water quality, streambank condition, floodplain connectivity, and habitat elements such as LWD, pool frequency/quality, and off-channel habitat). However, in addition to long-term beneficial effects, some short term detrimental effects may be associated with construction activities. For example, sediment pulses from bed and bank disturbances could affect fish in the project area; such impacts would be minimized through construction timing and implementation of best management practices.

Several projects are located in or near bald eagle breeding and wintering areas, and two projects are located near areas where Northern spotted owls and marbled murrelets have been observed. Construction activities would result in noise above ambient levels, which could disrupt nesting, feeding, or wintering birds. Prior to commencement of construction activities at these sites, the USFWS would be consulted regarding the timing and duration of construction activities as well as any vegetation removal.

4.4 Cultural Resources

The basin contains numerous recorded archaeological, historical, and traditional Native American properties. Many if not most of the archaeological sites and traditional Native American locations are closely associated with the Stillaguamish River and its primary tributaries.

Under all alternatives, short-term impacts to cultural resources resulting from the proposed restoration activities could occur during construction. Short-term construction impacts would result from movement and use of construction equipment at the restoration sites. The level of impact would vary depending on factors such as the extent of previous disturbance, the age of the affected sediments, and the action planned.

Long-term impacts to cultural resources would be associated with the ongoing functioning of the restoration activities. The majority of the proposed restoration activities are designed to modify stream morphology. Changes in channel position and morphology, either intended or as an unexpected consequence of habitat improvements, have the potential to affect sub-surface archaeological material, possibly historical structures or buildings, or important characteristics of traditional cultural properties.

Evaluation of project-specific impacts would occur as part of the environmental review for individual restoration projects.

4.5 Socio-Economic Resources

4.5.1. Traffic and Transportation

Implementation of any of the project alternatives and subsequent construction would require the movement of equipment and materials along existing roadways within the Stillaguamish Basin. The impact on roadways and traffic will depend on the location and type of the restoration activities.

Access to proposed restoration sites will vary from site to site. Construction of temporary access roads, of variable length, may be required in some cases.

4.5.2. Land and Shoreline Use

Because the Stillaguamish River Basin contains a wide variety of land use types, this section qualitatively discusses potential land use impacts that could result from implementation of the restoration alternatives. Evaluation of project-specific land use impacts would occur as a part of the environmental review for individual restoration projects.

General land use patterns and aesthetic qualities should not be adversely affected under any alternative. Land ownership may be affected if direct land purchase is required; however this should not affect the overall balance of ownership patterns within the basin. Land management practices would not be affected since the pertinent local plans and ordinances, as well as state planning regulations, encourage the preservation and restoration of the Basin's vital natural resources.

The nature and scope of the restoration activities likely to be implemented (e.g., restoration of natural habitat, in-river restoration, etc.) preclude significant, basin-wide land use impacts from occurring. Short- and long-term impacts on immediately adjacent land uses from construction activities (lasting only the duration of the construction period) will be analyzed and mitigated under the project-specific environmental review process.

Public access to natural resources could benefit from the individual restoration projects, if the project(s) include trails, viewpoints, and interpretive signs. In such cases, given that roadways and parking must be provided for viewing areas, environmental impacts might result. The specific project design process should balance the goals of public access and habitat restoration.

Descriptions of current development trends, and the federal, state, Tribal and local government plans and policies, have been reflected in the basin's comprehensive development plans, including land use, transportation, public facilities, housing, and community services. Restoration site planning, construction, and maintenance would not significantly impact development planning within the basin.

Site-specific documentation will assess the potential to induce growth and consistency with applicable comprehensive development plans adopted for the area. Land use types will affect the potential for the success of any restoration project more than restoration activity will impact land use patterns. Land for restoration must not only be available, but it must also be compatible with existing plans and federal, Tribal, state, and local regulatory constraints on the use of land for restoration purposes.

4.5.3. Recreation

Outdoor recreation is an integral facet of the quality of life in the Pacific Northwest. The basin is used for recreation purposes for both water-sports and more passive activities (e.g., fishing, bird watching, and hiking); therefore, many people would be easily exposed to disturbances in or near recreational facilities/areas within the basin.

The nature and scope of the restoration activities likely to be implemented (e.g., restoration of natural habitat, in-river restoration, etc.) preclude significant, basin-wide recreational impacts from occurring. Public access to natural resources could benefit under each of the alternatives, if restoration projects include viewpoints and interpretive signs. The specific project design process should balance the goals of public access and habitat restoration.

The greatest potential for recreational impact exists with the placement of large woody debris (LWD) within the river and its tributaries. The popularity of boating and floating recreation within the basin necessitates that individual restoration project environmental reviews address the placement and visibility of LWD in-river to reduce the potential for injury to boaters or damage to their equipment. In-depth evaluation of project-specific impacts would occur as a part of the environmental review for individual restoration projects.

4.5.4. Visual Quality and Aesthetic Resources

General aesthetic qualities should not be adversely affected under any alternative. Minor changes in localized views may result; however, this should not affect the overall aesthetics within the basin. Primary viewers in the vicinity of individual restoration projects, and the most sensitive to changes in the visual environment, would include residents and recreational users. Although those viewers in the vicinity of any of the individual restoration projects may view the visual changes positively, other residents may view the changes negatively.

4.5.5.

4.5.6. Population

The nature and scope of the restoration activities likely to be implemented preclude significant, basin-wide socioeconomic impacts from occurring. Short- and long-term impacts from construction activities (lasting only the duration of the construction period) will be analyzed and mitigated under the project-specific environmental review process.

Restoration work in the basin should not have significant adverse impacts upon the area's neighborhoods or community cohesion for the following reasons:

- No splitting of neighborhoods would occur.
- No isolation of any ethnic group or portion of any ethnic group would occur.
- No new developments would result, other than those that would foster public access and awareness of the communities' natural resources.
- Property values should not be decreased.
- There should be no separation of residents from community facilities.

Regional economic impacts, such as the effects of any alternative or project on the spatial distribution of development, will be insignificant.

4.5.7. Public Services and Utilities

The nature and scope of the restoration activities likely to be implemented preclude significant, basin-wide impacts to public services and utilities. Specific short-term impacts from construction activities should be minor and localized.

4.6 Hazardous and Toxic Wastes

As with any proposed construction activity, the potential to encounter hazardous and toxic waste exists. While any of the alternatives needs to address this potential, the extent of this occurrence differs by project sites considered under each alternative. Proximity to industrial sites in areas such as Arlington or Stanwood probably would have the highest chances of encountering some wastes. Also areas that have been in agricultural production for long periods and have used chemicals for control of nuisance species also run some risk. Site specific evaluations for restoration activities would need to occur under any of the scenarios.

4.7 Conclusions

Under No Action (Alternative 1), restoration projects would be limited to a small number of individual projects rather than the proposed program that could result in a larger cumulative contribution to resource restoration. Undoubtedly there will be other restoration activities on-going within the Basin through several different venues. To date, there is no single restoration program dedicated to the Stillaguamish Basin other than what is discussed in this document. In contrast, both of the action alternatives (Alternatives 2 and 3) would consolidate restoration efforts in the basin under one “umbrella” plan, resulting in large-scale habitat improvements throughout the basin. One potential consequence of the No Action Alternative would be that, for a variety of reasons (e.g., funding limitations, issues of land ownership, and manpower limitations), restorations would be limited to a small number of projects rather than a program that could result in a larger cumulative contribution to resource restoration. Also, additional adverse effects on aquatic and watershed resources could occur as a result of not restoring the degraded resource under a more comprehensive watershed approach. Finally, sites considered for restoration purposes might be developed for other non-habitat purposes if the plan was not implemented.

In general, Alternative 2 would provide ecological benefits to a larger area of the basin and to more species than Alternative 3. Alternative 2 would include restoration efforts throughout the basin to benefit multiple fish, riparian, and river-dependent species, whereas Alternative 3 would focus on chinook salmon habitat in the mainstem river and major tributaries only.

Therefore, Alternative 2 has the greatest potential for resulting in benefits to basin habitats. The approach to habitat restoration outlined under Alternative 2 will provide the basis for project selection under the Stillaguamish Ecosystem Restoration Plan.

Overall, each of the alternatives may result in temporary, relatively minor negative impacts as projects are being constructed (for example, construction may generate noise or dust). However, once projects are completed, the long-term benefits to the basin's ecology and aesthetics would be positive. Using the mitigation measures would minimize negative impacts on recreation, cultural resources, and the environment during and after construction.

5. PLAN FORMULATION

5.1 Plan and Criteria Development

As evaluated in the previous section, Alternative 2 has the greatest potential for improving fish and wildlife benefits throughout the Stillaguamish basin. This alternative also places emphasis on a ecosystem based approach that focuses on maintaining or restoring watershed processes that salmonid species are dependent upon.

Ecosystem restoration can be pursued from various perspectives. Beechie et al. (1996) discussed restoration goals and priorities in the context of salmonid restoration in western Washington river basins, including one sub-basin of the Stillaguamish River. They stated that the principal goal of ecosystem restoration should be to restore the watershed processes that create and maintain habitats and ecosystem functions, but that prioritization of specific restoration activities may be based on local management objectives. This means that highest priority may be given to restoration projects that address the recovery of particular species or communities, as long as they are consistent with the overall goal of restoring ecosystem processes and functions.

The concept that restoration of habitat-forming processes is the most fundamentally sound approach to ecosystem restoration has been endorsed by various authors, and is the basis for an ongoing ecosystem restoration planning program in the Green/Duwamish River basin (U.S. Army Corps of Engineers, Seattle District 1997). Within the Stillaguamish basin, long-range objectives identified by the U.S. Forest Service (1996) are consistent with this approach in that they encourage re-establishment of late-seral forest conditions and control of sources of artificially accelerated sediment inputs. Other planning efforts, such as the Stillaguamish Implementation Review Committee (1995), similarly identify restoration of processes as an important focus of attention, including restoration of more natural patterns of hydrology.

Although all of the major resource assessment and planning efforts within the Stillaguamish Basin recognize that restoration of ecosystem processes is the fundamental goal of any basin-wide effort, they also emphasize an immediate focus on conditions influencing salmonid populations and habitats. The economic and cultural importance of salmonids within the region makes restoration of fish habitats a major local management priority. Such a focus is consistent with the general guidance for the Corps' ecosystem restoration program and current ecological restoration theory. The complex life-histories of salmonid species, with their requirements for specialized habitat conditions at various locations within the watershed and at various times of year, make them especially vulnerable to the cumulative impacts of alterations that have occurred within the basin over the past century. At the same time, these complex relationships make salmonids particularly good surrogates for a wide variety of other fish and wildlife species. The viability of salmonids directly contributes to the health of other elements of the system through their contributions to food webs and nutrient cycles. Restoration of high quality salmonid habitat includes consideration of hydrologic patterns and water quality, sediment movement and storage, availability of specific habitat features such as large woody debris, and the spatial arrangement and temporal accessibility of specialized habitats such as side channels. All of these components depend in part on characteristics of the terrestrial system, such as continuity and quality of riparian plant communities and floodplain wetlands. Therefore, the following general guidelines were adopted for selecting and evaluating potential restoration projects:

- Projects should address local management objectives, which place the highest priority on restoration efforts that will benefit salmonid populations. In addition, due to the critical need to halt and reverse population declines among certain salmonids, the selected projects should have some immediate benefits to fish in addition to contributing to long-term ecosystem recovery.
- Projects should address basic ecosystem functions and processes, in that they focus on habitat continuity, quality, and the restoration of systems that will be self-sustaining.
- Projects should have clear benefits to a wide variety of other species in addition to salmonids.
- Projects should involve engineering expertise traditionally associated with the Corps (i.e., manipulation of hydrology and sediment).
- Projects selected for inclusion in the program must produce environmental benefits that justify their cost. A cost effectiveness analysis must be conducted to ensure that least cost alternatives are identified for various levels of environmental output; costs and benefits may be calculated in both monetary and non-monetary terms. A final group of candidate projects will be selected from cost-effective alternatives based on the increment of environmental benefit relative to cost associated with each project.

5.2 Reconnaissance Study

As described in Section 1.3 of this document, a Reconnaissance Study entitled *Stillaguamish River Ecosystem Restoration General Investigation* was completed in December 1997. The purpose of this study was to examine the need for ecosystem restoration in the Stillaguamish Basin; to identify potential projects; to determine the federal interest in planning for such projects; and to assess the level of interest and support of non-federal sponsors in the identified projects. Projects that were considered appropriate for possible inclusion in a basin-wide restoration program were recommended for further evaluation under a Feasibility Phase Study.

The Reconnaissance Study drew on a wide variety of information to identify sources of ecosystem degradation and restoration options for the Stillaguamish River Basin. These sources include an extensive body of published literature, resource studies conducted by local, tribal, state, and federal agencies, and the knowledge and recommendations of resource managers working in the basin. Agencies represented on the Reconnaissance Study team included: Snohomish County, the U.S. Fish and Wildlife Service, the National Forest Service, the Tulalip Tribe, the Stillaguamish Tribe, the Washington

Department of Fish and Wildlife, the city of Stanwood, and the Stillaguamish Diking District.

5.2.1. Initial Project Identification

As a first step in addressing the project objectives, the Reconnaissance Study Team reviewed the planning documents and studies described in Section 1.5 of this document and developed a preliminary list of potential projects. Particularly useful were potential sites and actions identified by the Restoration Subcommittee of the Stillaguamish Implementation Review Committee (SIRC) and the Forest Service. A preliminary analysis of critical factors limiting coho populations (Pess 1997) included a more detailed assessment of 13 of the highest-priority projects identified by the SIRC. In addition to these documents, the Reconnaissance Study Team solicited direct input from a variety of agencies involved in resource management within the basin.

In April 1997, the Reconnaissance Study team conducted a series of field reviews to assess a variety of potential projects and determine their significance for habitat quality on the ecosystem level. The field assessments were conducted with the assistance of resource professionals from local, state, and federal agencies as well as the tribes.

This process produced a list of 15 potential restoration projects suitable for more detailed assessment. Most of these candidate projects were located within the lower mainstem portion of the basin. This is primarily because the mainstem, its adjacent floodplain, and the (formerly) intertidal areas have undergone the most extensive alteration. Three additional projects had flood damage reduction potential in addition to possible ecosystem restoration effects; these 3 flood projects have been removed from consideration, and are currently being studied under a different Corps authority. Five additional projects were added and evaluated after completion of the Reconnaissance Phase study.

Some projects upstream of the mainstem were also determined to be appropriate for inclusion in the next step of the assessment process, generally because they may be particularly important in addressing the critical need to restore salmonid habitats. These involve reconnection of of-channel habitats and blocked tributaries along the Forks. Most of the potential projects in upper portions of the basin were not selected for further review because they: 1) were not considered to conform to relate to traditional Corps interests; 2) did not address more than one of the selection criteria; 3) were already under consideration for implementation under other programs such as the President’s Forest Plan; or 4) were either too large and long-term or too small (no ecosystem-level significance) for implementation under the guidelines of the Corps’ ecosystem restoration program.

These projects can be grouped into three general restoration approaches: (1) reconnection of distributaries, side channels, wetlands, and similar off-channel habitats; (2) re-establishment of appropriate channel characteristics and riparian vegetation on tributary streams that currently traverse open fields; and (3) restoration of habitats that have been differentially impacted within the basin, and are now uncommon relative to their historic extent. Individual projects may incorporate elements of all three of these general approaches, however. Intertidal reconnection, for example, may result in the eventual development of blind tidal channels.

The 15 initial restoration projects are listed below. More information on each of these projects was provided in the *Stillaguamish River Ecosystem Restoration General Investigation Reconnaissance Report* (Corps 1997).

1) *Hat Slough Entrance*: remove sea dikes, excavate a tidal channel, construct a set-back levee

2) *Mainstem Hat Slough*: enhance an existing intertidal channel

3) *South Pass*: remove sea dikes, excavate a tidal channel, construct a set-back levee

4) *Old Stillaguamish Entrance*: install a reverse tidegate

5) *Confluence of Koch Slough*[1] *and the Stillaguamish River*: provide access to side channel habitat, create of off-channel seasonal rearing habitat, and add LWD to the project reach

6) *Koch Slough Weir*: install a fish passage structure

7) *Koch Slough North Meander*: reconnect the Slough to the mainstem

8) *Koch Slough/Thompson Slough*: reconnect the Slough to the mainstem [NOTE: in the Feasibility Phase investigation, this project is called *South Meander*]

9) *Norman Road Wetland*: plant a buffer of spruce and cedar around an existing wetland area

10) *South Fork Tributary No. 319*: plant a riparian buffer, build a fence to prevent livestock from accessing the creek, and culvert installation

11) *Tributary No. 358C*: plant a riparian buffer, and build a fence to prevent livestock from accessing the creek

12) *Tributary 169 (McGovern Creek)*: plant a riparian buffer, and build plant a riparian buffer, and build a fence to prevent livestock from accessing the creek

13) *North Fork Tributary No. 138 (Koonz Creek)*: rehabilitate and replace culverts

14) *Tributary 147*: excavate new channel and plant riparian buffer

1 Koch Slough is also known as Cook Slough.

15) *Cloverdale Golf Course*: plant a riparian buffer, and build a fence to prevent livestock from accessing the creek

The current phase of the study, the Feasibility Phase, was initiated two years after the Reconnaissance Phase was completed. At this time, the team decided to revisit the project list to see if any additional information was available that would lead to inclusion or deletions of additional projects. The technical team met on two occasions to evaluate the project list using the same project criteria developed for the study. At this time it became obvious to the technical team that sedimentation issues were important, and that the first group of projects had not really addressed the issue. As a result, five new projects were added to the list, two of which aimed at stabilizing major landslides that deposited material directly into the River:

16) *Port Susan*: construction of LWD islands on mudflats

17) *26 Maintenance Sites*: modify Corps maintenance practices (i.e., incorporate bioengineering techniques, no longer maintain sites)

18) *Portage Creek*: redirect creek from ditch to meandering channel, add LWD, plant riparian vegetation

19) *Hazel Slide*: stabilize landslide

20) *Gold Basin Slide*: reduce sediment input to South Fork from Gold Basin landslide.

5.2.2. Project Evaluation

During the Reconnaissance Study, these projects were subject to an evaluation process involving the application of set restoration effectiveness criteria. This evaluation was specifically structured to be used in the context of the candidate projects identified in the initial screening process. For each of seven criterion, each project was assigned a score in a range of 0 (least effective) to 5 (most effective), based on the professional judgment of the evaluators and analyses specific to conditions and objectives in the Stillaguamish basin (e.g. Pess 1997). This scoring process was designed to reflect net gain derived from each project (i.e., the change from existing conditions). Information to support decisions regarding the distribution and quality of resources, and the effects of proposed restoration actions, was taken from the resource databases and GIS systems described in Section 1.5 of this document.

Application of the seven criteria produced a "restoration effectiveness rating" (RER) for each project; the RER served as an indicator of the *probable relative effectiveness* of that project. The evaluation criteria, S1 through S10, are listed below; these criteria are thoroughly described in the *Stillaguamish River Ecosystem Restoration General Investigation Reconnaissance Report* (Corps 1997). The first three criteria relate to projects that influence salmonids and other species directly, and are scored in terms of the differential between without-project conditions and with-project conditions. The remaining criteria relate to ecosystem-scale considerations and feasibility, and are scored according to stated criteria or relative to the effects of other proposed projects. The potential range of scores for each criterion was 0 to 5.

- Immediate benefits to salmonids (S1. with-project, S2. without-project)
- Long-term benefits to salmonids (S3. with-project, S4. without-project)
- Benefits to other species (S5. with-project, S6. without-project)
- Reversing losses of rare habitats (S7)
- Sustainability and contributions to habitat-forming processes (S8)
- Ecosystem-level effects (S9)
- Feasibility (S10)

A panel of experts was convened to apply the scoring criteria to each of the potential projects identified in the initial stages of the general investigation. This panel consisted of 6 persons, including representatives of the Tulalip and Stillaguamish Tribes (2 panelists), the local sponsor (Snohomish County, 2 panelists), and the Corps (2 panelists). All of the panel members were resource professionals familiar with the basin, and all had participated in field reviews of the potential restoration projects. The panelists reviewed the scoring criteria, suggested changes, and reviewed the specific proposals for each restoration project. Each panelist then assigned scores for each criterion for each project based on his or her best professional judgement. Following discussion of the resulting scores, a group consensus score was assigned to each rating factor for each project.

A simple formula was used to calculate overall RER for the 15 potential restoration projects and for 2 of the 3 flood reduction projects. The differentials of each of the first three sets of Criteria Scores (with-project minus without-project, S1 through S6) were added to the remaining Criteria Scores (S7 through S10) to derive an overall RER for each project, as follows:

$$\text{Restoration Effectiveness Rating (RER)}_{\text{(Project } x\text{)}} = (S1-S2) + (S3-S4) + (S5-S6) + S7 + S8 + S9 + S10$$

In their raw form, RERs are dimensionless. For analyses like this, which involve combinations of many types of restoration actions, the raw RERs allow comparisons based solely on ecological effectiveness. Measures of cost can be combined with such measures of environmental outputs to estimate cost-effectiveness. In some instances, it may be desirable to combine RERs with some aerial measure (acreage, stream miles, etc.) to support more detailed economic analyses. It is important to note, however, that combination of dissimilar projects in order to obtain a common unit should be approached carefully.

Table 3. Project Scoring

		Immediate Benefits to Salmon		Long Term Benefits to Salmon		Benefits to other species		Reverse losses of Rare habitats	Sustainability/ Habitat Forming Processes	Eco-system level effects	Feasibility	RER	Rank
		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10		
1	Hat Slough Entrance	4	1	4	1	5	3	4	3	4	4	23	1
2	Mainstem Hat Slough	3	2	2	2	3	2	4	2	3	3	14	16
3	South Pass	3	1	4	1	5	3	4	3	4	5	23	1
4	Old Stilli Channel	4	2	4	2	4	2	3	4	4	2	19	9
5	Confluence	4	1	4	1	3	3	4	3	4	3	20	7
6	Koch Slough Weir	4	1	4	1	3	0	2	3	4	4	22	3
7	North Meander	4	1	4	1	3	3	4	2	4	2	18	12
8	South Meander	4	1	5	1	3	3	4	3	4	3	21	5
9	Norman Road Wetland	1	1	1	1	4	2	4	4	2	4	16	14
10	S. Fork Trib 319	2	2	2	2	4	3	2	3	2	3	11	20
11	Trib 358C	2	2	3	2	3	2	2	4	2	3	13	18
12	Trib 169	3	3	3	3	3	2	2	4	3	3	13	18
13	N. Fork Trib 138	4	2	4	2	3	3	2	3	3	4	16	14
14	Trib 147	3	2	3	2	4	2	2	3	2	3	14	16
15	Cloverdale	4	2	4	2	4	3	3	3	3	5	19	9
16	Port Susan	3	2	4	2	4	2	4	3	3	2	17	13
17	26 Sites	2	1	3	1	3	1	1	2	2	4	20	7
18	Portage Creek	4	3	5	3	4	2	4	4	3	3	19	9
19	Hazel Slide	3	0	4	0	2	0	3	2	5	3	22	3
20	Gold Basin Slide	3	0	3	0	2	0	3	2	4	4	21	5

Table 3 summarizes the results of the panel's ratings, the overall RERs, and the ranking of project priorities based on those scores. The highest-scoring projects involved reconnections of large sloughs, cutoffs, or intertidal habitats. The lowest-scoring projects involved reconnection and/or rehabilitation of small tributaries; these lower scores were largely a function of the perceived lack of ecosystem-wide benefits, and lack of significant positive effects on overall salmonid populations. Cost analysis of the projects will also need to occur. Therefore a high RER does not automatically assure that a project will be constructed, cost will also be taken into consideration.

5.3 Recommended Plan

Those projects that received the highest RER scores were selected for inclusion in the recommended plan. The following section discusses individual projects proposed under the recommended plan; the locations of these projects can be found in Figures 5, 6, and 7. However, not all of these projects may be built as a result of real estate issues, extensive costs, or a lack of local sponsorship. The proposed construction schedule for these projects is over the next ten years.

5.3.1. Port Susan

This project consists of twelve sites located in the estuarine portion of Port Susan Bay near the mouth of Hat Slough (T31N R3E). The sites are scattered throughout the tideflats in the eastern portion of the Bay.

The purpose of the project is to increase habitat diversity and complexity in the estuary by creating intertidal marsh habitat. Historically, Port Susan Bay had a large and diverse array of estuarine habitats, such as vegetated shallows, extensive mudflats, and fringing marshlands. As early as the 1870s sea dikes were constructed at the land-water interface in an effort to convert marshes to agricultural land. This conversion, while eliminating tidally-influenced wetlands and sloughs, did not alter the tideflats on the exterior of the sea dikes. Presently, there are uncharacteristically wide expanses of flats interspersed with just a few marsh islands in the southeastern portion of the bay. While mudflats provide many benefits to fish and wildlife, most notably benthic and epibenthic production, this area could benefit from additional marshland. Nutrient export to the mudflats could make them more productive, and marshes would provide refuge from predators. Plus, more marsh would add to both the species diversity and habitat complexity in the area.

Each of the twelve sites would be occupied by a barge with a clamshell dredge at high tide. The equipment would be held in place and work would commence at low tide. The dredge would excavate a large hole, into which large pieces of wood (30’ dbh with root wads) would be placed. The wood would be interwoven so that key members meshed forming a “V” shape with the root wads facing out. The material that was excavated would be placed back into the hole and also on top of the wood, along with some large rock, to hold the cribs in place. Several stacked members (20’ dbh) would be placed on top of the structure to capture sediment. Much of the structure would be buried, but several key members would be exposed and the top of the structure would be at an elevation of +10 MLLW. If the final elevations were suitable, estuarine emergent vegetation would be planted.

This pilot project would test two hypotheses: (1) can interlocked large woody debris be used to trap sediment coming out of Hat Slough and raise the bed elevation to that which supports intertidal marsh habitat, and (2) do suitable scour channels form on the bayward side of the structures to allow juvenile salmonids access the area at low tide. Since this project is experimental in nature we intend to develop a monitoring plan to test our assumptions.

FIGURE 5.

Not available electronically.

FIGURE 6.

Not available electronically.

FIGURE 7.

Not available electronically.

5.3.2. South Pass

The projected is located in the Stillaguamish estuary, adjacent to South Pass, near where the Old Stillaguamish channel empties into Port Susan Bay (T32N R3E Section 26). The site, formerly in agricultural production, is currently owned by the State Department of Fish and Wildlife. State Highway 532 bisects the property.

This portion of the estuary was diked for agricultural production. These sea dikes, combined with the filling of sloughs, interrupted tidal flow and diminished nutrient export from the marshes to adjoining habitats such as mudflats. This project offers an opportunity to restore, on a large scale, the tidal hydrology of a portion of the former estuary. Work on this property will reconnect the Bay's mudflats with a historic marsh area.

Project features include removal of sea dikes and excavation of a tidal channel. The dike material would be placed in existing borrow ditches to match the existing ground line. One section of the southern dike system, approximately 100' in length, bisects a slough. This dike section would be breached, the culvert would be removed, and the area would be excavated down to reconnect the slough. LWD would be placed and, if elevations were appropriate, emergent vegetation would be planted at the new connection. Two new setback levees would be constructed from imported material. The alignment of the northern cross levee would be adjacent to Highway 530, for flood protection. The exact location of the southern cross levee has not yet been negotiated; this site is a significant haven for snow geese during the winter, so measures would be taken to insure that their needs continue to be met.

5.3.3. Hat Slough

The projected is located in the Stillaguamish estuary, on the right bank of Hat Slough near its mouth at Port Susan Bay (T31N R3E Section 1 and T31N R4E Section 6). The site, over 300 acres in size, is currently in agricultural production. The Nature Conservancy and U.S. Fish and Wildlife Service are attempting to purchase the property.

Like the South Pass project discussed above, the purpose of this project is to restore tidal hydrology to a portion of the site. A sea dike on the southern and western portions of the property would be breached in up to eight locations. These breaches, approximately 50' wide, would occur where remnant or existing channels were/are located. Any culverts at these locations would be removed, and new channels about 400'long would be excavated on the landward side of the breach to allow for new slough formation. The excavated material would be used to fill borrow ditches used to construct the original dike. The banks of the new channels would be planted with emergent vegetation, and LWD would be placed in the channel. A new set-back cross levee would be constructed from imported material. Its exact alignment has not yet been determined, as this site also supports a significant number of snow geese during the winter.

5.3.4. *Old Stillaguamish Channel*

This project is located at the confluence of Hat Slough and the Old Stillaguamish Channel, in the estuarine portion of the Stillaguamish Basin (T31N R4E Section 5). This location is just downstream of the City of Stanwood, at River Mile 8 on the Old Stillaguamish River Channel (RM 3 on Hat Slough).

Historically, the "old" Stillaguamish channel was the main river channel, and Hat Slough was a small narrow backwater carrying water only during high flow events. An early settler by the name of Hat widened and deepened the slough, presumably for log storage. Floods throughout the early 1900s expanded the slough, and a flood in 1920s caused the main river channel to shift. Today, during much of the summer and early fall, the old river channel is a stagnant, tidally influenced slough with poor water quality and high water temperatures. Whenever flows in the Stillaguamish mainstem are low, fresh water enters the Old Channel only during flood tide. Tides enter the Old Channel from both ends, then ebb back the way they came—there is little net downstream flow.

The project objectives are to improve the Old Stillaguamish Channel's water quality and riparian corridor. Cool, oxygenated flow is sought in the channel. To achieve this goal, a reverse tidegate would be installed in the channel about a quarter of a mile downstream from the confluence with Hat Slough. The tidegate would be constructed of concrete and span the entire channel width, but would be fish passable. The tidegate would capture freshwater during flood tides, producing an average daily downstream flow of roughly 1.5 million cubic feet.

One notable change since the Draft Environmental Assessment was written: this project is now being considered under the Corps' Section 1135 authority, so that it can be constructed in a more timely manner.

5.3.5. *Confluence*

The confluence site is located in the Stillaguamish's lower basin, on Koch Slough upstream of the Stillaguamish River/Koch Slough confluence and the Burlington Northern Railroad, and downstream of the Larson Road Crossing (T31N R4E Section 2).

A large gravel bar, approximately 200 feet wide and 800 feet long, is located in the Koch Slough channel. During summer and fall, a side channel is exposed along the right side of the gravel bar. However, the lack of a steady volume of cool, oxygenated flow during these dry periods makes this side channel insufficient for fish passage and rearing. Objectives for this site include adding complexity to the project reach, providing access to approximately 1100 feet of side channel habitat, and creation of approximately 500 feet of off-channel seasonal rearing habitat. This project consists of: (1) construction of an engineered log jam at the upstream head of the existing gravel bar, (2) construction of six smaller bank jams along the side and main channels, and (3) excavation of an existing overflow channel.

The large logjam, a Bar Apex Jam (BAJ), would promote increased flow into the existing low velocity channel along the right bank. This cool, oxygenated flow would provide levels adequate for summer rearing habitat for anadromous salmonids. The design would provide complex habitat with scour pools and cover, while minimizing fish strandings. The six bank jams will be designed to protect existing banks, and like the BAJ would provide cover and complexity while creating holding pools under the exposed rootwads. Riverbed material excavated while constructing the logjams would be placed in and over the structures to enhance stability; any excess materials will be disposed of offsite in an approved landfill. The excavation of approximately 500 feet of an existing overflow channel that runs parallel to Koch Slough would provide quality off-channel habitat. It would be excavated until a connection with groundwater (to provide adequate flows of 3-5 cfs) is made; this is expected to occur at a depth of approximately 10 feet. This channel would be connected to the mainstem Stillaguamish just upstream of the confluence. Channel slopes would be planted with riparian vegetation, and LWD may be placed at 50-foot intervals to supplement natural wood recruitment. No spawning is sought at the project site.

The exact placement and dimensions of the seven logjams cannot be specified until detailed hydraulic, hydrologic, and structural analyses have been completed. Access to the site would occur via an existing farm road, and a new temporary road constructed by extending an existing turnout through a patch of blackberry that runs along the wooded right overbank. A spur off this new road would connect to the gravel bar; it would extend down the bank, across the stagnant channel, and to the bar. Two 4000 ft^2 staging areas would be established on the right bank, and the gravel bar would provide a laydown area. Construction would occur in the wet, during summer low flow months outside of migration periods as specified by WDFW.

5.3.6. North Meander

The project site is located in the Stillaguamish's lower basin, on an old meander channel of Cook Slough just downstream from the Stillaguamish Weir (T31N R4E Section 1).

This old meander, which is about 4000 feet long, was cut off from the lower Stillaguamish in 1936-37 as part of a Works Project Administration flood control project. Although the North Meander is completely disconnected from the river, it does provide some wildlife benefits since a large riparian buffer consisting mostly of deciduous trees is present. Groundwater infiltration does feed the slough, but this water stagnates in the summer causing water quality concerns.

The goal for the North Meander project is to provide off channel refuge to juvenile salmonids during time of high flows in the Stillaguamish River. In addition, the project would provide both summer and winter rearing and refuge for juvenile salmonids. Both this project and the similar project just across the river (South Meander) represent a real opportunity to gain back some of the historical rearing habitat that has been lost in the system. Reconnection of these two old meander bends that are now side-channel sloughs can increase summer smolt coho production potential by approximately 22,000 and winter production potential 50,000. There will also be some vegetative plantings in the project area to improve shade and provide additional wildlife habitat.

There are currently two alternatives for making a connection to the River for the North Meander. The first alternative would be to construct (excavate) a whole new channel that flows towards the northwest to the Old Stillaguamish River. This new channel entrance would be about fifty feet wide and the bottom of the channel would be flush with the existing bottom elevation of the Old Stillaguamish River. Large Woody Debris would be keyed into the bankline to allow for a scour hole to form at the new channel entrance. Any new or exposed surfaces from the construction would be planted with native vegetation. The second option for restoration at the North Meander includes excavation of material to form a new channel connection and entrance to Cook Slough. This option would probably provide more channel length. However, due to downcutting in the area over the past several years the amount of fill to be removed would be substantial. Like the previously mentioned connection to the Old Stilliguamish River, the channel entrance would be fifty feet wide with woody debris placed at the channel entrance. Both alternatives rely on excavating down in the upper channel and capturing groundwater to produce flow. During construction of either of the alternatives, a one-acre staging area would be used. In stream work would be scheduled for summer and construction impacts would be minimized through the use of best management practices. Additional information on ground water elevation and topography would be obtained during the plans and specifications phase of the project. This information, combined with real-estate concerns and costs, will provide the information on which alternative is pursued.

5.3.7. South Meander

The project is located in the Stillaguamish's lower basin, on an old meander channel on the south side of Cook Slough (T31N R4E Section 12 and T31N R5E Sections 6 and 7).

Like the North Meander discussed above, the south meander, also about 4000 feet long, was cut off from the lower Stillaguamish in 1936-37 as part of a Works Project Administration flood control project. Although the South Meander is completely disconnected from the river, it does provide some wildlife benefits since a large riparian buffer consisting mostly of deciduous trees is present. Groundwater infiltration does feed the slough, but this water stagnates in the summer causing water quality concerns.

The proposed plan for the South Meander includes connecting the existing waterbody to Portage Creek, which then empties into the mainstem just downstream from the project. This would be done by expanding the existing channel by excavating several high spots along the channel length. A preliminary evaluation of water surface elevations and topography seems to indicate that this is feasible. Planting of native vegetation would occur along the stream channel in areas where there is just pasture. During construction a one-acre staging area would be used. In stream work would be scheduled for summer and construction impacts would be minimized through the use of best management practices. Addition information on ground water elevation and topography would be obtained during the plans and specifications phase of the project.

5.3.8. 26 Maintenance Sites

This project is comprised of 26 individual maintenance sites constructed during 1930s by the Works Project Administration. These sites are located in the Stillaguamish's lower basin, between RM 8.25 and 22. Twenty-one of the maintenance sites are on the mainstem Stillaguamish, while five are located on Cook Slough.

The Corps currently maintains these sites by brushing and/or cutting down small trees, and placing riprap for bank stabilization. There are also several sites that are maintained by Snohomish County and the State of Washington. Very little or no maintenance is currently being performed these sites.

This project seeks to restore and enhance channel complexity and riparian habitat on the 26 sites maintained by the Corps of Engineers by modifying maintenance procedures or, in some cases, eliminating maintenance entirely. When an existing bank has become oversteepened as a result of undercutting, accepted bioengineering alternatives for bank protection would be implemented. The new measures would provide more riparian edge than is currently present. These actions should help to reintroduce habitat features that have been missing since the mid 1930s into this reach of the river.

5.3.9. Koch Slough Weir

The project site is located in the Stillaguamish's lower basin, on Koch Slough approximately 1800 feet downstream of the Interstate-5 crossing of the Stillaguamish River. The weir is located immediately downstream from where the mainstem Stillaguamish forks to form Koch Slough (T31N R4E Section 2).

The Koch Slough weir, completed in 1937, was designed to keep adequate flows in both the mainstem Stillaguamish and Koch Slough, and to reduce backwater during flood events. The weir was repaired and modified several times during the 1980s and 1990s in efforts to improve fish passage and maintain structural integrity. However, upstream salmonid migrants, particularly pink salmon, have difficulty passing through the existing ladder during low flows.

This project involves construction of a new fishway on the existing weir. The proposed design was developed by Ken Bates of WDFW to function over a wide range of flows. This "pool and chute fishway" acts as a pool-weir fishway during low flows, when flow plunges and dissipates in pools. During high flows, the fishway acts as a hybrid between a pool-weir fishway and a roughened chute structure, creating streaming flow conditions down the center of the fishway. The new fishway would be keyed into the weir crest, near the center of the weir to minimize potential poaching. Prior to construction, hydrologic and hydraulic analyses would be performed to insure that species-specific fish velocity criteria and flooding constraints are met.

Two sheet pile coffer dams (approximately 50' x 50' each) would be installed upstream and downstream of the weir so that construction can occur in the dry. Construction would occur during summer low flow months outside of migration periods, as specified by WDFW. Construction would require the placement of clean, washed quarry spalls in the Slough to provide temporary vehicle access to the weir during construction. This material would be removed upon project completion.

5.3.10. Portage Creek

This site is comprised of three contiguous reaches of Portage Creek, in the Stillaguamish's lower basin. The upper project reach, approximately 4000' in length, is contained within the existing Portage Creek Wildlife Refuge Area, owned by the Snohomish County Parks Department. The middle project reach extends immediately downstream from the upper reach boundary to Interstate 5 and is approximately 10,600' long. The lower project reach extends from Interstate 5 to the creek's confluence with Koch Slough and is approximately 17,600' long. Land adjacent to the lower and middle project reaches is privately owned and currently under active agricultural use.

Although construction of Interstate-5 reduced flow in Portage Creek from historic levels, current stream flow is adequate to provide fish spawning and rearing habitat. In the lower and middle reaches, the primary factors that limit fish habitat value are a lack of shade and a lack of channel complexity/diversity. Nearly all woody debris has been removed from the channel, and reed canary grass is the predominant bank cover. Within the upper reach, Portage Creek flows are conveyed through a constructed ditch system, and are hydrologically disconnected from a former wetland area. This ditched conveyance system, combined with the network of drainage tiles installed throughout the site, collectively impede reestablishment of wetland conditions. Currently, there are approximately seven miles of accessible spawning habitat available upstream of the upper Portage Creek project reach.

This project would enhance channel complexity and riparian habitat in the lower and middle reaches of Portage Creek. In the lower reach, LWD would be keyed into the bank on alternating sides of the low flow channel, approximately every 50 feet. At these LWD sites, an equivalent area would be excavated from the channel bed/bank to maintain cross sectional area for flow conveyance; excavated materials would be disposed of on-site (in upland agricultural lands only). A bank-to-bank riparian buffer (above OHW) would then be established. Plantings would consist of native species (no hybrids or horticultural varieties), such as Sitka spruce, western red cedar, hemlock, willow, Pacific crabapple, cottonwood, big leaf maple, wild cherry, hazelnut, and alder. Dense areas of reed canary grass would be scarified or removed, where possible. Reed canarygrass would be further controlled through shading as the native plantings mature; it is anticipated that several years of reed canary grass control will be needed before patches are entirely shaded out. Similar LWD debris placement and planting are proposed for the middle reach. However, in this area a 50' buffer on each side of the channel would be planted. In addition, approximately 20% of the banks in the lower and middle reaches, in areas where farmers run cattle, would be fenced. LWD placement would occur only during low flows and non-migratory periods, as specified by WDFW. Planting would occur during February or March.

In the upper project reach, the project goal is to redirect Portage Creek from an existing ditch channel into a newly excavated meandering channel, and to restore the area to forested wetland. Approximately 750' of an existing ditch at the eastern end of the site would be filled, using soil excavated during construction of the new main channel.

Conveyance in the remainder of the ditches would be reduced using LWD and soil plugs. Existing drainage tile would be removed throughout the site. LWD would also be placed to direct flow along the new main channel. A network of dendrites branching out from the new channel would be constructed to provide a means of fish egress as water levels drop. The entire project boundary within the upper reach (approximately 120 acres) would be planted with forested wetland species to restore high-quality salmonid rearing and wildlife habitat. Only native species (no hybrids or horticultural varieties), such as Sitka spruce, western red cedar, Pacific crabapple, red alder, red osier dogwood, hemlock, Pacific ninebark, currant, and thimbleberry, would be planted. Non-native species currently present at the site, such as reed canary grass and poison hemlock, would be removed per applicable Snohomish County and Natural Resource Conservation Service guidelines prior to planting. Snohomish County plans to construct a segment of the Centennial Trail along the alignment of a former farm road, which roughly bisects the site. A 10' diameter (approximate) culvert would be installed where the trail crosses the new Portage Creek channel.

5.3.11. Cloverdale

The Cloverdale Farm site is located in the North Fork basin, off of State Route 530 and 115th Avenue NE in the Trafton area of Snohomish County (T32N R6E Section 30). The site includes the former Cloverdale Farm, which was recently acquired by Snohomish County, and a grazed pasture that is under private ownership.

A small-unnamed tributary of the North Fork Stillaguamish runs between the Cloverdale Farm, which was briefly a public golf course, and a field where livestock graze. This creek is partially ditched and lacks riparian cover; however, there is evidence of coho spawning and overwintering in this stream. The tributary enters the site from a culvert under State Route 530 and then runs north through a wooded ravine. The tributary then enters the grazed pasture, where the landowner has redirected it off his property, east towards a wetland zone on the County's land. The tributary continues through the wetland area until it reaches an abandoned Burlington Northern Railroad embankment at the site's northwest boundary. At this point, the tributary flows west through a channel that runs parallel to the embankment until it reaches the North Fork Stillaguamish River. Some flow occurs, through a culvert, between the tributary and a small egress channel on the north side of the railroad embankment; this culvert is known to strand fish. The landowner has excavated a narrow, straight ditch through his pasture to promote drainage of the property after winter and spring flooding events. This ditch is in the approximate location of the former tributary channel. Under the current hydrologic scheme, groundwater is collected and conveyed too effectively to support the conditions that would provide adequate salmonid rearing habitat.

The primary project objective at the Cloverdale site is to restore forested wetland rearing habitat that connects to upstream spawning habitat and the North Fork Stillaguamish. A portion of the privately owned grazing area would be acquired, then the existing drainage ditch would be filled and a meandering channel would be excavated. A riparian buffer, ranging from 150' to 400' in width, would then be established. Only native species (no hybrids or horticultural varieties), such as Sitka spruce, western red cedar, Pacific crabapple, red alder, red osier dogwood, hemlock, Pacific ninebark, currant, and thimbleberry, would be planted. A new 18” diameter culvert with a debris rack would be installed to prevent stranding on the north side of the railroad embankment. Snohomish County may convert the railroad embankment into the Whitehorse bike and pedestrian trail. This project may include construction of a gravel trail leading off the proposed Whitehorse trail to the banks of the North Fork; a 24” culvert would be installed to maintain fish passage. The project design may also incorporate measures, such as LWD or settling ponds, to control sedimentation originating in the ravine in the southern portion of the project site.

5.3.12. Hazel Slide

This site is located on the north side of the North Fork of the Stillaguamish River, near river mile 20 (T32N R7E Section 10).

The Hazel landslide occurs within a deep deposit of unconsolidated sands and underlying lacustrine silts exposed along the remnant of a large glacial terrace formed after the last advance of continental ice into Puget Sound. Surface exposures along the landslide indicate a relatively uniform stratigraphy consisting of about 50 meters of well-graded sand overlying an unknown depth of horizontally bedded silt. In the Hazel reach, the North Fork has moved an immense volume of material to create the current valley topography. Incision of the valley initiated large-scale slumping of the deposits along the valley margins. Landsliding in glacial deposits such as these tends to be associated with river erosion into slope toes along meander bends. It is this type of incision, coupled with patterns of groundwater flow that has made Hazel landslide active for over four decades. During the past 60 years, the site has undergone two periods of relatively low landslide activity and two periods of relatively high activity, the latter of which extends to this day. The gradual changes in landslide geometry resulting from failures at the toe of the slide can reduce stability of the entire slide mass, thereby increasing rates of activity up-slope and increasing the potential for catastrophic failure. Therefore, it is thought that stabilization of the slide toe would stabilize the slide and reduce the potential for a catastrophic failure.

The purpose of this project is to construct a series of LWD revetments that would deflect the North Fork away from its right bank, thereby eliminating toe cutting at the slide, and to create settling ponds for fine materials delivered to the North Fork from the multiple streams that drain the slide area. These structures would also create adult chinook holding habitat and mainstem off-channel habitat currently lacking in the North Fork basin. Revetment A would isolate the landslide from the North Fork and eliminate the toe cutting that is affecting the stability of the landslide, while creating deep pools. LWD is expected to accumulate near a stagnation point on the riverward side of revetment A; this log raft would form a scour pool, providing an excellent salmonid feeding area. Revetments B, C, and D would create a series of settling ponds to help decrease the magnitude of fine sediments delivered to the North Fork. These ponds would create a network similar to beaver ponds. Initially, the pseudo beaver pond complex created between the landslide and revetment A would be quite expansive. However, as the creeks drain the slide and deliver sediments, an increasing area would be converted to fine sediment storage. The eventual equilibrium condition of the slide/pond complex, as well as the time frame of development, is uncertain. There are two possibilities: the entire area between revetment A and the landslide could be converted to fine sediment storage, or stabilization of the landslide could occur prior to filling the entire storage ponds and some off-channel habitat would remain.

Construction of the log revetment structures would occur in the wet, during summer low flow months outside of migration periods as specified by WDFW. A temporary access road and staging area would be constructed through a wooded area (primarily deciduous trees) and across a large sandbar (sparsely vegetated with willows) on the North Fork's left bank. Additional evaluations such as geologic and geotechnical studies need to occur on this project during the next portion of the study to better define the project.

5.3.13. Gold Basin Slide

This site is located on the north side of the South Fork Stillaguamish, between river miles 32 and 33, across the river from the U.S. Forest Service Gold Basin campground (T30N R8E Section 14 or 23 {indefinite section boundary}).

Like the Hazel landslide described above, the Gold Basin landslide involves glacial sediments. However, its mode of operation is quite different. Differences in behavior between Hazel and Gold Basin result, in part, because of differences in the materials involved and spatial organization of those materials. The glacial deposits of Gold Basin are comprised of sand and silt, but their distribution is more heterogeneous, both vertically and laterally. The spatial heterogeneity in the juxtaposition of permeable (sand) and impermeable (silt) deposits results in complex and unpredictable patterns of groundwater flow.

This project has a similar purpose to the Hazel/Steelhead Haven Landslide described above. Slope failures that occurred in 1998 and 1999 filled the channel that was toe-cutting the landslide. This has forced the river away from the landslide, into a more stable configuration. The objective of revetment A is to prevent the river from eroding its way back through these fines to the toe of the slope, thereby re-establishing more unstable conditions. Revetment B is positioned to increase the residence time of flows draining the slide by creating a settling pond for fines from these flows. The expected post-project conditions would be similar post- construction conditions at Hazel; however, scour pool development near revetment A is not expected.

Construction of the log revetment structures would occur in the wet, during summer low flow months outside of migration periods as specified by WDFW. Additional evaluations such as recreation impacts, geologic and geotechnical studies need to occur on this project during the next portion of the study to better define this project. Close coordination and involvement with USFS will also be needed.

6. ENVIRONMENTAL IMPACTS OF THE PREFERRED PLAN

This section of the Environmental Assessment evaluates the potential impact of the preferred plan. The intent is to analyze both the positive and negative aspects that could result if the preferred plan were implemented. Additional site-specific environmental analysis would occur prior to construction of individual restoration projects. Project-specific impacts would be evaluated as part of the environmental review/permitting process for these projects.

For the purposes of this evaluation, the 13 proposed projects could be categorized into seven broad types restoration activities. These different types of actions would generally result in the same types of effects, both long term beneficial effects and short-term construction-related effects. Therefore, these categories will be referred to in the brief impact evaluation that follows. The categories are their corresponding projects are:

1) Estuarine Restoration: Port Susan, South Pass, Hat Slough

2) Off Channel Improvements: North Meander, South Meander, Confluence

3) Tributary Rehabilitation: Portage Creek, Cloverdale

4) Landslide Stabilization: Hazel Slide, Gold Basin Slide

5) Water Quality Improvements: Old Stillaguamish Channel

6) Bankline Retrofitting: Maintenance Sites

7) Fish Passage: Koch Slough Weir

6.1 Physical Characteristics

6.1.1. Geology and Soils

Under the proposed plan there will be short-term impacts to soils which result from the movement and use of construction equipment. The level of impact will vary from site to site depending on location, current level of disturbance, soils type, presence of hard-surfaced roads for access and other factors. Construction activities would result in temporary disturbance to soils at the construction site, and soil compaction. Extensive excavation would occur during construction of the tributary rehabilitation and off-channel improvement projects. Most of the projects involving LWD structures would also result in bed and bank disturbances. Depending on the project, this material would either be repositioned on the site, or taken off-site for disposal. Long-term impacts to soils would be associated with the ongoing function of the restoration activities. Since the Stillaguamish River system is dynamic, the movement of alluvium exposed to river flows will continue over the long term. The effects of specific restorations will be site-dependent and will be determined and minimized through site-specific design of projects.

6.1.2. Climate

No significant impacts to the climate of the region are expected as a result of these restoration projects.

6.1.3. Hydrology

The majority of proposed restoration activities on the Stillaguamish are designed to modify stream, side channel and/or wetland morphology to benefit fish resources and other wildlife. All proposed restoration projects will, to some degree, affect surface water conditions within the Stillaguamish basin. Construction impacts to surface water would be minor since construction activities are not expected to alter surface water patterns or quantities. Impacts on stream morphology would be long term rather than construction-related, however. Main and side channel modifications, installation of in-channel structures (e.g., woody debris), and modifying tributary and mainstem flows all represent activities that, in the long term, would alter the morphology of the Stillaguamish river system. Such stream modifications, associated primarily with the off channel improvement and tributary rehabilitation projects, are directed toward restoring the long-term function of aquatic and riparian ecosystems. Channel modifications or installation of in-channel habitat features would alter channel complexity and diversity. Ultimately fish habitat characteristics such as substrate embeddedness, pool frequency and quality, and off-channel habitat will improve as a result of project-related changes in stream morphology. Increases in streamside vegetation along tributaries and the mainstem could result in seasonal modifications in surface water (i.e., higher use of groundwater during the growing season). Short term impacts to groundwater could occur from construction at the proposed sites, and the level of impact would vary from site to site depending on location, current level of disturbance, soils type, presence of hard-surfaced roads and other factors.

6.1.4. Water Quality

Impacts to water quality would occur during construction from the movement and use of construction equipment at the restoration sites, and from the excavation or addition of gravels and other soils. The level of impact would vary from site to site depending on location, current level of disturbance, soils type, presence of hard-surfaced access roads, and other factors. As with any in-stream construction project, even with best management practices (see below under mitigation measures) there will be a short-term release of some sediment. Due to timing restrictions, impacts to migratory salmonids are expected to be minimized. Drainage and grading/erosion control plans would need to be prepared for each specific project proposed. In general, it can be anticipated that even with erosion control, some sediments would move off-site into tributaries, side channels and the mainstem of the Stillaguamish river. Along with these sediments, naturally occurring soil nitrogen and phosphorous would be mobilized, and the concentration of these nutrients can be expected to increase in runoff from the site.

Any actions that could result in an increase in sedimentation, turbidity or any other project-specific adverse water quality impacts will be addressed during the permitting process on a site-specific basis. The impacts resulting from construction activities will be mitigated through techniques such as the use of sediment curtains or other technologies designed to reduce sediment transport. Construction equipment will be monitored to ensure diesel, gas, or oil is not released into waters at or adjacent to the project site. When considered within the context of all the other activities in the watershed that continue to degrade Stillaguamish River water quality, the small scale and short duration of potential restoration construction activities would not result in significant effects to this resource. Water quality would be expected to improve in the long term as the function of the restoration projects increase, particularly for those activities designed to increase streamside vegetation, bank stability, and flows in stagnant side channels. Streamside planting and protection of riparian zones would further provide filtration of overland surface water movement and water quality protection, as well as improvements to stream temperatures due to increased shading.

Mitigation Measures:

- Procedures will be developed for flagging sensitive areas (e.g., wetlands, sensitive plants, cultural resources, etc.) and utilities off-limits to construction. Best Management Practices (BMPs) relevant to the operation of heavy equipment at restoration sites will be implemented to minimize impacts of soil compaction, stream crossings, construction access roads and staging areas, stockpiling of soil and construction materials, sanitation, and excavation, and maintenance of equipment (i.e., refueling, etc.).

- Set erosion control fences, and stabilized construction entrance.

- Connections to the river will be made last. Work will occur behind a berm and in the dry for as long as practicable.

- In water work will be coordinated with Washington Department of Fish and Wildlife to reduce the potential impacts on migratory salmonids.

- Cover newly exposed surfaces with straw or other suitable material to limit erosion.

- Remove all spoil piles.

- Rehabilitate staging area and other disturbed areas outside of channel construction area.

- Remove temporary erosion control features, such as silt fences, straw bales, and stabilized construction entrances, upon completion of construction.

- Check roadway for dirt tracking and clean roadway at a minimum of weekly

- Vegetate area of construction with native plants upon the completion of construction.

Air Quality
Because of the nature of the activities likely to be implemented, air quality impacts would most likely be associated with ground clearing activities and emissions from construction equipment. Such activities would be short-term and would have minimal impact on overall air quality in the region. On a long-term basis, air quality will either remain unchanged or improve slightly due to increased vegetation in the immediate area of each restoration project.

Land clearing for individual projects (if required) would result in the generation of fugitive dust emissions. Clearing activities include grubbing and earth moving, dredging, soil and sediment storage/transport, digging, grading, burning and planting. These activities would generate fugitive dust in amounts roughly correlating to the amount of material being moved and the duration of the clearing activity. Once construction activities were completed there would be no further fugitive dust emissions.

Please refer to the air quality conformity analysis presented in Section 10.1.8 of this document for a discussion of Clean Air Act compliance.

Mitigation Measures:
The following mitigation measures could be implemented to minimize fugitive dust emissions:

- Water all excavated or graded areas.
- Time plantings or other ground covering options (e.g., gravel) to minimize time that soil is exposed to wind and drying.
- Minimize the total construction area disturbed by clearing, earth moving, or excavation.
- Limit onsite construction vehicle speed to 15 miles per hour.
- Sweep paved streets adjacent to the project site at least once per day to remove silt accumulated from construction activities.
- Maintain all construction vehicle internal combustion engines according to manufacturer specifications.

Noise
Construction activities would generate short-term noise impacts due to the use of heavy equipment. Noise impacts would depend on the nature and location of the activity, the surrounding land uses, the number of sensitive noise receptors (i.e., residences) in the immediate vicinity of the project, and the types of equipment used. These noise levels may also have a temporary impact on resident wildlife populations. Such impacts will last only as long as construction activity occurs, and are therefore not likely to have a significant impact on these populations.

Mitigation Measures:
To reduce or minimize temporary noise impacts associated with construction activities, the following measures could be incorporated into individual projects:

- Restrict construction activities within 1,000 feet of residences to daytime hours. Additionally, no construction should be performed within 1,000 feet of an occupied dwelling on legal holidays, or between 10 p.m. and 7 a.m. on other days.

- All equipment should have sound-control devices no less effective than those provided on the original equipment. No equipment should have unmuffled exhaust.

- Place stationary equipment as far away from existing businesses and buildings as is reasonably possible.

6.2 Natural Resources

6.2.1. Vegetation

At some sites, restoration activities would require modifications to existing vegetation during construction, but generally the proposed projects would improve vegetation resources in the long term. Restoration activities would primarily affect riparian habitats, in two general ways: impacts caused by construction activities (i.e., vegetation removal required for site access), and impacts intended as an element of the restoration.

The estuarine restoration projects, two of which involve dike breaching, would open up agricultural lands to tidal influence. These areas are then expected to be naturally recolonized by estuarine emergent vegetation. During construction of projects in the lower, North Fork, and South Fork basins, riparian and other vegetation may be removed in order for equipment to gain site access. This could result in a temporary reduction of woody vegetation along stream and riverbanks. However, all areas where vegetation is cleared for site access would be re-vegetated with native species. In addition, the planting of riparian vegetation is a significant component of the off channel improvement, tributary rehabilitation, and bankline retrofitting projects. The species, location and density of vegetation for planting would vary based on site-specific conditions. The species of choice would be those defined as beneficial for riparian planting by WDFW, USFWS, and the Natural Resources Conservation Service (NRCS).

6.2.2. Fisheries

Restoration activities covered under this report would occur within salmonid passage, spawning, and rearing habitat within the Stillaguamish River system. The overall purpose of the restoration plan is to improve the health of the Stillaguamish River ecosystem for fish and wildlife by restoring the amount and quality of spawning and rearing habitat as well as water flow and quality. The focus of the proposed projects will be to improve fish habitat in the estuary and lower basins. This approach is necessitated by declining fish stock and habitat loss.

During construction phase, proposed restoration activities may temporarily degrade fish habitat by delivering sediments from instream and bank disturbances downstream. In the long term, activities such as importing sediment and LWD, modifying channel cross-sections, increasing channel complexity, and riparian plantings would aid natural stream processes (e.g., LWD recruitment, pool formation, retention time and nutrient transformation of salmon carcasses in the river). In addition, the landslide stabilization projects would reduce sediment loading and the water quality improvement project would introduce clean, cool water into a stagnant channel. The estuarine restoration, off-channel improvement, and tributary rehabilitation projects would provide high quality, accessible rearing habitat. The level of benefit to be achieved through implementation of these activities will be based on such site-specific factors as location, existing riparian vegetation, and proximity to other habitat, stream channel profile, velocity, and a variety of other factors.

6.2.3. Wildlife

The overall purpose of the planned restoration projects is to improve the Stillaguamish River ecosystem for fish and wildlife by restoring habitat as well as water flow and quality. All projects will have an impact on wildlife during construction but will ultimately produce improved habitat conditions for a variety of wildlife.

Noise from equipment operation and the removal of vegetation to gain access to restoration sites will temporarily impact wildlife. Construction may also temporarily degrade water quality due to disturbance in riparian areas during instream construction. In the long term, however, restoration activities will result in an improvement to wildlife habitat. The activities of greatest benefit to wildlife would include importing and placing LWD, planting vegetation along tributaries and the mainstem, increasing floodplain habitat and wetlands, including tidally influenced areas, and protecting existing wetlands.

6.3 Threatened and Endangered Species

The proposed restoration activities would occur within the range and known occurrences several fish and wildlife species protected under the Federal Endangered Species Act (see Table 2). As required under Section 7 of the ESA, the Corps will evaluate potential impacts of the proposed projects on protected species in a separate Biological Assessment, which will be coordinated with the USFWS and NMFS.

Generally speaking, a number of salmonid habitat indicators in the Stillaguamish Basin are currently considered to be “at risk” or “not properly functioning.” The proposed projects have been designed specifically to improve a number of these indicators (e.g., water quality, streambank condition, floodplain connectivity, and habitat elements such as LWD, pool frequency/quality, and off-channel habitat). However, in addition to long-term beneficial effects, some short term detrimental effects may be associated with construction activities. For example, sediment pulses from bed and bank disturbances could affect fish in the project area; such impacts would be minimized through construction timing and implementation of best management practices.

Several projects are located in or near bald eagle breeding and wintering areas, and two projects are located near areas where Northern spotted owls and marbled murrelets have been observed. Construction activities would result in noise above ambient levels, which could disrupt nesting, feeding, or wintering birds. Prior to commencement of construction activities at these sites, the USFWS will be consulted regarding the timing and duration of construction activities as well as any vegetation removal.

6.4 Cultural Resources

Federal historic preservation policy has been under development since the beginning of the twentieth century. There are four basic tenets that provide the basis for this policy: 1) cultural resources are considered valuable to the nation; 2) these resources are finite, fragile, and non-renewable; 3) the federal government is responsible for the stewardship of such resources in public ownership for the public good; and 4) the government is responsible for protecting cultural resources from adverse effects resulting from federally-funded or licensed undertakings. The National Historic Preservation Act of 1966, as amended, (NHPA) requires federal agencies to consider the affects of their undertakings on properties eligible for listing on the National Resister of Historic Places (NRHP). This consideration usually involves identifying cultural resources, evaluating their NRHP eligibility, determining project effects on eligible resources, and assessing measures to mitigate adverse impacts. The regulations implementing Section 106 of the NHPA were revised in June 1999. As lead federal agency on the Stillaguamish Environmental Restoration Project, the Corps consults with other involved federal agencies (U.S. Forest Service and U.S. Fish and Wildlife Service), the Washington State Historic Preservation Officer (SHPO), and affected Indian tribes (Stillaguamish and Tulalip). The National Environmental Policy Act of 1969 (NEPA) and the Washington State Environmental Policy Act (SEPA) also require consideration of cultural resources and effects on tribes. Other federal laws that may apply, especially related to TCP and human remain issues, include the Washington Indian Graves and Records Act (RCW 27.44), American Indian Religious Freedom Act of 1971, and the Native American Graves Repatriation Act of 1990.

As discussed in Section 2.4, it is anticipated that the greater project area contains a variety of cultural resources including prehistoric campsites, specialized resource procurement sites, village sites, traditional cultural properties, and historic period sites. Many of the archaeological sites and traditional Native American locations are closely associated with the Stillaguamish River and its primary tributaries. The potential for the discovery of more archaeological sites is high given the geological and modern history of the middle and lower basin. Additionally, large areas within the basin have never been subjected to systematic surface or subsurface investigation. Prehistoric site types may consist of inundated occupation areas (e.g., sites dating between 9,000 and 5,000 years ago), fishing sites (e.g., weirs), coastal and riverine shell middens, defensive earthworks, inland wet sites (notable for excellent preservation of organic materials), fire-altered rock concentrations, lithic scatters, isolated artifacts, and rock shelters. Traditional cultural properties and burials represent locations of special concern and require sensitive treatment. Historic structures and/or historic archaeological sites occurring within the project area may be associated with early industry (e.g., timber or mining), homesteading, communication, transportation, and flood control.

Any one of the potential restoration areas has the potential to encounter cultural resources and each will have to be subjected to a cultural resources survey sufficiently in advance of construction and possibly testing and mitigation if historic properties are identified. There is less potential for disturbance of buried cultural materials at the 26 levee maintenance locations, however, the levees themselves were part of the 1926 to 1937 Works Progress Administration projects. Although these features of the built environment do technically meet the 50-year rule for consideration for the National Register of Historic Places, such engineering features are not unique in the region, or important to any specific historical events, and repairs and augmentations over the years have reduced their integrity as sites, and thus the levees do not meet any of the criteria of significance for eligibility to the National Register. Monitoring construction at the levees may provide an opportunity to examine soil matrix that was removed from the original surface for the presence of cultural materials.

A quantitative analysis of impacts to cultural and historic resources cannot occur on a programmatic level. Therefore, this section qualitatively discusses potential impacts that could result from implementation of the restoration alternatives. Evaluation of project-specific impacts would occur as part of the environmental review for individual restoration projects.

Under all alternatives, short-term impacts to cultural resources resulting from the proposed restoration activities could occur during construction. Short-term construction impacts would result from movement and use of construction equipment at the restoration sites. The level of impact would vary depending on factors such as the extent of previous disturbance, the age of the affected sediments, and the action planned.

Long-term impacts to cultural resources would be associated with the ongoing functioning of the restoration activities. The majority of the proposed restoration activities are designed to modify stream morphology. Changes in channel position and morphology, either intended or as an unexpected consequence of habitat improvements, have the potential to affect sub-surface archaeological material, possibly historical structures or buildings, or important characteristics of traditional cultural properties.

As specific projects are developed, research and field investigation will be undertaken in consultation with the Washington State Office of Archaeology and Historic Preservation, the Advisory Council on Historic Preservation, and concerned Tribes and local governments to gather information necessary for compliance with Section 106 of the National Historic Preservation Act (NHPA) (36 CFR 800) and other applicable laws, regulations and orders. The general procedures will include efforts to identify historic properties that may be affected by the undertaking; the gathering of sufficient information to evaluate the eligibility of properties found for the National Register; and consultation among agencies and concerned parties to avoid or mitigate adverse effects to the significant properties (see Memorandum of Agreement (MOA) in Appendix A). If the properties are of value only for their research potential, and the State Historic Preservation Office (SHPO) approves data recovery as mitigation, then a determination of "no adverse effect" can be achieved. Mitigation for traditional cultural properties or properties judged significant for reasons other than research potential may require measures other than data recovery. In addition, there is concern about discovery of archaeological material or human remains while construction is in progress or as a later consequence of the new habitat development.

A MOA which sets forth the means by which the Corps will comply with Section 106 of the NHPA and other statutory requirements has been developed. The MOA will address such issues as monitoring during construction, treatment of newly discovered historic properties, and a plan to be applied if human remains are inadvertently discovered during construction or during long-term habitat development.

The MOA may also include additional stipulations to satisfy state legislation and concerns of state agencies. The SHPO will represent the state's interests, while the Corps will represent the interests of all other federal agencies whose lands are affected by the project in the development and implementation of the PA.

Mitigation Measures:
The MOA will ensure that all applicable federal and state statutes are complied with, and that terms and conditions in these regulatory permits and other official project authorizations are followed to eliminate or reduce adverse effects to cultural resources. All projects would be designed to identify historic properties and mitigate for any adverse effects. In addition, the following measures could be incorporated into individual restoration projects:

- All regulatory permits, official project authorizations, and compliance with applicable federal, state, and local regulations and ordinances (e.g., National Environmental Policy Act, National Historic Preservation Act, Level I Contaminants Survey, etc.) must be secured before project implementation. All terms and conditions in these regulatory permits and other official project authorizations must be followed to eliminate or reduce adverse impacts to cultural or historic resources.

- Significant modifications to an approved work plan must be reviewed and approved by appropriate agency personnel and the landowner(s) before the work can be carried out or continued. This may include change requiring modifications of permits, or alterations to the scope or intent of the project.

- Use existing roadways or travel paths for access to project sites, where feasible.

- All waste from project activities must be removed from the project site before project completion and disposed of properly.

- Include cultural resources studies as early as possible in project design to avoid late discovery of cultural or historical properties that could delay implementation of a project.

- Significant modifications to an approved work plan must be reviewed for cultural and historic resources if new disturbance to native sediments is included. Modifications must be approved before the work can be carried out or continued. This would include changes requiring modifications of permits, or alterations to the scope or intent of the project.

- Minimize the total construction area disturbed by clearing.

- Avoid use of heavy equipment and techniques that will result in excessive disturbance.

- Flag cultural and historic resources prior to construction, and monitor construction activities to ensure flagged properties are avoided.

- Have an onsite inspector who is familiar with how to address cultural resource issues.

- Monitoring should be performed within one year of project completion to ensure that restoration activities implemented at individual sites do not create unintended consequences for cultural and historic resources in the vicinity of the projects.

6.5 Socio-Economic Resources

The nature and scope of the restoration activities proposed under this plan preclude significant, basin-wide socio-economic impacts from occurring. No splitting of neighborhoods, isolation of ethnic groups, or separation of area residents from community facilities would occur. Property values should not decrease, and the economic health of area businesses should not be adversely impacted.

Aesthetic qualities of the Stillaguamish Basin would not be significantly affected by any of the proposed projects. Minor changes to views in localized areas and the temporary presence of construction vehicle would occur in the short term. The planting of riparian vegetation that would occur with the off-channel improvements, tributary rehabilitation, and bankline retrofitting projects may create a more natural appearance, thereby improving aesthetic qualities.

Construction vehicles may temporarily disrupt local traffic. Public services may be temporarily impacted by construction activities. The relatively high-risk nature of heavy construction may increase the likelihood of medical services being required at individual project sites. Construction equipment and careless smoking may increase the potential for fires in the area, especially during the dry summer months. Potential adverse impacts would not be expected to be significant.

A variety of recreation uses occur in or near the Stillaguamish river. Fishing, swimming and boating are the most common. Several of the projects include the placement of large woody debris in or near the waters edge. Impacts to recreational boaters could occur depending on where and how would is placed.

Mitigation Measures:
To reduce or minimize impacts on transportation within the basin, either temporary impacts associated with construction activities or long-term, the following measures could be incorporated into individual restoration projects:

- Develop a transportation plan for proposed restoration sites. The plan will include access considerations, scheduling, traffic control and specific transportation and traffic measures required by permits.
- Use existing roadways or travel paths for access to project sites.

To reduce or minimize impacts on recreation within the basin, either temporary impacts associated with construction activities or long-term, the following measures could be incorporated into individual restoration projects:

- Use properly muffled and maintained construction equipment.
- Minimize dust releases through the use of dust suppression techniques.
- Use proper traffic controls, including flaggers and signage where appropriate, to minimize traffic difficulties.
- Use existing roadways or travel paths for access to project sites, where feasible.
- For projects that include placing LWD in the mainstem channel, coordination with recreational boat clubs will occur. It may be possible to post LWD locations on a Web page for recreational boaters to access. Upstream signage alerting boaters of LWD should also be included.
- Include public access to natural resources through trails, viewpoints, and interpretive signs where associated environmental degradation would not be detrimental.

To reduce or minimize impacts on the visual quality and aesthetics within the basin, either temporary impacts associated with construction activities or long-term, the following measures could be incorporated into individual restoration projects:

- Place all construction staging and storage areas away from locations that would be clearly visible from recreational facilities/areas.
- Restore temporary roads and staging areas to pre-construction grades and revegetate those areas to reduce the amount of visual contrast.
- All waste from project activities must be removed from the project site before project completion and disposed of properly.

To reduce or minimize socioeconomic impacts and impacts on public services and utilities within the basin, the following measures could be incorporated into individual restoration projects:

- All applicable regulatory permits, official project authorizations, and compliance with federal, state, and local regulations and ordinances must be secured before project implementation. All terms and conditions in these regulatory permits and other official project authorizations must be followed to eliminate or reduce adverse impacts.
- Significant modifications to an approved work plan must be reviewed and approved by appropriate agency personnel and the landowner(s) before the work can be carried out or continued. This may include change requiring modifications of permits, or alterations to the scope or intent of the project.
- Restrict construction activities within 1,000 feet of residences to daytime hours. Additionally, no construction should be performed within 1,000 feet of an occupied dwelling unit on legal holidays, or between 10 p.m. and 7 a.m. on other days.
- Monitor the project sites for evidence of unauthorized use.
- During project construction, have a readily accessible water truck and/or chemical fire suppression materials available on-site to allow immediate fire response.
- Provide fire extinguishers on vehicles and equipment used during construction.
- Minimize or restrict high fire-risk activities during extreme dry weather periods.
- Provide project staff with cellular phones to enable timely communication with fire and emergency services.
- Provide appropriate sanitation facilities on-site during construction.
- Field locate and flag any existing underground utilities in the vicinity of the individual projects, and where avoidance is not feasible, use hand excavation methods.

6.6 Hazardous and Toxic Wastes

A preliminary evaluation was undertaken to identify the presence of hazardous and/or toxic wastes in the preferred ecosystem restoration sites, and to estimate the volume of any contamination. This initial screening included searching records and databases from EPA, Washington Department of Ecology, and METRO for information regarding known or suspected contaminated sites. Public groundwater-supply wells, CERCLIS, RCRA, and EPCRA sites, and PCS facilities were also noted. That information was then plotted on a map of the study area to determine proximity to preferred ecosystem restoration sites. The locations of the preferred restoration sites are outlined below along with potential HTRW issues of concern found during the preliminary screening.

Land surrounding the Stillaguamish river and its tributaries is used for major agricultural activities. All agricultural areas are suspect for herbicide, pesticide, and insecticide contamination of soil and water. Because of the long agricultural history of the area of interest, the presence of background concentrations of these contaminants and their degradation products is likely. This type of low level contamination is not considered in this report. This report includes only a qualitative analysis of known sources of contamination such as those listed in reports and databases as described above. A site visit will be preformed prior to any construction activities at the selected locations to visually determine the potential for HTRW hazards by locating clandestine dumping debris, identifying the condition of existing structures and prior land use, and obvious physical changes such as vegetation stress, recent grading, landfills and burning. During construction activities, samples for HTRW assessment should be taken at those locations identified as highly likely to contain hazards. That assessment will include characterization and/or quantitative investigation of chemical constituents of contaminated project sites.

A number of confirmed and suspected contaminated sites are listed in close proximity to parts of the study area. Several sites are located near the eastern reach of Portage Creek, south of Arlington; specifically the Unocal Bulk Plant Superfund Site and numerous hazardous waste sites affecting air, soil, groundwater, and drinking water. Most of the listed sites appear to be located some distance from ecosystem restoration sites and are not expected to affect construction activities. However, we will be cognizant of the proximity of restoration locations to manufacturing facilities, gas stations, hospitals and other buildings that may have released contaminants into soil or groundwater. As with any area, a major flood can potentially initiate a release of contaminants from the listed sites but that subject is outside the scope of this study. Additionally, river sediments may contain toxic or hazardous compounds that are unknown at this time; however, sediment testing is outside the scope of this initial survey.

HTRW concerns in the Stillaguamish river area are low with the exception of the area immediately south of Arlington and adjacent to Portage Creek. Portions of Portage Creek are immediately south of the city of Arlington where a number of CERCLA, RCRA, and TCI sites are listed. Specific river relocation areas identified as requiring excavation or other construction activities will be thoroughly investigated before work commences. The degree of concern necessary at specific restoration locations will be dependent upon what is found during the site visit. HTRW personnel will be on site prior to and during any geotechnical investigations to investigate the site and/or collect soil and water samples for analysis if necessary. Evaluation of samples will reveal if additional assessment regarding use of the site in this project are required. All other potential ecological restoration sites appear to be free of obvious HTRW concerns. Since there is potential for contamination due to agricultural activities or clandestine dumping at some sites, however, a full HTRW investigation will be conducted prior to specific restoration activities in order to decrease the risk of impact to projected activities.

6.7 Conclusions

Implementing some or all of the proposed 13 restoration projects should supply both immediate and long-term environmental benefits to the fish and wildlife in the Stillaguamish Basin. The proposed restoration plan attempts to take a balanced and reasonable approach. This plan does not propose to rectify all of the pressing issues associated with maintaining natural resources in a rapidly developing watershed. The restoration suggested in this plan does not include a return to the historic condition, nor does it address important management and regulatory initiatives. The focus has been on developing a set of restoration options that could be readily implemented. The result of this planning process is a focus on capital improvement projects that can provide immediate and long-term benefits to aquatic portions of the system. This plan proposes to improve ecological functions for a variety of aquatic species over the entire watershed by focusing on restoring riverine process. The proposal also considers the current condition of the valley, its residents, and its social needs. The planning effort focused on improving habitat functions without changing flood conditions or removing existing infrastructure.

While we consider this restoration plan as an important set of actions, it is not nor does it intend to be the complete answer to the resource problems of the Stillaguamish Basin. It is an important first step in balancing resource needs with other competing uses. However, other changes such as land use planning and fisheries management also need to occur if habitat degradation is to be truly reversed.

7. MONITORING

Monitoring is an important element of the restoration plan. There are several reasons for monitoring to be included in the plan itself, such as to improve the understanding of restoration methods, to reduce uncertainty in planning such projects in the future, to facilitate the use of adaptive management principles, and public education.

This section does not contain the actual monitoring plan. Rather it outlines the approach that the monitoring plan will incorporate. A monitoring plan will be approved by the technical committee for this study just prior to construction of the first projects in about 2002.

Monitoring will probably occur on a site- or project-specific level, as well as a river reach level and ecosystem (basin) level. To be meaningful, monitoring will be tied to the specific restoration goals of a particular project. Some larger scale monitoring will also be used to determine the cumulative effect of all the restoration projects by monitoring at the river basin level. Because there is much emphasis on restoring riverine processes where possible, geomorphic evaluation will be part of the monitoring plan. Analysis of sediment distribution, river cross sections, flow depths and aerial photos will be used to evaluate how successful the projects have been.

Three types of monitoring are proposed to answer the following questions:

- Implementation: Did we do what we said we would?
- Effectiveness: Did our actions have the desired effect?
- Validation: Were the assumptions that we made correct?

The steps that will be followed in developing a monitoring plan are described below.

7.1 Develop Specific Goals and Objectives

This will be done at a project level and basin level.

7.2 Develop Performance Criteria

Criteria will be based on program and project objectives. Program objectives are discussed in Sections 1.2, 3.3, and 5. Specific project objectives have also been developed.

7.3 Choose Monitoring Methods

Examples of sampling methods under consideration include:

- Estuarine Habitat Assessment Protocol (Simenstad et. al. 1991) will be used on restoration projects that occur in the estuary (such as the Port Susan and South Pass projects).
- For other projects standard methods will be used to assess fish presence and use such methods as seining or electroshocking.
- Percent cover of vegetation and species will be documented.
- For invertebrate analysis, the assessment of biotic integrity will be used (Karr 1981).
- Physical data such as water quality will focus on dissolved oxygen, temperature and sedimentation and be consistent with the "Standard Methods for Evaluating Water and Wastewater".
- Birds and other wildlife will also be evaluated usually for presence/absence and perhaps some behavior and productivity at selected projects.

The scale of effect for restoration activities is also of interest. This would include both temporal and spatial scales. Important considerations besides the methodologies will be the timing, frequency and duration of sampling. From a timing perspective, individual projects will be monitored over five years but not necessarily every year. A typical project would be monitored in years one, three and five after construction. From a spatial perspective, projects will be monitored throughout the river basin.

To determine effects at an ecosystem scale, a variety of methods can be used. They include financing a screw trap (a tool for a particular type of fish sampling) and analysis. In areas where large woody debris and gravel is placed, river cross section will be evaluated at several locations over time.

7.4 Manage the Data and Report Results

The Corps will maintain a database on the results and issue a report every two years after monitoring has been initiated.

7.5 Feedback Mechanisms

Using the results obtained from monitoring and based on project objectives, there will be an opportunity to adaptively manage the restoration projects. For each project that is not achieving its potential, contingencies will be developed. These contingencies or remedies fall into three broad categories:

- No Action
- Maintenance (physical actions to move the program or project towards the desired objectives)

- Modification of project goals and objectives

References that used to help develop the final monitoring program include:

- Planning Aquatic Ecosystem Restoration Monitoring Programs, Ronald M. Thom et al., 1996, IWR Report 96-R-23

- Planning and Evaluating Restoration of Aquatic Habitat from an Ecological Perspective, David Yozzo et. al., IWR report 96-EL-4 1996.

Prior to initiating any fish monitoring, permits will be obtained from the appropriate resource agencies (USFWS, NMFS, WDFW).

7.6 Operation and Maintenance

An operation and maintenance plan will be developed for each project during the final design phase and prior to construction of the project.

8. CUMULATIVE EFFECTS

The proposed restoration projects would have beneficial cumulative effects with other habitat enhancement projects, and would tend to counteract some of the adverse impacts of development projects on habitat and related natural resources. The potential for cumulative short-term construction impacts is limited by the potential for the projects under consideration to overlap in time and space. The beneficial effects of habitat restoration are less localized and temporary, so they have more potential for cumulative impacts.

Restoration projects are designed to restore or enhance lost or degraded habitat functions and to reduce the fragmentation of habitat areas. The projects are expected to restore ecological functions among the habitats throughout the Stillaguamish River, so that overall impacts should be beneficial to species which use these habitats.

There are no anticipated additional indirect impacts to wildlife other than those described in the previous sections. There is potential for both beneficial and adverse cumulative impacts to wildlife resulting from restoration and enhancement activities conducted under any action alternative plan (e.g., converting upland to wetland) and other projects occurring in the vicinity of the primary and expanded study areas.

It is anticipated that restoration would benefit threatened and endangered species by increasing foraging habitat, providing habitat for degraded natural resources and services, and creating additional habitat. It is anticipated that adverse cumulative impacts to endangered, threatened and/or sensitive species would not occur

Indirect air quality impacts of restoration projects implemented under any action alternative would result from vehicle emissions from employees driving to and from the project sites during construction and for post-construction maintenance and monitoring.

These indirect emissions would be a very small fraction of the total airshed contaminant burden during construction, with long-term indirect emissions to be significantly less.

Cumulative long-term (residual) air quality is expected to improve from implementing any of the proposed restorations through extensive plantings. Oxygen production may increase. Construction activities are not expected to contribute any increase in criteria pollutant emissions.

Indirect impacts include those that may be attributed to the proposed action but are further removed in time or distance from the direct effects. Such impacts to land use and aesthetics are not anticipated to result from any of the alternatives, particularly since no significant direct effects to this resource are anticipated.

Carefully coordinated design and monitoring should make detrimental cumulative environmental impacts insignificant, including those resulting from the incremental impacts of the project. Since other habitat restoration or environmental remediation projects, land development or redevelopment activities, and the local governmental plans or policies would also be regulated by the same federal and state land planning and management regulations, it is unlikely that there would be adverse cumulative effects. Indeed, local ordinances, policies, and plans stress the importance of integrated efforts for the preservation and restoration of the area's vital natural resources. Therefore, there are no known actions, or current or future proposals, from which significant cumulative impact to land use or aesthetics could result in the study area.

Due to the fact that the potential for direct impacts upon utilities and public services from any of the discussed alternatives is small, any chance of additional substantive, direct, indirect, or cumulative impacts should also be remote.

Since none of the action alternatives are proposed to be conducted in areas designated for housing, direct, indirect, and cumulative impacts on population and housing should be negligible. Since none of the action alternatives are proposed to be conducted in areas designated for transportation projects, no direct, indirect or cumulative impacts on transportation are expected.

9. RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The proposed Stillaguamish River restoration program is intended to restore or improve habitat for anadromous fish, with some benefits to wildlife resources. These activities will restore a portion of the historic habitat conditions and functions within the Stillaguamish Watershed. The principal goal of the program is to achieve long-term enhancement of biological and natural resource productivity in the restoration areas. The proposed program is expected to reduce the harmful effects of human short-term uses of the environment that have occurred over time, and to promote long-term productivity within these restoration areas. This program will result in an improved productivity condition within the watershed that will benefit aquatic and terrestrial resources.

10. PROBABLE IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF RESOURCES

The proposed restoration program would not entail any significant irretrievable or irreversible commitments of resources. Construction of some habitat improvements would require importing materials such as rock, soil, gravel, and vegetation. Construction of structures such as culverts will require building materials such as steel, wood, plastic, or concrete, all resources that are plentiful and recyclable if so desired. The restoration projects would entail long-term commitment of land for fish and wildlife habitat purposes in lieu of other possible societal uses.

11. ENVIRONMENTAL COMPLIANCE

Coordination with agencies, Tribes and the general public has been an integral part of the Stillaguamish Ecosystem Restoration program. At the initiation of the study it was realized that there was no chance for success unless time and effort went into getting the public Tribes and agencies involved. To this end several mechanism were set up to facilitate this involvement, including:

- Creation of a technical work committee that developed the restoration plan. This group was comprised of Tulalip and Stillaguamish Tribal staff, U.S. Forest Service, U. S. Fish and Wildlife Service, State Department of Fish and Wildlife, the Corps, Snohomish County and local citizens. The technical committee was responsible for developing goals and objectives, identifying and evaluating projects, providing resource information that was used in plan formulation and acted as a conduit for implementing public participation.

- Development and distribution of the Reconnaissance Report. During the initial phases of the study a report was generated describing the proposed restoration activities. The draft report was circulated to obtain comments. These comments were incorporated into the final document.

- Public Outreach. An informational booth that described the proposed restoration activities was part of the Stillaguamish River Festival for the past four years.

- Public meetings. Several public meeting were held through out the lower Stillaguamish River Basin to obtain public input of the restoration plan. Meeting announcements were published in the local paper and members of the technical committee moderated the meetings.

- Field Trips. Several field trips were conducted for interested agency and the public to the various restoration sites.

- This Environmental Assessment has been extensively coordinated with local agencies and Tribes before the final document was developed. The Draft EA was distributed to agencies, Tribes and local citizens. A total of 32 copies were sent out for a thirty-day review (please see the distribution list in Appendix B). At the end of that period only four comments were received; these letters are included in Appendix C. Three of the comments agreed with the multi-species approach taken. Two comments requested more references in the document. These comments were addressed and included in the Final EA. Another comment concurred with the recommendation to conduct a professional archaeological survey of the identified project impact areas. The final EA and Finding of No Significant Impact (FONSI) will be distributed to the original distribution list that is included in Appendix B.

11.1 Compliance with Environmental Statutes

Various federal and state statutes may apply to the proposed construction activities. Public hearings may also be required. In-water projects require review by several resource agencies. Restoration work may also require compliance with various construction codes and health and safety and labor laws.

Key environmental statutes for which some compliance action is required are discussed briefly below. In addition, Tables 4 and 5 provide a summary of compliance requirements and sequencing.

11.1.1. National Environmental Policy Act

The National Environmental Policy Act (NEPA) was enacted in 1969. The act allows for the preparation of a joint NEPA/SEPA document for a single program or project, to avoid duplication of effort and reduce paperwork when federal and state/local permits are required. For this project, the Seattle District of the Corps of Engineers is the federal NEPA agency and has chosen to develop an Environmental Assessment (EA). The Corps distributed the draft document to affected Tribes and agencies for a 30-day comment period, then finalized and redistributed the Final EA. The comments that were received were incorporated in this final Environmental Assessment. If new information on individual projects arises, any issues requiring further analysis will be revisited in subsequent project-specific NEPA documents.

11.1.2. State Environmental Policy Act

The Washington State Environmental Policy Act (SEPA) was developed based upon NEPA and was enacted in 1971. Snohomish County, Surface Water Management is the lead local agency for SEPA for this project. The County may adopt this NEPA EA under the appropriate SEPA procedures. It is anticipated that separate SEPA documents will be prepared for site specific actions.

11.1.3. Endangered Species Act

In accordance with Section 7(a)(2) of the Endangered Species Act of 1973, as amended, federally funded, constructed, permitted, or licensed projects must take into consideration impacts to federally listed or proposed threatened or endangered species. At this point in the study, the Corps is in partial compliance with this statute. Programmatic BAs for chinook and coho salmon, bull trout, bald eagle, marbled murrelet and Northern spotted owl are currently being prepared for the Stillaguamish Basin restoration program and are expected to be submitted shortly.

The Corps has consulted with both the National Marine Fisheries Services and the U.S. Fish and Wildlife Service regarding potential impacts to federally listed species. The Corps will continue to consult with both agencies, under the Endangered Species Act Section 7 consultation process, as necessary and appropriate in order to maintain compliance with this federal statute.

11.1.4. Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 USC 470) requires that wildlife conservation receive equal consideration and be coordinated with other features of water resource development projects. This goal is accomplished through Corps funding of U.S. Fish and

Wildlife Service (USFWS) habitat surveys evaluating the likely impacts of proposed actions, which provide the basis for recommendations for avoiding or minimizing such impacts.

Coordination with USFWS has been ongoing throughout the study process. During the initial phase of study USFWS provided a Planning Aid letter that was supportive of the restoration program. In September 2000, the USFWS provided a Coordination Act Report (CAR) that further discussed fish and wildlife issues and recommendations. The Final CAR can be found in Appendix D. In the CAR, the USFWS offered their general support to the restoration program. They had a few questions on specifics of two projects which will need to be clarified later in the planning process. The USFWS is also a member of the technical committee that is involved in planning of the restoration activities. Their involvement in the committee is expected to continue thought the life of the project.

11.1.5. Clean Water Act

Under Section 404 of the Clean Water Act (CWA), a permit[2] is required for the discharges of dredged or fill material into water of the United States. Waters of the United States is defined to include wetlands. Site or project specific compliance under Section 404 will occur prior to any construction.

Under Section 401 of the CWA, a Water Quality Certification is required for activities requiring a federal license or permit, which may result in any discharge into the navigable waters. The certification, issued by the State of Washington Department of Ecology, ensures that the discharge will comply with the applicable provisions of Sections 301, 302, 303, 306 and 307 of the CWA. In order to obtain the required certification, the State of Washington may require a water quality modification.

11.1.6. Coastal Zone Management Act

The Coastal Zone Management Act of 1972, as amended requires Federal agencies to carry out their activities in a manner which is consistent to the maximum extent practicable with the enforceable policies of the approved Washington Coastal Zone Management (CZM) Program. The Shoreline Management Act of 1972 (RCW 90.58) is the core of authority of Washington's CZM Program. Primary responsibility for the implementation of the SMA is assigned to local government. Snohomish County implemented the SMA through the preparation of a Shoreline Master Program, which was approved by the Department of Ecology on December 27, 1974.

Copies of the Draft EA and Draft Restoration Plan have been provided to the Department of Ecology and Snohomish County. Evaluation of coastal zone consistency will be performed during project-specific permitting processes.

[2] If the lead agency for a project is the Corps of Engineers, a permit is not issued. Instead Corps staff prepares a 404 evaluation, which demonstrates compliance with the substantive requirements of the CWA.

11.1.7. Clean Air Act

The Clean Air Act required states to develop plans, called State implementation plans (SIP), for eliminating or reducing the severity and number of violations of National Ambient Air Quality Standards (NAAQS) while achieving expeditious attainment of the NAAQS. The Act also required Federal actions to conform to the appropriate SIP. An action that conforms with a SIP is defined as an action that will not: (1) cause or contribute to any new violation of any standard in any area; (2) increase the frequency or severity of any existing violation of any standard in any area; or (3) delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

Under the Federal General Conformity Rule (40 CFR Parts 6, 51, and 93), direct and indirect air pollutant emissions that are generated within a nonattainment area or a maintenance area as a result of a federal action are regulated. Because the activities proposed by this project would constitute actions by one or more federal agencies, the activities would need to be considered for conformity with the State Implementation Plan (SIP). Portions of the project area lie within the nonattainment area for particulate matter (PM-10) and maintenance area for carbon monoxide (CO) and ozone. As precursors to ozone, volatile organic compounds (VOCs) and nitrous oxides (NOx) are the regulated air pollutants that are subject to conformity within an ozone maintenance area.

Typical activities anticipated for restoration projects whose emissions (including carbon monoxide, particulates, volatile organic compounds, and nitrous oxides) would need to be included in the conformity analysis include, but are not limited to, those mentioned above. Activities would need to be specified according to location (inside or outside the nonattainment/maintenance area boundaries), type of equipment, and hours of operation. From these data, total emission estimates for each of the criteria pollutants (CO, PM-10, VOCs, and NOx) can be estimated using EPA emission equations and models.

If none of the applicable threshold values are exceeded, the projects are not subject to further conformity analysis under the SIP. If one or more of the threshold values is exceeded, measures to offset, mitigate, or otherwise reduce the emissions must be identified so that there is no net increase in the emissions of that particular pollutant.

The types of projects anticipated are far smaller than highway construction, port dredging, or commercial development projects. The sites where restoration construction projects are anticipated to occur are limited in size and the construction duration would generally be limited. In general, approximately one to three projects per year might be implemented under this program, not all of which would involve physical construction activities (e.g., land clearing, construction vehicles, etc.). As a result, it is unlikely that annual emissions for these projects will exceed the applicable annual thresholds. Nonetheless, as the projects are specified and scheduled, the annual emission estimate calculations must be performed to verify that the conformity thresholds are not exceeded.

11.1.8. National Historic Preservation Act

Section 106 of the National Historic Preservation Act (16 USC 470) requires that a federal agency having direct or indirect authority to issue a license authorizing an undertaking shall take into account the effect of the undertaking on historic properties.

The Section 106 process includes research and field investigation in consultation with the Washington State Office of Archaeology and Historic Preservation, the Advisory Council on Historic Preservation, and concerned Tribes and local governments. The process generally includes identifying historic properties that may be affected by the project; gathering information sufficient to evaluate the eligibility of properties found for the National Register; and consulting among agencies and other concerned parties to avoid or mitigate adverse impacts on significant properties. If the properties are of value only for their research potential, and the State Historic Preservation Office approves data recovery as mitigation, then a determination of “no adverse effect” can be achieved. Mitigation for traditional cultural properties or properties judged to be significant for reasons other than research potential may require measures other than data recovery. There is also concern about discovery of archaeological material or human remains during construction or as a later consequence of habitat development.

In order to comply with the National Historic Preservation Act, as well as the American Indian Religious Freedom Act, the Native American Graves Repatriation Act, and the Washington State Indian Graves and Records Act, the Corps has maintained coordination with the SHPO, affected Indian Tribes, and the Advisory Council on Historic Preservation (see MOA in Appendix). In addition, discussions with the Mt. Baker-Snoqualmie National Forest Archaeologist confirm that the Forest Service will be specifically consulted in regard to historic properties on their land (e.g., sites around the Gold Basin Campground) that may be affected by the project.

11.1.9. Washington State Hydraulic Code

Work that uses, diverts, obstructs, or changes the natural flow or bed of any freshwater or saltwater of the state requires a Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (WDFW). The statutory authority for this requirement is contained in Chapter 75.20 RCW and Chapter 220-110 WAC.

HPAs may be needed for restoration projects since most would involve some degree of work within the streambed of the Stillaguamish River and its tributaries (these would be obtained by the local sponsor for the project). WDFW has provided technical support for this program and they are members of the technical committee that is involved with projects selection and design. Continued coordination with WDFW will occur throughout the remainder of the Ecosystem Restoration study.

11.1.10 Executive Order 12898, Environmental Justice

Executive Order 12898 directs every Federal agency to identify and address disproportionately high and adverse human health or environmental effects of agency programs and activities on minority and low-income populations.

The Tulalip and Stillaguamish Indian Tribes constitutes a distinct, separate community of Native Americans who rely on Treaty-reserved fish for subsistence, economic, and spiritual purposes. The implementation of the preferred alternative is not expected to result in any disproportionate adverse environmental effects or impacts on the health of tribal members, or other minority/low-income populations.

The project does not involve the siting of a facility that will discharge pollutants or contaminants, so no human health effects would occur. No interference with Tulalip or Stillaguamish treaty rights is anticipated, as construction would not physically interfere with fishing in usual and accustomed places, and the restoration plan is intended to beneficially impact fishery resources. Implementation of the proposed projects would not negatively affect property values in the area, or socially stigmatize local residents or businesses in any way.

11.1.11 Native American Coordination

In the past several years a renewed emphasis has been placed on coordination with Native American Tribes by federal agencies. Not only are there a legal requirements for federal agencies to conduct this coordination but there is also an understanding that when natural resources are involved, the Tribes have both expertise and information to provide. For the Stillaguamish Ecosystem Restoration, informal coordination occurred from the onset of the project. While formal coordination meetings have yet to transpire, both the Stillaguamish and Tulalip Tribes in cooperation with Snohomish County were instrumental in initiating the study. Both the County and the Tribes were integral in establishing the Stillaguamish Implementation Review Committee, which first addressed the resource problems in the Basin. This was followed by a watershed assessment of the Stillaguamish to address impacts to coho salmon. Both products provided much of the technical foundation for the Restoration study and led to identification of projects. The majority of informal tribal coordination for this project has come through the study's technical committee (reference the beginning of this section). Both Tribes are members and regular participants of this group. As the study progresses, the close coordination that was established from the onset will continue.

Table 4. Compliance with Applicable Laws and Regulations[3]

Law/Regulation	Scope	Responsible Agency	Compliance	Permit
Federal				
National Environmental Policy Act of 1969 (NEPA), 42 USC 4321-4370d; 40 CFR 1500–1508	Disclosure of environmental impacts of proposed project; evaluation of alternatives. Applies to federal actions.	Federal lead agency, EPA	Full compliance	No
Clean Water Act (CWA), 33 USC 1251 et seq.; Section 404 and 301	Regulating discharge of dredge and fill material in waters of the U.S.; protection of wetlands.	Corps, EPA	Project-specific	Yes
Clean Water Act, Sections 401 and 402	Compliance with state water quality standards.	Ecology	Project-specific	Yes
Rivers and Harbors Act of 1899, 33 USC 403, et seq.; Section 10	Prohibits obstruction or alterations of navigable waters. Regulates construction of any structures within navigable waters of the U.S.	Corps	Project-specific	Yes
Endangered Species Act (ESA), 16 USC 1531 et seq.	Continued existence of listed threatened and endangered species.	USFWS, NMFS	Partial compliance	No
Coastal Zone Management Act (CZMA), 16 USC 1451 et seq.	Compliance with CZMA for protection of coastal zone[4][5]	NOAA, Ecology	Project-specific; review at state level.	No
Fish and Wildlife Coordination Act	Protection of fish and wildlife. Applies to federal actions only. The Act is currently being modified.	USFWS	Full compliance	No
Clean Air Act (CAA), 42 USC 7401 et seq.	Prevention of degradation of air quality.	EPA, Ecology	Project-specific.	No
National Historic Preservation Act (NHPA), 12 USC 470 et seq.	Preservation/protection of historic and prehistoric resources.	State, Tribes	Protect-specific; review at state level.	No
Federal Treaties with Treaty Tribes	Reserved hunting and fishing rights to signatory tribes.	Federal	Project-specific; review at federal level.	No.

[3] Some state and local permits may not be applicable to Corps projects.
[4] The local sponsor may want to obtain a Shoreline Substantial Development Permit and/or a Shoreline Designation rezone.
[5] The local sponsor may want to obtain a Hydraulic Project Approval (HPA).

Law/Regulation	Scope	Responsible Agency	Compliance	Permit
Archaeological Resources Protection Act, 16 USC 470 et seq.	Secures protection for archaeological resources and sites on public lands and Indian lands.	Federal	Project-specific when public lands involved.	No
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	Identification and addressing disproportionately high and adverse human health or environmental effects of programs, policies, on minority and low income populations	Federal	Programmatic and project-specific; NEPA documentation	No
Marine Mammal Protection Act, 16 USC 1361 et seq.	Protection for marine mammals and their parts, and products.	Federal	Project-specific	No
Migratory Bird Treaty Act, 16 USC 703 et seq.	Regulates harvest of migratory birds and impact of facilities to migratory birds	Federal	Project-specific	No
State				
State Environmental Policy Act (SEPA), Ch. 43 RCW	Disclosure of environmental impacts of proposed project; evaluation of alternatives.	Lead state/local agency Ecology	Partial compliance if EA is adopted by the state. Project-specific SEPA documentation may also required. Local review.	No
Aquatic Lands, Ch. 79.90 RCW	Navigation and commerce; management of wildlife habitat, natural area preserves.	WDNR	Project-specific use authorization required.	No
National Forest Management Act 1976 PL94-588	Provides consistency with Forest Management Act and Aquatic Conservation Strategy	USFS	Project Specific Review	No
Shoreline Management Act	Protection of shoreline/coastal areas and resources. Meets federal requirements under CZMA.	Local government, Ecology	Project-specific	Yes
Growth Management Act	Controls urban development. Protection of sensitive resources.	Local and county government, Ecology	Project-specific. Local jurisdictional review.	No
Forest Protective Act	Management of timber adjacent to state waters.	WDNR	Project-specific	Yes
Hydraulic Project Approval, Ch. 75.20 RCW	Protection of aquatic life, beds, and flow of state waters.	WDFW	Project-specific	Yes

Law/Regulation	Scope	Responsible Agency	Compliance	Permit
Washington Water Pollution Control Act	Governs discharges to state waters.	Ecology	Project-specific	Yes
Local[6]				
Zoning Ordinances	Restricts types of development within designated zones.	Local government	Project-specific	No
Clearing and Grading Ordinances	Regulates clearing and grading activities.	Local government	Project-specific	Yes
Noise/Nuisance Ordinances	Restricts noise and nuisance levels.	Local governments	Project-specific	No

[6] Some of these permits may not be applicable to all projects.

Table 5. Sequencing of Permit and Compliance Activities[7]

Activity	Applicability	Agency	Duration
1. Negotiation with property owner	Following appropriate site selection	Local jurisdiction	Indefinite
2. Pre-meetings with local governments	Following appropriate site selection	Planning/Zoning and Shoreline offices	Indefinite
3. Local zoning and environmental review	Upon submission of zoning application and SEPA checklist	Snohomish County Planning/Zoning, Ecology	1 to 12 months
4. Shoreline substantial development application	If project located adjacent to state waters	Local/Ecology	30 days
4a. NEPA	Project-specific NEPA compliance	Corps	4 months
4b. SEPA checklist (adopt NEPA EA for SEPA compliance)	Project-specific SEPA compliance	Snohomish County	4 months
5. Grading and excavation permit application; local approval; sensitive and/or critical area ordinance	Disturbance of 50 of more cubic yards of soil or clearance of vegetation	Snohomish County and local municipalities	1 to 2 months
6. Pre-meetings with state and federal agencies	Following site selection and local pre-meetings	Various state/federal	Indefinite
7. Aquatic access application	If project involves state-owned aquatic lands	WDNR	Indefinite
8. Hydraulic project approval	Effect or impact within ordinary high water mark of state waters	WDFW	1 to 2 months
9. NPDES application	Potential to discharge storm or surface runoff; at least 5 acres of disturbance	Ecology	1 to 3 months
10. Short-term modification of water quality permit application	Potential to affect quality of state waters	Ecology	1 to 2 months
11. Forest Practices Act Permit application	Timber removal near state waters	WDNR	1 month

[7] Some state and local permits may not be applicable to Corps projects.

Activity	Applicability	Agency	Duration
12. Corps Section 404 Permit	Dredge or fill in U.S. waters	Corps	Will depend on scope of work
13. Endangered Species Act coordination	Impacts on federally endangered species	NMFS, USFWS	Individual: 6 to 12 months Reevaluation of species presence prior to project implementation
14. Corps Section 10 Permit	Structures or excavation in U.S. waters	Corps	Will depend on scope of work
15. 401 Water Quality Certification	When Section 404 applies	Ecology	3 to 12 months
16. Tribal review	Potential to impact treaty rights	Tribe	Indefinite

12. CONCLUSIONS

This Environmental Assessment has included an examination of all practicable alternatives for meeting the goals and objectives of the Stillaguamish Ecosystem Restoration Study. The selected program alternative, the multi-species approach, and its associated projects are the most effective option that also meets the sponsor's needs. The proposed plan provides improved fish and wildlife benefits at a reasonable cost. The plan is consistent with national policy, statutes and administrative directives. The plan has been reviewed in light of overall public interest, which includes the views of the local sponsor and interested agencies. As a result of the long construction timeframe—ten years to complete all the projects—and the foregoing analysis, the projects contained in this study are not considered to be major federal actions that will significantly affect the quality of the human environment. Therefore, it has been determined that the preparation of an environmental impact statement is not warranted. Please reference the signed "Finding of No Significant Impact" in Appendix E.

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