U.S. Army Corps
of Engineers
Seattle District

Snohomish County
WASHINGTON

STILLAGUAMISH RIVER ECOSYSTEM RESTORATION
FINAL FEASIBILITY REPORT

STILLAGUAMISH RIVER
SNOHOMISH COUNTY, WASHINGTON

NOVEMBER 2000

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Executive Summary

Within the Puget Sound watershed, including the Stillaguamish River Basin, several anadromous fish stocks and wildlife species are either listed (chinook salmon, bull trout) or proposed for listing (coho salmon) as threatened under the Endangered Species Act. Environmental quality in the Stillaguamish River Basin ecosystem has been significantly impaired by the cumulative effects of industry, urbanization, agriculture, historic forest practices, and hydraulic modifications. The Stillaguamish River has experienced vast changes including: 1) partial filling of the estuary; 2) construction of a series of revetments and rechannelization sites by the Corps of Engineers in the 1930s; 3) construction of an extensive system of levees (primarily for agricultural development); 4) drainage and filling of wetlands; and, 5) timber harvesting in the upper basin. These changes have led to significant fish and wildlife degradation in the basin. While the degradation and elimination of natural fish and wildlife habitats in the basin has been extensive, there remain numerous opportunities for ecosystem restoration.

In an effort to address these issues, Western Washington's Snohomish County requested that the Corps of Engineers Seattle District partner with them to conduct a study under the Puget Sound and Adjacent Waters Authority, Section 209 of the Flood Control Act of 1962. $300,000 was appropriated for this effort in the 1996 Appropriation Act. The focus of this study was to address environmental problems related to hydrologic and hydraulic conditions in the Stillaguamish River Basin. This feasibility report documents the study including: identification of environmental problems and opportunities, evaluation of alternative solutions, description of the selected ecosystem restoration plan, discussion of federal and non-federal responsibilities for plan implementation, and recommendations.

The proposed Ecosystem Restoration Plan (Plan) recommends restoration features throughout the Stillaguamish River Basin that span from the river's tidal estuaries to spawning and wildlife areas in the upper basin. The Plan includes proposed restoration features at 10 sites within the basin that would provide critical salmon habitat, including spawning, rearing, refugia, and estuarine habitats. The plan will restore or reconnect access to 1,483 acres of habitat at a total implementation cost of $24,223,000 (October 2000 price level).

The Ecosystem Restoration Plan has been developed with extensive coordination with the interested federal, state, and local agencies as well as the project sponsor, Snohomish County, Washington. Along with Snohomish County, the recommended plan has the support of the Stillaguamish Implementation Review Committee (SIRC), the Stillaguamish Tribe, the Tulalip Tribe, the Washington State Department of Fish and Wildlife, and the U.S. Fish and Wildlife Service. Other interested agencies and citizens participated in the study process. The Plan was formulated consistent with planning guidance in Corps Engineering Regulation 1105-2-100, applicable federal laws, and executive orders. The Plan addresses requirements of environmental protection statutes regarding actions taken to comply with the Fish and Wildlife Coordination Act, the Endangered Species Act, and the National Historic Preservation Act.

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1. INTRODUCTION

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, is no exception. Over time, the effects of industry, urbanization, agriculture, and historic forest practices have resulted in vast changes throughout the Stillaguamish River watershed. Changes have included the partial filling of the estuary, construction of a series of revetments and rechannelization sites by the Corps of Engineers in the 1930s, construction of an extensive system of levees (primarily for agricultural development), drainage and filling of floodplain wetlands, and harvesting of timber in the upper watershed. These changes 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 cutthrout trout are candidate species for listing under the Endangered Species Act. With much of the watershed's natural habitats for these nationally significant species destroyed or degraded, there are intense needs and numerous opportunities for ecosystem restoration.

1.1 Study Authority

The Stillaguamish River Basin Ecosystem Restoration Study is authorized by, Section 209 of the Flood Control Act of 1962 (Public Law 87-874), which allows the Corps to conduct a comprehensive study of the Puget Sound and Adjacent Waters in western Washington. Congress initially authorized this study in the Energy and Water Development Appropriations Act of 1996 with an appropriation of $300,000 for a reconnaissance study. The reconnaissance phase was completed and the Feasibility Cost-Sharing Agreement was signed with Snohomish County in 1998. The feasibility phase of study was initiated in 1999, resulting in this feasibility report.

1.2 Study Purpose and Scope

The purpose of this ecosystem restoration project is to restore fish and wildlife habitat that was lost as a result of human activities throughout the watershed. Agricultural practices in the lower Stillaguamish watershed, rural development in the mid watershed, and forest practices in the upper watershed, all have had significant negative effects on the river and its ecosystem.

The scope of this study was to formulate a project that addressed critical habitat restoration needs throughout the Stillaguamish River watershed; from tidal estuaries in the lower watershed to spawning and rearing habitats in the mid- and upper watershed. While restoration focused on one part of the basin

would provide localized fish and wildlife habitat benefits, the synergy and cumulative benefits gained by restoring habitats in all parts of the basin far outweighs the simple sum of benefits from individual sites.

1.2.1 Study Goal

The overall goal of the Stillaguamish River Ecosystem Restoration Study is to recommend measures that will restore diverse and sustainable riverine habitats on an ecosystem scale within the study area. A primary goal of the study is to recommend restoration of habitats for riverine life stages of anadromous fish in the study area.

1.2.2 Specific Objectives

Specific ecosystem restoration study objectives include:

- Restoring estuarine habitats
- Restoring salmon spawning habitats
- Restoring juvenile salmon rearing and refugia habitats
- Rehabilitating degraded tributaries

1.3 Study Area

The Stillaguamish River watershed (Figure 1) is within the Puget Sound Trough in northwestern Washington State. The watershed is bounded on the east and the north by the Skagit River watershed, on the south by the Snohomish River watershed and on the west by Puget Sound. The river's headwaters begin high in the Cascade Mountain Range, flowing westward about 43 miles to the shores of Puget Sound.

1.3.1 Climate

The climate is characterized as maritime. Typical conditions bring cool wet winters and mild summers. Mean annual precipitation averages 30 inches in the western lowlands. The forested foothills of the Cascades have a mean annual average precipitation of 80 inches. Approximately 75 percent of the watershed's precipitation falls between the months of November and March. At elevations greater than 3,000 feet, much of the precipitation may fall as snow. Major winter and spring flood events can occur when warm tropical rainstorms result in heavy rain at high elevations (rain on snow events). Peak flows typically occur from November to March and result primarily from rain on snow events. Snowmelt can cause secondary peak flows in the early summer periods, typically in May.

1.3.2 Topography

There are a wide variety of topographic formations in the watershed; including mountains, narrow canyons, gently rolling foothills, and level benchlands. The North Cascades area, of which the Stillaguamish Basin is a portion of, is topographically irregular and is characterized by peaks and valleys shaped by glacial activity. The drainage of the South Fork of the Stillaguamish begins at Three Fingers Peak (the highest mountain on the South Fork at 6,854 ft) in the Cascade Mountains and drops more than 3,600 feet in about eleven miles. For the ensuing four miles, the South Fork enters an expansive floodplain region until it reaches the confluence with North Fork at Arlington. The North Fork rises in a glaciated valley from a high point at Whitehorse Mountain (elevation of 6,890 feet) and joins the South Fork at an elevation of about 100 feet. The mainstem valley floor starts at the confluence and gradually slopes downward towards Port Susan where it meets the waters of Puget Sound.

1.3.3 Drainage

The drainage area of the watershed is approximately 684 square miles and includes more than 890 miles of anadromous stream habitat, which represents about 31% of the total stream network. The two main branches of the Stillaguamish River are the North and South Forks that form the main stem in Arlington (plates 2,3,4). The River enters Puget Sound through 3 distributaries: 1) Hatt's Slough, 2) South Pass (both enter Port Susan Bay), and 3) West Pass (that enters Skagit Bay).

2. EXISTING PROJECTS, PRIOR STUDIES, AND REPORTS

2.1 Prior Studies and Reports

In order to identify and evaluate potential restoration features in this study, a variety of resources were consulted. These include: a) 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), b) regional scientific studies of critical factors influencing habitat quality in 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 c) studies specific to the Stillaguamish basin (e.g. Benda et al. 1992, Collins et al. 1994). In addition, a number of studies and analyses have been initiated in recent years specifically to characterize the condition of the watershed (or sub-watersheds), to identify factors limiting ecosystem function, and to isolate potential restoration actions that might substantially improve particular problem areas or deficiencies. These studies and resources were consulted during this feasibility study to take advantage of existing information to the fullest extent. Some of these studies are summarized below in the following paragraphs.

Problem identification also involved a series of meetings and field reviews that brought together interested agencies and organizations as well as biologists familiar with the basin to discuss resource issues from a variety of perspectives. Input from residents of the basin was incorporated in the problem identification phase in the form of survey results from a study conducted by the Department of Ecology (Gersib and Blake 1997).

2.1.1 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. 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 to meet specific restoration objectives.

2.1.2 Stillaguamish River Sub-Basin Summaries and Restoration Strategies

The Stillaguamish Implementation Review Committee (SIRC), Restoration Subcommittee 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 trout and salmon habitat in 13 Stillaguamish sub-basins (SIRC 1995). The draft plan is considered a work in progress that continues to be refined as new information becomes available.

2.1.3 Snohomish County and Tribal Resource Inventory and Planning Documents

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

2.1.4 Forest Service Studies

The U.S. Forest Service 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 conducted 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.

2.1.5 State of Washington Studies

The State of Washington has conducted numerous studies throughout the basin. The Department of Ecology's Deer Creek Watershed Analysis and Washington State Conservation Commission (1999) are two significant reports dealing with the basin.

2.1.5 Corps of Engineers Vegetation Mapping and Resource Inventory Compilation

The Seattle District, Corps of Engineers has assembled various resource maps 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 [such as the Washington Rivers Information System (WARIS) (Hudson and Knutson 1993)], or with modifications and improvements developed in the course of studies conducted by the Department of Ecology, Snohomish County, the Stillaguamish Tribe and the Tulalip Tribes, 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 this study.

2.1.6 Corps of Engineers Flood Control Studies

The Seattle District Corps of Engineers has published several reports on flood control for the lower Stillaguamish River and the Stanwood Area. Reports were completed in 1935, 1967, and 1980 but City of Stanwood support was not previously obtained for the local cost share of a flood control project. A Section 205 flood control study for the lower Stillaguamish River is underway at the time of preparing this report and has multiple local entities supporting the project, in addition to the City of Stanwood.

3. BASELINE CONDITIONS

3.1 Baseline Conditions

An assessment of baseline conditions was conducted for the Stillaguamish Ecosystem Restoration Study. This assessment characterizes historic and existing watershed conditions in the categories of Geology and Geomorphology, Hydrology and Hydraulics, Environmental Resources, and the Human Environment. The Environmental Assessment (EA) provides a more detailed description of the baseline condition. The following pages provide summaries of the baseline conditions assessment for each of these categories.

3.1.1 Geology and Geomorphology

The Stillaguamish River Watershed (SRW), like other river basins arising in the Cascade Range east of 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 movements of tectonic plates, which are manifested by seismic activity and volcanism, and glaciation.

The Cascade Range and foothills were primarily formed from seismic uplift and volcanic action. The North Cascades are particularly complex being composed primarily of sedimentary deposits, which are extensively folded and uplifted (Franklin & Dyrness, 1973). These sedimentary and volcanic bedrock materials underlie the more recent glacial deposits and soils. The Vashon glaciation, which ended between 10,000 and 20,000 years ago, was the most recent period of Washington's glaciation, which covered the entire Puget Sound region under a thick cordilleran ice sheet and extended to just south of the present day city of Olympia. This glaciation left behind the deposits of outwash materials and compacted till material seen today in most of the soils and surface formations in the Puget Sound region. Vashon ice dams formed glacial lakes in many of the river valleys coming out of the Cascades and left behind deposits of gravels and compacted till material seen today in most of the soils and surface formations of the region as well as 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. The glaciolacustrine clays and silts have been the main source of the significant sediment production of the basin. The unconsolidated glacial sediments, especially in the steeper slopes, are extremely prone to mass wasting and erosion.

3.1.2 Hydrology and Hydraulics

The presettlement 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. The lower reaches contained mostly low gradient, alluvial streams. The area was (and still is) naturally sediment rich with braided channels in the valley bottoms.

The Stillaguamish River headwaters begin in the Cascade Mountains at about 7,000 feet in elevation. The watershed drainage area is approximately 684 square miles, and is bounded by the Skagit River Basin to the north, and the Snohomish River Basin to the south. The North and South Forks of the Stillaguamish join at the present day city of Arlington (elevation 120 feet) to form the mainstem Stillaguamish.

From Arlington to Port Susan and Skagit Bays, the Stillaguamish River meanders through a wide, fertile floodplain. The river branches into two main channels, the Stillaguamish River and Koch's Slough. These two branches converge again west of Silvana and the Stillaguamish is one river again for three miles. The Stillaguamish River drains into Port Susan Bay via two distributary channels: the main channel in Hatt's Slough and the lesser Stillaguamish River. During the summer low flows, the Stillaguamish River flow declines to approximately 1 cfs. The three main tributaries to the lower Stillaguamish River are Pilchuck Creek and Church Creek, which drain from the north, and Portage Creek, which drains from the south. The tidal effects reach upstream to river mile 7, which is just above the confluence of Koch's Slough. The very low summer flows in the Old Stillaguamish River Channel allow salt water to move upstream further than historic conditions when summer flows were above 200 cfs.

The North Fork headwaters begin in the extreme northeastern portion of the basin also at an elevation of about 7000 feet. It then flows in a southeasterly direction for approximately 46 miles. At this point, it joins the South Fork at an elevation of 120 feet. The North Fork drains an area of about 284 square miles. The first 16 miles of the North Fork (including the major tributaries of Squire and Deer Creeks, and the Boulder River) have very steep gradients and flow through narrow valleys. Near the City of Darrington, the North Fork emerges from the higher mountains. The North Fork then enters a wide valley characterized by braided channels, back channel sloughs, and ox-bow lakes. This continues until the confluence with the South Fork.

The South Fork headwaters arise in the southeastern portion of the basin. The drainage area covers about 255 square miles. Above the present town of Silverton, the South Fork loses about 2000 feet in elevation in 3 miles, and then opens up into a broader valley floor (at about elevation 1800 feet). The river then flows 26 miles through a gradually widening valley bordered by high mountains and ridges. The river continues to drop an additional 1,000 feet in elevation to the head of Robe Canyon, then an additional 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 a natural falls at the present-day City of Granite Falls then continues four miles further to the confluence with the North Fork at Arlington.

In the early part of the century, several "splash" dams were developed on small tributaries to both forks. These dams were some of the first human caused blockages to fish migration in the basin. They also had severe local impacts when the dams were breached to intentionally sluice logs downstream to the mills or shipping ports.

The major basin hydrologic characteristics remain relatively unchanged from presettlement conditions in that there are no dams on the mainstem or other significant artificial impoundments. Surface water withdrawals from the river for irrigation and city water supplies are relatively minor. The major changes have come from the development practices for both logging and agriculture.

Large flood events are generally the result of warm rainfall melting an already existing significant snowpack during the months from November to March (rain on snow event). Over one third of the basin is in this rain on snow area (1,000 to 3,000 ft. elevation).

Logging and agricultural practices dramatically altered channel dynamics on the river and its tributaries. 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, etc.). It also controlled channel morphology by creating pools and trapping spawning gravel and providing a major impetus for channel migration.

Agricultural practices resulted in the channelization of many streams for enhanced drainage and flood control. Farmers cleared and drained or filled a high percentage of the wetlands for either pastureland or crop 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 structure or the complete loss of the wetland.

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 by the removal of the vegetation. Many researchers also expressed the opinion that logging practices exacerbated natural mass wasting events. In either case, Pess, et al. (Draft 1997) identified sediment deposition in the streams as one of the major limiting factors in salmonid production in the basin. This is especially true in the tributaries. For example, the Deer Creek stream system once supported one of the largest populations of summer-run steelhead in the Puget Sound. About two-thirds of the stream network was naturally accessible to anadromous fish and contained high quality habitat. Sedimentation, much of it from the 1984 DeForest Creek slide, resulted in a significant decline of fish populations. Fishery experts attributed this to the burial of spawning gravels and pools and a general decline in water quality. Also two major slides that effect the main river are the Hazel slide on the North Fork and the Gold Basin slide of the South Fork.

Bortleson (1980) noted one interesting aspect of sediment dynamics on the Stillaguamish River; the delta outside of the sea-dikes has grown significantly from what the 1886 maps indicate. The most dramatic increase has occurred in the southern part of the delta near Hatt's Slough, where several inter-distributary islands have formed. Bortleson stated that the progradation represented rapid sediment accumulation due to shifts in the sediment load from distributary channels in the lower mainstem (2.5 sq. km outside of the dikes). Bortleson theorized that the relative sizes of the former channels indicated most of the streamflow went through West Pass (to the north) and South Pass. Hatt's Slough appeared to be a minor distributary at the time of the 1886 mapping. In contrast, the present main flow of the Stillaguamish River--and, therefore, the greatest sediment load--is through Hatt's Slough. The other distributaries have since narrowed because of sediment loading in the channels.

The progradation of the mudflat is not surprising given the sediment loads of the Stillaguamish River. Any increase in the sediment load above natural rates may also have contributed to the progradation (Bortleson, 1980). Bortleson attributes increased sediment rates to farming, land clearing, logging, and/or dredging upstream.

3.1.2.1 Major Tributaries to the Stillaguamish River

3.1.2.1.1 Northern Tributaries to the Mainstem

Church, Pilchuck and the Harvey/Armstrong Creek systems are the major tributaries from the north side of the mainstem Stillaguamish. These creeks are accessible to anadromous salmonids including coho, chum, steelhead, cutthroat, and bulltrout (and/or Dolly Varden). Problems in these tributaries include loss of riparian vegetation, declining summer base flows, agricultural runoff and high sediment loads.

3.1.2.1.2 Southern Tributaries to the Mainstem

Portage and Fish Creeks and Tributary 30 are the major tributaries from the south side of the mainstem Stillaguamish. These creeks are accessible to anadromous salmon including coho, chum, steelhead and cutthroat and bulltrout (and/or Dolly Varden). In fact, the Fish Creek system has the highest quality coho spawning habitat of all the lower Stillaguamish mainstem tributaries (mean annual smolt production of 7545; Nelson et.al. 1997). Problems in these tributaries also include loss of riparian vegetation, declining summer base flows, agricultural runoff and high sediment loads.

3.1.2.1.3 South Fork Stillaguamish

Canyon and Jim Creeks are the major tributaries to the South Fork Stillaguamish. The Upper South Fork has a fishway at Granite Falls that does not allow passage for smaller fish such as pink, chum, Dolly

Varden, and cutthroat. It also partially blocks coho and chinook. Steelhead is the only species not significantly affected by the fishway. The other systems are accessible and utilized by chinook, coho, winter and summer steelhead, chum, cutthroat, pink and Dolly Varden. Other problems in these tributaries include high sediment load, mass wasting and bank instability.

3.1.2.1.4 North Fork Stillaguamish

The major tributaries to the North Fork are the Boulder River and Squire and Deer Creeks. Fortson Creek is also a very productive small stream for coho salmon (Nelson, et al., 1997). Deer Creek supports coho and steelhead runs, but has extensive sediment and channel problems as a result of heavy logging on unstable slopes.

The North Fork itself supports all species of salmon, with habitats ranging from poor to excellent. It is the main producer for all anadromous species and races in the system, except sea-run cutthroat and bull trout/Dolly Varden. . Coho, chinook and winter steelhead runs are supplemented with hatchery stock. Problems with the North Fork, and its tributaries, include "flashy" runoff patterns associated with heavy logging in the watershed, channel instability and scouring, sediment load, declining low flows, lack of LWD, lack of pools, and water quality degradation. Bull trout/Dolly Varden are more successful on the South Fork due to temperature requirements for incubation.

3.1.2.2 Flooding and Flood Control

The most extensive river modifications have occurred in the mainstem below Arlington and in the estuary. Since the 1860s, several private and public entities have constructed small flood control levees and dredged channels for purposes of both flood control and converting wetlands to agriculture. Private individuals also built sea-dikes around most of the original salt marshes mainly for conversion to agricultural production. Landowners and government agencies have constructed flood control projects on the North and South Forks. Most of this effort resulted in cutting off many of the side channels and sloughs associated with the original river way. In the mainstem river, the majority of the river levees are not able to hold even a 5-year flood event and much of the land downstream of I-5 floods annually.

Downstream of Arlington, the Corps has two authorized projects on the Stillaguamish River, only one of which has been built. In 1939, the Corps was authorized to provide works to reduce bank erosion and channel changes on the mainstem between Arlington and Hatt's Slough, a distance of 15 miles. The site included revetments at 26 places on the river and Koch's Slough, and a 275 foot control weir at the mouth of Koch's Slough that limits flow through the slough; and two cut off channels, each about 900 feet long,

to limit sharp bends in Koch's Slough. As a result, most of the flow is channeled into North Slough. The Corps modified the weir in 1991 to allow better fish passage during low flows; however, the weir is still a blockage for smaller species such as pink salmon. A river bar has built up at the entrance to the Stillaguamish Channel and, during flood events, the river over tops the bar, which increases the sediment load on the Stillaguamish Channel. Short agricultural levees have been built along portions of the Stillaguamish Channel near Stanwood and along Hatt's Slough, restricting the river's natural tendency to migrate across the floodplain. Lower flows result in less gravel cleansing and shifting in the river, resulting in fewer spawning areas for anadromous fish. The other authorized Corp's project, which was never built, was a navigation project to Stanwood.

3.1.3 Water Quality

This water quality summary is based on review of several recent water quality studies and reports produced by other entities such the State of Washington Department of Ecology, Snohomish County Public Works, and Tulalip Tribe Fisheries Department. These various reports are listed in the reference section of this report.

Historically, the Stillaguamish River and its tributaries were surrounded by mature coniferous forest and the riparian zone was dominated by conifers, deciduous trees and various shrubs. This thick vegetation provided high quality water by shading streams to maintain cool water and retarding soil erosion caused by large runoff events. With more trees in the watershed, storm runoff was generally slower moving, overland sheet flow rather than faster, channeled flow. The water quality conditions were excellent with low temperatures, high DO levels, low levels of nutrients, and no bacteria or other pollutants present in significant quantities.

Currently, the Washington Department of Ecology has classified the Stillaguamish River as Class AA (extraordinary) upstream of the confluence with Squire Creek in the North Fork and the confluence with Canyon Creek in the South Fork. Below these creeks, the river is classified as Class A (excellent). Despite these good ratings, episodic fish kills have occurred. Causes include a spill of cement (high pH), a chlorine spill, discharges of dairy waste (nutrients, pesticides, bacteria, which leads to low DO), and low DO. 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).

In 1989 and 1998, the Washington Department of Ecology identified the lower Stillaguamish as an impaired water body because of water quality degradation (WDOE, 1989 and 1998). Most of the lower Stillaguamish flows into Port Susan Bay. As a result of bacterial contamination, commercial shellfish harvesting is restricted throughout much of Port Susan Bay (Nelson, Thornburgh et al, 1991). In fact, in 1986 one third of the tideflats of Port Susan Bay were closed to commercial shellfish harvesting due to

bacterial contamination of the water and high fecal coliform counts on the meat of eastern softshell clams (SCPW, 1989).

The 1998 Section 303(d) List of Impaired Waterbodies (WDOE, 1998) lists much of the watershed as impaired for fecal coliform, temperature and dissolved oxygen. Segments impaired for fecal coliform include Fish Creek, Harvey Creek, Jim Creek, Jorgenson Slough (Church Creek), Martha Lake Creek, Old Stillaguamish Channel, Port Susan Bay, Portage Creek, mainstem Stillaguamish River, North Fork Stillaguamish River, and South Fork Stillaguamish River. Segments impaired for high temperatures include Deer Creek, Higgins Creek, Little Deer Creek, Pilchuck Creek, mainstem Stillaguamish River, North Fork Stillaguamish River and South Fork Stillaguamish River. Segments impaired for low dissolved oxygen concentrations include Pilchuck Creek, Portage Creek, mainstem Stillaguamish River, and South Fork Stillaguamish River. The mainstem Stillaguamish River near urban areas is also impaired for arsenic, copper, lead, nickel and nitrogen. All of these impairments primarily affect the quality of aquatic habitat for fish and the aquatic food web. Fecal coliform loads can also lead to a closure of the river for water contact recreation.

Non-point source pollution has been identified to some extent with each of the predominant land use types. Non-point sources of pollution in the Stillaguamish watershed include septic tanks on rural residential land, commercial and non-commercial (hobby farm) agricultural practices (animal waste runoff), and forestry practices. The U.S. Soil Conservation Service estimates there are about 1,060 agricultural operating units in the Stillaguamish watershed (SCPW, 1989). Furthermore, non-point sources of nutrients, bacteria and sediments are expected to increase with continued development of the watershed, particularly if the riparian buffers and wetland areas are further degraded.

High sediment loads come from land development, tree harvesting and erosion. High nutrient levels are from fertilizers, failing septic systems and animal manure, while bacteria sources are 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 where dry season fecal coliform levels are very high. Also, low permeability of the silts and loams mean poor absorption for septic tank waste. In the lower watershed, river reaches that contain hobby farms have the greatest alteration in water quality while the commercial agricultural sites had less impact.

3.1.4 Environmental Resources

3.1.4.1 Vegetation

Historically, the Stillaguamish River basin was dominated by coniferous forests since the retreat of the last glaciers. Western hemlocks and cedars predominated in the lower elevations (up to 2,000 ft.), silver fir predominated at mid elevations (2,000 to 3,200 ft.) and mountain hemlocks dominated the higher non-

alpine elevations (3,000 to 4,400 ft.). Other coniferous tree species included Douglas fir, Sitka spruce, and western white pine. Areas of disturbance from fires, landslides, or flooding were dominated by deciduous tree species such as big leaf maple, black cottonwood, red alder, and willows. Large open prairies or other habitats dominated by herbaceous species were not common.

Habitat in the lower Stillaguamish River Basin historically consisted of extensive marshes (salt water and brackish), freshwater wetlands, and riparian habitats. In intertidal areas, bullrush (*Scirpus maritimus*), sedge (*Carex lyngbyei*) and seaside arrowgrass (*Triglochin maritimum)* dominated the lower elevations (Bortleson, 1980). Significant inputs of large woody debris to the delta area enhanced fish and wildlife habitat. This, combined with the estuarine habitat types, would have provided niches for an extremely diverse benthic flora and fauna.

Currently, most of the remaining forest today contains coniferous and deciduous forest patches of a relatively young age. Extensive logging and human caused fires have eliminated most of the old-growth coniferous forests in the basin; only about 12% of the original acreage remains. The edge effect of dispersed patch or 'staggered-setting' system of clearcutting has indirectly affected additional habitat. This form of forest fragmentation shifts the landscape into a spatial and temporal mosaic of varying aged forest patches. This 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.

Riparian areas have had the most dramatic changes; by 1980, the mature cedars, Douglas firs, spruces, pines, hemlocks and deciduous trees in most of the basin's riparian zones had been removed. The majority of the present riparian zones are 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 large woody debris (LWD) to the stream systems now or in the near future.

Another major change in vegetation was the shift from forest to open areas dominated by herbaceous vegetation (usually grasses). This would have been a fairly rare component of the postglacial landscape; open areas usually represented emergent wetlands or recently burned areas. Agricultural clearing and urban development permanently changed thousands of forested acres into open grasslands (about 10% of the current landscape). Although this may appear to be an increase in habitat diversity, it actually represents a fragmentation of the forest, further increasing the current "patchy" nature of the landscape.

Agricultural and urban development also converted many emergent and forested wetlands into agricultural lands. This occurred through the placement of fill, building dikes and levees, and the construction of drains, ditches and other methods to remove or lower surface and ground water. It is difficult to estimate the extent of wetland loss and/or conversion in the Stillaguamish Basin. However, the U.S. Fish and Wildlife Service has estimated that approximately 50 % of the state of Washington's

wetlands have disappeared since settlement (Peters, pers. comm.). Specific to the Stillaguamish watershed, agricultural and urban development within the basin has resulted in the loss of most of the floodplain, freshwater tidal, and estuarine wetlands.

Although logging in the upper watershed has had dramatic effects on the patterns and distribution of vegetation, the resulting vegetation has some resemblance to past conditions, in that it is still forested. In the lower watershed, however, agricultural and urban development totally altered pre-settlement habitats in the valley basins of the lower forks and mainstem. The end result is that almost all of the forests and riparian areas of the valley basins are now open pasture, agricultural land, and/or urban and rural settlements.

Much of the Stillaguamish River delta areas have been filled for agricultural purposes, destroying intertidal habitat. Historically there was a series of distributaries in the delta that no longer exist. They have been filled for agricultural purposes and the majority of the delta is 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.

3.1.4.2 Fisheries

Historically the Stillaguamish Basin acted as a series of interconnected habitats that supplied all of the fresh water needs for a wide variety of migratory salmon and trout. The once large estuary with its sloughs and off channel habitats provided excellent rearing areas. The extensive well-buffered, cool, stream system in the upper watershed contained all of the channel attributes that salmon and other cold water species require. It was estimated that historic coho smolt production alone accounted for 1.5 to 2.5 million smolts per year (Pess et al. draft 1997). The numbers of salmon and trout formerly associated with the Stillaguamish is not well chronicled.

By the 1960s 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 have been a very productive salmon system, as indicated in Table 3-1.

Table 3-1. Average Annual Natural Anadromous Production for the Stillaguamish River

Average Annual Natural Anadromous Production for the Stillaguamish River by Species 1956-1965 (Puget Sound Task Force, 1970)(USFS 1995)						
	Chinook	Coho	Chum	Pink	Sea run Cutthroat	Steelhead
Range	640-	33,900-	11,000-	375,000-	582,00-120,700	26,800-
Average	43500	312700	258600	1,920,000	**79,200**	60,000
	19,700	**106,000**	**16,970**	**806,200**		**39,500**

Notes: Production values include harvest and escapement. Steelhead and sea-run cutthroat trout production values include hatchery and natural production. Pink salmon production values are for odd years only. Bold numbers (in thousands) are average annual production values.

Currently, the Stillaguamish River has runs of many anadromous salmon species including chinook, coho, chum, and pink salmon, summer and winter steelhead, sea-run cutthroat trout and bull trout or Dolly Varden (native char). Although sometimes anadromous, it is likely that the majority of Stillaguamish River native char are resident. Various hatcheries (state and tribal owned) have supplemented the wild runs since 1939 with summer chinook, chum, and coho salmon. The Washington Department of Fish and Wildlife (WDFW) and the Western Washington Treaty Indian Tribes (published as the Washington State Salmon and Steelhead Stock Inventory; hereafter SASSI) have designated the summer/fall chinook stock as depressed. NMFS listed Puget Sound stocks of chinook salmon as a threatened species in 1998. Recent coho and chinook escapements are listed below, in Table 3-2. Western Washington bull trout were listed as threatened in 1999.

Escapement levels for Stillaguamish coho and chinook have been highly variable 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, harvesting and degradation of habitat (pers. com. Chris Dietrich WDFW 6-2-97). Salmon and trout migrate, spawn and rear in over 890 miles of river and streams within the basin (Pess et. al. 1997, Chris Dietrick). Salmon and trout use the mainstem primarily for transportation and rearing. Spawning takes place mostly in the North and South Forks and its tributaries.

Table 3-2. Recent Coho and Chinook Escapement Estimates to the Stillaguamish River Basin

Recent Coho and Chinook Escapement Estimates to the Stillaguamish River Basin		
Stillaguamish Escapement	**Number of Fish**	**Number of Fish**
Year	*Coho*	*Summer Chinook*
1996		1,237
1995	17,700	775
1994	25,600	773
1993	8,800	759
1992	12,500	639
1991	4,000	1,536
1990	15,000	*no data*

A number of resident fish are also present in the basin, including resident cutthroat and rainbow trout, non-native brook trout, large-scale sucker, several species of sculpins, Pacific, river and brook lamprey, peamouth chub, mountain whitefish, three-spine stickleback, speckled dace and redside shiner. The non-native largemouth and smallmouth bass, yellow perch, and brown bullhead have also been introduced into the basin.

3.1.4.3 Wildlife

Similar to other western Washington river basins, the historically extensive mature forests of the Stillaguamish provided habitats for many species of wildlife. This included large predators such as grizzly bear, black bear, and cougar. Other mammals found throughout the basin included Roosevelt elk, black-tailed deer, beaver, and numerous small mammals. Beaver played a very large role in creating complex systems of pools and wetlands in the smaller tributaries and back channels. Avifauna included bald eagles, osprey, spotted owls, marbled murrelets, harlequin ducks, and other species of passerine birds, raptors, and waterfowl. Wildlife corridors between different habitat types allowed wildlife to move easily throughout the basin. Riparian areas were extremely important wildlife corridors for a variety of species. The extensive mature and mixed-age coniferous forests were also habitat for wildlife species with large home range requirements.

The marshlands and eelgrass beds in the Stillaguamish estuary supported a great variety of shorebirds and waterfowl. The Stillaguamish River basin is on the Pacific flyway and provided important resting and feeding habitat for migratory birds such as black brant. It also provided overwintering habitat for northern migrant species such as snow geese and tundra swan. Several amphibian species occur in the

basin, including Cascade frogs and red-legged frogs. Historic marine mammal usage in the Port Susan estuary probably included sea otter, California sea lion, harbor seals, porpoises and killer whales.

Currently there are about 300 species of wildlife that occur throughout the basin (200 birds, 63 mammals, 13 amphibians and 5 reptiles) (USACOE, 1997). Although this appears to be a diverse fauna, 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. Species that have been eliminated are the gray wolf, the sea otter and the grizzly bear. All are top of the food chain predators. Species whose populations have been severely diminished include the spotted owl, marbled murrelet, the pine martin, the 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.

There are several reasons for the change in distribution and abundance of wildlife in the basin. The fragmentation of forests from over a century of logging has resulted in less habitat 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.

The smaller forest patches have resulted in very different habitat conditions than those of pre-settlement time. Smaller patches have different microclimate conditions and less ability to buffer weather extremes. Additionally, the smaller patches have a greater amount of edge. The edges allow for less habitat for the species associated with late-successional and old growth forests. The greater the patch size, the more interior forest habitat available for species associated with late-successional and old-growth forest conditions. Thus, as fragmentation increases, the species associated with late-successional forest decline (U.S. Fish and Wildlife Service, 1995).

Logging, agricultural practices, and rural-urban development have fragmented the riparian zones in much of the Stillaguamish basin. This fragmentation has diminished the value of riparian zones as travel corridors for wide ranging species. It also reduces their effectiveness in providing habitat for home range territories. Loss of wetland throughout the basin has reduced the available habitat for waterfowl and shorebirds, with a resultant drop in populations.

3.1.4.4 Endangered and Threatened Species

The following species are listed or proposed to be listed under the Endangered Species Act, and do occur or may occur in the project area.

Bald Eagle. The bald eagle is listed as threatened in Washington. 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 migrate to wintering ranges in Washington in late October and are most commonly found along lakes, rivers, marshes, or other wetland areas west of the Cascade Range, with an occasional occurrence in eastern Washington. There are two bald eagle wintering concentrations located within the project area (basin). There are also 11 bald eagle nesting territories in the basin.

Northern Spotted Owl. The northern spotted owl was federally listed as threatened throughout its range (Washington, Oregon, N. California). Spotted owls can be found throughout the west slope of the Cascade Range below elevations of 4,200 feet. Preferred habitat is composed of mature or old growth coniferous forests with multilayered, multispecies canopies. Habitat characteristics include moderate to high (60-80 %) canopy closure, large overstory trees, substantial amounts of standing snags, in-stand decadence, and coarse woody debris of various sizes and decay classes scattered on the forest floor (Gore et al.) There are 24 spotted owl site centers in the project area. There is also critical habitat designated for the spotted owl in the project area.

Marbled Murrelet. The marbled murrelet is listed as a threatened species. Murrelets inhabit shallow marine waters and, like spotted owls, nest in mature and old growth forests. All nest locations in Washington have been located in old-growth trees that were greater than 32 inches diameter at breast height. Nest stand characteristics generally include a second story of the forest canopy that reaches or exceeds the height of the nest limb, thereby providing a protective enclosure surrounding the nest site. A single, large, closed-crowned tree, which provides its own protective cover over the nest site may also be used by murrelets. Large, moss-covered limbs in tall trees are utilized for egg laying. Marbled murrelet nests have been located in stands as small as seven acres and are generally within 50 miles of marine waters (Hamer and Kim, 1995). There is also critical habitat designated for the marbled murrelet in the basin.

Gray Wolf. The gray wolf is listed as an endangered species in Washington and can utilize a broad spectrum of habitats, as long as they include an abundance of prey (generally ungulates), suitable denning and rendezvous sites, as well as areas away from human disturbance. The availability of prey may be the primary factor in determining habitat suitability (Stevens and Lofts, 1988). Den sites are most commonly burrows in sandy soils, but can be located in a variety of settings, from downed logs and hollow trees to rock caves. Rendezvous sites tend to be near a source of open water in small meadows with limited visibility.

Grizzly Bear. The grizzly bear is listed as a threatened species. It is not closely associated with late-successional forests, but inhabits vast areas of diverse habitat types, including alpine meadows. The presence of an abundance of berries, fish and other food is necessary to support these large omnivores. Grizzly bears have large home ranges of up to 1,004 square miles in size. They usually move down to lower elevations after emerging from their high elevation denning areas in the spring. Most often, grizzly bears are found in remote areas where human activity is limited and roads are few or closed to access,

especially to hunting. No grizzly bears or sign of grizzly bears have been observed in the Stillaguamish basin. Sign has been observed in the northern reaches of the Cascades, north of the Stillaguamish basin.

Chinook Salmon. Puget Sound stocks of chinook salmon are listed as a threatened species. Key habitat requirements for chinook salmon include adequate stream flow, high quality spawning gravel, low temperatures, high DO concentrations, and side channels and estuarine habitat for rearing. Summer/fall chinook inhabit the Stillaguamish River basin. Wild stocks have been mixed to some extent with hatchery supplements in the Stillaguamish basin.

Bull Trout. Western Washington stocks of bull trout have been listed as a threatened species. Native char are present in the Stillaguamish River basin; however, it is not known if they are bull trout or Dolly Varden. Bull trout typically prefer very cold stream temperatures (<60°F), and abundant and complex in-stream cover. Native char are found in the North and South Forks of the Stillaguamish and their tributaries.

Coho Salmon. The Puget Sound/Strait of Georgia stocks of coho salmon are a candidate species for listing. Coho salmon typically spawn in small to medium sized rivers and tributaries and rear for one or more years in freshwater before migrating to saltwater. Coho utilize most of the tributaries to the Stillaguamish River, and the North and South Forks.

Spotted Frog. The spotted frog is listed as a candidate species for listing in Washington. Spotted frog populations have declined dramatically in both western Washington and Oregon. In Washington, the species is known to occur at several locations east of the Cascade Range (Leonard et al., 1993). It is believed that the non-native bullfrog and other aquatic predators have seriously reduced these populations. Adult spotted frogs are found in or near perennial water bodies such as springs, ponds, lakes, or slow moving streams and are often associated with emergent, non-woody vegetation (Leonard et al., 1993). It is rare to find a spotted frog more than three feet away from water. They tend to sit in the shallows, half submerged, or they float in deeper water, clinging to aquatic vegetation with their head visible. Spotted frogs eat invertebrates, and adults can eat other small frogs (Light, 1986).

Other Species of Concern. Pacific fisher, California wolverine, long-eared myotis, long-legged myotis, Pacific Townsend's big eared bat, olive sided flycatcher, northern goshawk, tailed frog, northwestern pond turtle, Pacific lamprey, and river lamprey are all species of concern that may occur in the Stillaguamish River basin.

3.1.5 Socio-Economic Resources

3.1.5.1 Cultural and Historic Resources

The earliest evidence of human settlement of the Stillaguamish basin dates back to the retreat of the Pleistocene glaciers approximately 13,000 years ago (Early Lithic). This early period is represented by campsites and stone tool manufacturing sites on high beach and river terraces in the Puget Sound area. The prehistoric inhabitants of the Puget Sound area gradually became more experienced in regional and seasonal resource exploitation. Fishing, hunting and plant gathering became more specialized. Increased contact and trade with groups in eastern Washington is evident as lithics from this area were commonly used for tool manufacture. Resource specialization, increased population, improved food storage methods, and establishment of larger villages were all signs of a more sedentary lifestyle after approximately 2,500 years ago (Middle Developmental Period). The Stillaguamish basin contains a variety of cultural resources ranging from prehistoric campsites, specialized resource procurement sites, village sites, and early historic period sites. Prehistoric site types in the southern Puget Sound area consist of shell middens, lithic scatters, wet sites and rock shelters.

The tribes most closely associated with the upriver and forested territory of the northwestern Washington river basins were, from north to south, the Nooksack, Upper Skagit, Sauk Suiattle, Stillaguamish, Skykomish, Snoqualimie, Muckleshoot and Puyallup. The separate river basins generally were the boundaries for the separate tribes. Among these groups, there were close similarities in language groups (Salish), political organization, lifestyle and religious beliefs. Kinship ties, shared subsistence areas, dynamic trade networks and topographic continuity linked groups and provided the basis for sustained relationships.

The territory of the *Stoluck-wha-mish* (Stillaguamish -- 'River People'), extended from the headwaters to Puget Sound (Hollenbeck, 1987). The tribal settlement pattern focused around permanent villages. 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 et al., 1991). The Snohomish, the Stillaguamish, and likely the Snoqualmie peoples used a portage between Pilchuck River and the South Fork Stillaguamish River on their way to the Puget Sound. All of these neighboring tribes shared the use of the Stillaguamish territory (Hollenbeck, 1987).

The primary Indian tribes interested in this study are the Stillaguamish Tribe at Arlington, and the Tulalip Tribes at Marysville. Other tribes that may have an interest include the Sauk-Suiattle Tribe at Darrington, and possibly the Lummi Tribe, in Bellingham. The basin lands were ceded by regional Indian tribes to the US Government under the Point Elliott Treaty of 1854. The treaty provided for continuation of tribal access to usual and accustomed fishing stations and other privileges on ceded lands. Accordingly, project

coordination has actively included the key Federally recognized tribes as part of the study team, and actively sought the participation of the other tribal groups. The project area has significance to Native Americans for fishing, hunting, gathering of native plant material, access to the river and wetlands. Tribal consultation will occur on a government-to-government basis with elected tribal officials to confirm their support for and/or reservations about the proposed undertaking.

Euro-American settlement in the basin began with loggers establishing camps around Stanwood (then known as Centerville) in the 1860s. 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. 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 continues as an active industry today.

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).

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 in 1898 damaged the railroads, which 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).

Historic structures in the basin include various homes, mines and other buildings dating to pre-1940s. These structures are primarily concentrated in Stanwood, Silvana, Arlington, Oso, and Granite Falls.

3.1.5.2 Land Use and Population

Most of the current basin's population live in or around the cities of Arlington (at the confluence), 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. The number of hobby farms is also increasing along the South Fork, west of Granite Falls. Agricultural areas are 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 population of the entire basin was estimated in 1995 to be about 90,000. This is projected to grow by about 2% a year (USACOE, 1997).

The land along the South Fork and its tributaries below Granite Falls to Arlington is mostly in private ownership. These lower reaches are also in agricultural lands with a growing rural 'hobby-farm' population. The largest exception to this pattern is the Jim Creek tributary, which is almost entirely within the Naval Reserve Station.

Timber production is the most prevalent land use on the South Fork above Granite Falls outside of the National Forest; the majority of the upper South Fork is within the Mt. Baker-Snoqualmie National Forest. Most of the rest of the basin of the South Fork is in large landholdings by timber companies or small private holdings.

The mainstem of the North Fork and many of its tributaries are in private ownership, with some state owned lands. Agriculture is the dominant land use along the mainstem of the North Fork, with timber production the prevalent land use in the upper watershed and tributaries outside of the National Forest. Much of the upper watershed is within the Mt. Baker-Snoqualmie National Forest.

In the Mount Baker National Forest Lands in both forks is late-successional reserve (LSR), with portions in wilderness and adaptive management area (AMA): while timber management is allowed to facilitate late-successional stand characteristics within LSRs, and (within AMAs) to meet social and economic objectives, recreational activities continue as the dominant use.

3.1.5.3 Recreation

The major recreational areas within the Stillaguamish basin are concentrated in the upland forested areas or along the river. The county and other 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. Much of the upper basin is in U.S. Forest Service ownership and there are many campgrounds and hiking trails. Much of this recreation is centered around the town of Darrington where the mountain loop highway provides access to hikers, berry pickers and the occasional miner. Fishing is also a popular activity and there are several state fishing access locations. The unmanaged access points to the river are rumored to be providing opportunities for poaching on salmon species, either out of season or on species that are not open for fishing.

3.2 Future Without-Project Conditions

If this ecosystem restoration plan is not implemented, there will still be some fish and wildlife habitat restoration actions undertaken in the Stillaguamish River basin. However, the County and Cities in the

basin have limited funds with which to pursue restoration actions. It is expected that the tribes, County or State of Washington will undertake some small restoration actions in response to the ESA listings of anadromous fish. Without this plan, and federal involvement, it would take much longer to implement an equivalent scale of restoration in the basin, jeopardizing the potential recovery of the anadromous salmon species. This plan is designed to provide habitat linkages and corridors for wildlife species as well, which might not occur with site-specific local jurisdiction restoration actions.

In short, while some restoration will continue with or without this project, the opportunity to restore broad-scale ecosystem functions and processes to sustain and create aquatic and riparian habitats will have been delayed or lost. It is unlikely that future proposals will consider ecosystem functions and requirements for a multi-species assemblage of plants, fish and wildlife on a basin wide scale. This will continue the trend, to date, of focusing on single species requirements and while often causing unforeseen adverse effects on other species, leading to continued listings of more and more species under the Endangered Species Act; rather than preserving the ecosystem, which supports a broad range of species.

4. PLAN FORMULATION

4.1 Problem Identification

A number of studies have been undertaken in recent years to identify existing habitat conditions, limiting factors to production of fish and wildlife, and various other environmental studies. Some of these studies were briefly summarized in Section 2. The cumulative information gained from these studies shows the Stillaguamish River basin has suffered a significant decline in the quantity and quality of fish and wildlife habitat as a result of timber harvest, agricultural and urban development, and irrigation and flood control facilities. The trends suggest a continuing decline of habitat and fish and wildlife populations unless restorative action is taken.

Snohomish County requested that the Corps initiate a flood control and ecosystem restoration study in the basin. In the reconnaissance phase, the Corps and County convened a series of meetings and field reviews that brought together interested agencies and organizations as well as biologists familiar with the basin to discuss resource issues from a variety of perspectives. Input from residents of the basin was incorporated in the problem identification phase in the form of survey results from a study conducted by the Department of Ecology (Gersib and Blake 1997). The primary interest of local agencies, tribes and public is in restoring the anadromous salmon stocks that utilize the basin.

4.2 Problems and Opportunities

The three major resource problems in the basin are described in this section, with recommendations on how these problems could be reduced. These problems are characterized by 1) altered hydrology and geomorphology, 2) altered vegetation communities, and 3) degradation of fish and wildlife communities.

4.2.1 Altered Hydrology/Geomorphology (Water, Wood and Sediment)

The hydrology of the basin has been dramatically altered in many portions of the basin by agricultural activities, urbanization, road building, loss of wetlands and beaver ponds, and timber harvesting. All of these activities tend to change water infiltration and storage within the watershed such that high flows become more common and flashy, and low flows become lower and longer lasting. Widespread logging in the headwaters, in particular, appears to have contributed to more severe effects from rain-on-snow events that cause flooding and channel scouring.

Channel conditions have changed significantly in some places (Collins 1992). Both sediment deposition and erosion have occurred in many locations, channel width and braided channels have changed, and certain channel segments and tributaries have been substantially straightened 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 Koch's Slough in 1939. Diking of the tidally influenced portion of the mainstem eliminated an extensive network of tidal sloughs and channels. Other mainstem diking and bank work effectively isolated the floodplain and sloughs from the river. The lack of large woody debris as a major influence on in-channel processes, may have contributed to channel downcutting in addition to having direct effects on aquatic and riparian habitat condition and availability.

Sediment recruitment, storage, and movement have also been significantly changed. Gravel mining at various locations within the channel has removed gravels and other important sediments from the river. Sediment sources are naturally high in many areas due to the inherent instability of soils and lacustrine parent materials on steep slopes. However, in some areas major slides have occurred that appear to be influenced by land management actions (such as timber harvest) that altered runoff patterns and channel locations, or otherwise destabilized slopes. 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 associated floodplain have received all of these effects and show the most dramatic alterations. The fundamental dynamic nature of the lower river has been largely halted by levees. This simplification of the system, in turn, has had significant adverse effects on native plant communities and fish and wildlife habitats and populations.

4.2.2 Altered Vegetation Communities

Vegetation community changes have occurred throughout the basin but have been most dramatic in the lower mainstem portion of the basin. The original complex of distributary channels and tidal sloughs produced a mosaic of dynamic vegetation types that included salt and brackish marshes, freshwater marshes and swamps, and tidal freshwater swamps intergrading with riparian and floodplain forests. The floodplain forests included extensive former and active sloughs and side channels that were 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 among the matrix of ancient forest stands.

With the arrival of European settlers, the mainstem floodplain was logged and, together with the intertidal zone, hydrologically modified through channel modification, ditching, and diking. The intertidal slough

and channel system was largely eliminated, and the salt marsh zone is currently limited to a fairly narrow band outside the dike system. The modern landscape of the lower valley is agricultural, and the remaining forested areas are relatively small stands dominated by hardwoods of various ages. Streamside vegetation consists primarily of narrow, discontinuous bands of hardwoods. Freshwater marshes are very limited in extent.

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 area. This system interspersed with and graded into upland forest types. Mosaic patterns in upland areas and riparian zones in steep terrain were maintained by fire or by snow and/or debris avalanches.

As logging moved out of the mainstem valley and into the hills it often involved highly destructive practices, including splash-damming, that not only altered the condition of the logged areas but often had detrimental impacts on stream channels elsewhere in the basin. 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 presettlement system were on the order of centuries, while post-harvest slash fires and fires sparked by railroads occurred commonly during the period of intensive exploitation. Slides initiated in cutover areas and from poorly designed roads also occurred far in excess of 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.

Forest Service management objectives in the basin, as a result of the Northwest Forest Plan, generally are geared toward increasing the proportion of federal lands in a late-seral condition, with a special emphasis on protecting riparian areas. 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. Therefore, while the structure 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.

4.2.3 Degradation of Fish and Wildlife Habitats

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.

4.2.3.1 Loss And Fragmentation of Habitat Area

Conversion of the floodplain and riparian zone to pasture, urban areas, and other uses has dramatically reduced the available terrestrial and aquatic habitats. The formerly extensive areas of intertidal habitat and floodplain forest are reduced to discontinuous fringes along watercourses and the edge of the bay, and the few remaining "blocks" of habitat are relatively small and are generally isolated within an agricultural landscape. Approximately 85% of the original salt marsh has been eliminated due to diking and erosion (Collins, cited in Pess, 1997). Within the upper basin there remain extensive areas that are largely forested, but logging, fire, road building, and other influences over the past century have changed the pattern of forest cover. The present day forest is broken into relatively small patches of various ages. 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. Anadromous fish must transit long distances between suitable habitats, exposing themselves to water quality problems, predators and reduced prey resources.

The general loss and fragmentation of habitats within the basin has had differential impacts. Certain habitat types have been particularly depleted. For example, much of the drainage and land-reclamation activity in the lower basin has been directed specifically at converting wetlands to farmland, and low-elevation floodplain and intertidal wetlands have suffered a disproportionate impact relative to upland areas and higher elevation wetlands. Similarly, although forest cover has been largely retained in the upper basin, there has been a major shift in age class distribution, from timber harvest, such that late-seral systems are relatively rare. The upper basin has also suffered from a significant increase in the incidence of landslides, as a result of forest practices (Pess, et al; draft 1997).

The result of these differential losses of certain habitats has been to significantly impact fish and wildlife species that entirely 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 particularly decimated in the lower portions of the basin.

4.2.3.2 Loss of Ecosystem Processes

Fish and wildlife habitats within the Stillaguamish basin are particularly tied to dynamic ecosystem processes. Forest mosaics were formerly maintained by fire, disease and avalanche. 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 major in terms of shading and organic inputs. Inputs of large woody debris, in particular, had significant effects on habitat structure, sediment storage, and nutrient processing within channel systems.

All of these habitat-forming processes have been dramatically altered by changes in land use, hydrologic controls, and resource exploitation in the period since European settlement. As noted above, natural patterns of forest disruption and regeneration have been largely replaced 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.

4.2.4 Opportunities for Restoration

In spite of the major problems present, the Stillaguamish River basin has great potential for successful restoration; largely because the basin is not significantly urbanized. Lands which have been converted to agricultural, silvicultural or mining uses can still be reclaimed without significant loss of economic value and restoration actions are not severely constrained by floodplain structures and facilities that must be protected. Additionally, while the lower river is extensively leveed and revetted, the middle and upper portions of the basin are fairly unconfined. This study seeks to address all three major resource problems in the basin in order to restore the anadromous salmon assemblage in the river. While restoration focused in one part of the basin would locally enhance habitat quantity and quality, the synergistic effect of restoring all major components of the ecosystem will far exceed the sum of benefits from localized restoration projects. This ecosystem restoration plan is designed to improve the hydrologic and geomorphic condition of the basin, to restore native vegetation communities and to restore degraded fish and wildlife habitats. Of critical importance is the restoration and reconnection of slough and distributary channels (Pess, et al 1997), which could provide habitat for a very significant increase in production of coho and steelhead in the basin.

4.3 Significance of Environmental Resources and Degradation

The environmental resources that have been degraded are aquatic and terrestrial habitats of the Stillaguamish River basin. These habitats formerly supported significant runs of seven or eight species of anadromous salmonids: chinook, coho, chum and pink salmon, steelhead and sea-run cutthroat trout, and bull trout and/or Dolly Varden char. Two of these species have been listed as threatened under the ESA: chinook salmon and bull trout, and one more species, coho salmon, is likely to be listed in the near future.

Chinook salmon and bull trout have been particularly affected because of the loss of estuarine and intertidal marsh habitat (chinook) and the extensive timber harvest activities in the upper watershed which have deposited sediment in spawning and rearing areas and raised water temperatures by reducing shade and groundwater recharge (bull trout). The channelization of the lower river has eliminated most of the side channels and sloughs, which are utilized extensively by coho and chum salmon and steelhead trout. The migration corridor is now potentially lethal to fish during the summer as a result of low flows, high temperatures and high nutrients and fecal coliform concentrations. The loss of exchange between the river and its floodplain has resulted in the loss of prime spawning and rearing habitats for most species of salmon.

Another five species of wildlife that occur, or may occur, in the watershed are also listed under the ESA: bald eagle, marbled murrelet, northern spotted owl, gray wolf and grizzly bear. Canada lynx are proposed for listing and the Oregon spotted frog is a candidate species. The habitat fragmentation resulting from extensive timber harvest has pushed these species, which require large areas of relatively undisturbed habitat, to the brink of extinction in Washington state. These species would significantly benefit from the restoration of natural forest communities and riparian corridors for migration.

Additionally, the Stillaguamish River basin is part of the usual and accustomed fishing grounds for the federally recognized Stillaguamish, Sauk-Suiattle and Tulalip Indian Tribes. It is a federal responsibility to ensure that resources necessary for the continuation of native cultures are maintained. Without this type of ecosystem restoration plan, it is likely that salmon and some wildlife species will go extinct in this basin.

4.4 Scoping of Study Area

For the purposes of this study, the study area is the Stillaguamish River Basin. Since the primary authority of the Corps is water resources development, the potential area for site-specific projects will generally be within the 500-year floodplain of the Stillaguamish River and its tributaries. This entire study area is within Snohomish County, however some reaches of the river are within the jurisdiction of cities and Indian tribes.

4.5 Formulation of Alternatives

4.5.1 Description of Restoration Alternatives

During the study, the sponsor and interested agencies and tribes worked with the Corps to develop a list of potential sites and the criteria for screening the sites based on their ability to restore the anadromous salmon assemblage. The anadromous salmon assemblage is all of the species that occur in the Stillaguamish basin: chinook, coho, chum, and pink salmon, steelhead, sea-run cutthroat, and bull trout and/or Dolly Varden. The sites must address at least one of three major problems in the basin in order to have an appropriate scale of benefits: 1) altered hydrology/geomorphology, 2) altered vegetation communities, or 3) degradation of fish and wildlife habitats. In addition, the sites must also comply with the following general guidelines in order to have the support of the local sponsor and agencies: 1) have immediate benefits to fish in addition to contributing to long-term ecosystem recovery; 2) address ecosystem functions and processes that will sustain and create habitats over time; 3) provide benefits to other species in addition to salmon; 4) should include features traditionally associated with the Corps (water resources engineering) rather than focusing on acquisition or revegetation only.

The various previous studies in the basin had identified over 800 potential site-specific or programmatic restoration actions to benefit fish and wildlife species. The Stillaguamish Implementation and Restoration Committee (SIRC) evaluated those potential sites based on what entity could implement them (including volunteers) and developed a list of 26 sites that appeared to meet the Corps criteria for federal involvement. The study team and interested agencies and tribes then conducted a series of brief field evaluations of the 26 potential site locations in the basin. A total of 20 potential sites were identified as suitable for Corps evaluation. One of the sites was a flood control project strongly advocated by the local sponsor. This project was pulled out of this ecosystem restoration study and is being conducted under Section 205 authority concurrent with this study. The remaining 19 restoration sites selected for further study can be categorized as follows:

- Sites that enhance aquatic ecosystem continuity and connectivity (such as side channel reconnections or removal of barriers to fish passage)
- Sites that enhance terrestrial ecosystem continuity and connectivity (such as revegetation of the riparian zone or floodplain)
- Sites that enhance the spatial distribution and area of rare or critically important habitat types (such as restoration of tidal marsh or swamp habitats)

Most of the 19 sites identified are in the lower half of the basin because this is the area that has undergone the most extensive habitat fragmentation and lost the critically important estuarine and tidally influenced habitats, as well as non-tidal sloughs and side channels. Slough and side channel habitat have lost the second largest amount of habitat area in the basin (after beaver ponds), and are critically important rearing and wintering areas for juvenile salmonids (Pess, et al. draft 1997). The restoration alternatives are listed and briefly described in Table 4-1. Plates 2 through 4 show the location of each proposed site.

Table 4-1. Description of Restoration Features at Proposed Sites

Name of Site		Description
A	Church Creek/Jorgensen Slough	Replace tide gates to allow fish passage, revegetate riparian zone along 1.5 miles of creek.
B	Cloverdale	Restore forested wetland, create a naturally meandering channel for tributary, revegetate, and install fish accessible culvert connection to river.
C	Koch's Slough Weir	Construct new fish passage facilities.
D	Corps Revetments	Modify maintenance procedures on Corps' revetments, abandoning some sites if no longer needed, allow riparian vegetation to grow on sites.
E	Gold Basin Slide	Place LWD jams to protect toe of landslide, allow sediment settling behind LWD jams, revegetate.
F	Hat Slough Entrance	Removal of dikes, excavate tidal channels, revegetate with marsh species, new dike to protect uplands.
G	Hazel Slide	Move river channel away from landslide, place LWD jams to protect toe of landslide, allow sediment settling behind LWD jams, revegetate.
H	Lower South Fork, Trib 319	Place LWD, spawning gravels, revegetate riparian zone.
I	Lower South Fork, Trib 358c	Place LWD, spawning gravels, revegetate riparian zone.
J	Mainstem Hat Slough/Hazelton Channel	Reconnect side channel, vegetate narrow buffer.
K	Norman Road Wetlands	Restore wetlands for wildlife purposes/revegetate with native species.
L	North Fork, Trib 138	Reconnect tributary to mainstem, place LWD, spawning gravels, revegetate riparian zone.
M	North Meander	Reconnect old meander bend to Old Stillaguamish Channel, place LWD, revegetate riparian zone.
N	Old Stillaguamish Channel	Install tide gate to impound water in the old channel during high tides, with slow release during low tides, revegetate 50 foot buffer along channel.
O	Port Susan Habitat Islands	Construct wooden cribs to trap sediment and promote natural colonization of vegetation (marsh restoration).

Name of Site		Description
P	Portage Creek	Restore forested wetland, re-meander upper reach of creek, place LWD, revegetate riparian zone in lower and middle reaches of creek, fencing to prevent cattle from accessing creek.
Q	South Meander	Reconnect old meander bend to Portage Creek, place LWD, revegetate riparian zone.
R	South Pass	Removal of dikes, excavate former slough channel and reconnect to Port Susan Bay, revegetate with marsh species.
S	Stillaguamish Confluence	Install LWD jams, excavate side channel, revegetate riparian zone.

4.5.2 Restoration Measures and Evaluation Methodology

The nineteen restoration sites were ranked by an expert panel composed of Corps, County, resource agency and tribal biologists and scored based on their potential benefits and likelihood of achieving those benefits. The following evaluation criteria were used in developing a *Restoration Effectiveness Rating* for each site. Each site rating factor is described below.

Table 4-2. Site Rating Factors

Restoration Effectiveness Rating Factors
1) Immediate benefit to salmonids (without project)
2) Immediate benefit to salmonids (with project)
3) Long-term benefit to salmonids (without project)
4) Long-term benefit to salmonids (with project)
5) Benefits to other species (without project)
6) Benefits to other species (with project)
7) Reverses losses of rare habitats
8) Self-sustainability/develops habitat forming processes
9) Ecosystem level effects
10) Feasibility

Factor 1-2: Immediate Benefit To Salmonids. This criterion is intended to reflect the local and federal management priority that emphasizes halting the decline of certain salmonid populations, particularly coho and chinook. Determination of beneficial actions involves consideration of limiting factors, proximity to refugia, and similar concerns (Pess 1997). "Immediate benefit" means that significant benefits will be achieved within two years of site completion. Therefore, a site that involves planting of riparian vegetation might achieve only limited benefits within two years, while reconnection of a

distributary channel that is already fully forested along its banks would have substantial immediate benefits.

Scoring Guide:
0 – poor conditions for salmonids
1-4 – increasingly better conditions for salmonids
5 – best conditions relative to other proposed sites

Factor 3-4: Long-Term Benefit To Salmonids. This criterion is intended to reflect eventual, sustained benefits to salmonids, particularly with respect to limiting factors. The newly vegetated riparian zone in the example above would score the same as the already-vegetated area, all other considerations being equal. However, a side-channel reconnection that would be expected to become disconnected due to sedimentation within a decade would have a low score under this criterion.

Scoring Guide:
0 - no long-term benefit
1-4 - increasing benefits to salmonids in terms of numbers of species and/or total numbers of individuals affected
5 -maximum long-term benefit relative to other proposed sites

Factor 5-6: Benefits To Other Species: This criterion refers specifically to considerations of habitat structure and the size and configuration of habitats as they are likely to affect species other than salmonids. It was applied in terms of broad groups of species (e.g. waterfowl, furbearers, neotropical migatory birds, etc.). Delays in achieving full function (e.g. maturation of planted vegetation) were considered in assigning scores.

Scoring Guide:
0 - no added benefit for species other than salmonids
1-4 - increasing benefits in terms of numbers of species or species groups affected
5 - maximum benefits relative to other proposed sites

Factor 7: Reverses Losses of Rare Habitats: This criterion addresses the differential losses of certain habitat types that have occurred due to development and resource exploitation. Restoration actions that increase the acreage and/or numbers of rare habitats are scored more highly than actions that increase habitats already well represented in the basin. Rare habitats may include such areas as intertidal wetlands with blind channel systems, floodplain emergent wetlands, side channel habitats, and mature floodplain forests. The designation of a particular habitat type as "rare" includes consideration of the location of the site within the system – habitats that are common in one area may be locally uncommon in others.

Scoring Guide:

0 - no added natural habitats

1-4 - increasing acreage and rarity of restored habitats

5 - maximum increases relative to other proposed sites

Factor 8: Sustainability and Contributions to Habitat-forming Processes: Restoration actions which will tend to be self-sustaining and contribute to the creation and maintenance of habitats on-site and elsewhere in the system score highest for this criterion. This refers to sites that restore key physical processes, although those processes may involve biological attributes. For example, actions that will contribute large woody debris to downstream systems receive higher scores than actions that do not contribute woody debris. Such actions may include both re-establishment of meander behavior (which recruits large woody debris), and re-establishment of riparian forest (which provides the needed material). Restoration of large areas where processes such as channel migration or blind channel formation can proceed at rates characteristic of relatively undisturbed areas received the highest scores for this criterion.

Scoring Guide:

0 - site requires regular maintenance and does not contribute to habitat formation on- or off-site

1-4 - sites increasingly self-sustaining and contributing to habitat formation

5 - site self-sustaining, and with maximum contribution to habitat-forming processes relative to other proposed sites.

Factor 9: Ecosystem Level Effects: Although all of the above criteria imply benefits to the entire ecosystem, this criterion is specifically intended to credit site effects which will have demonstrable off-site benefits such as water quality improvement and flood water storage. This criterion also credits sites that reconnect tributary systems, because of the significant impact of salmon carcasses on tributary nutrient cycles. Generally, the degree to which an action is considered to have "ecosystem-level effects" increases with increasing scale of the area affected, and with multiple effects.

Scoring Guide:

0 - site has no off-site effects

1-4 - site scores increase with multiple off-site effects or increasing magnitude of effect (e.g. amount of flood water detained, miles of tributary connected, length of riparian buffer between stream and agricultural inputs, etc.).

5 - site has maximum benefits relative to other proposed sites

Factor 10: Feasibility: The feasibility criterion reflects the likelihood that the site can be constructed as proposed, and that it will function as intended. Also included in this part of the evaluation is: the level of engineering needed for the site, potential impact on flooding and access/land ownership consideration. The effect of a low score for this criterion is to discourage further effort on sites that may prove infeasible unless the probable environmental returns are high enough to offset the uncertainties regarding implementation.

Scoring Guide:

0 – site unlikely to be constructed, or to function as intended

1-4 - scores increase with increasing confidence that site can be constructed and will function as intended

5 – no reason to doubt that site can be built and will work as intended

A panel of experts was convened to apply the scoring criteria to each of the potential sites identified in Table 4-1. The panel consisted of representatives of the Tulalip and Stillaguamish Tribes, the local sponsor (Snohomish County), and the Corps. All of the panel members were resource professionals familiar with the basin, and all had participated in field reviews of the potential restoration sites. Each panelist assigned scores for each criterion and site based on his or her best professional judgment. Following discussion of the resulting scores, a group consensus score was assigned to each rating factor for each site, displayed in Table 4-3.

Each alternative received a score of zero to five, with zero corresponding to "no value" and five corresponding to "highest value". To calculate the restoration effectiveness rating for each alternative, the changes from without- to with-project scores for ranking factors 1 through 6 scores were calculated and then added to the scores from the remaining categories.

Table 4-3. Restoration Effectiveness Ratings

ECOYSTEM RESTORATION EVALUATION											
	IMMEDIATE BENEFITS TO SALMONIDS		LONG-TERM BENEFITS TO SALMONIDS		BENEFITS TO OTHER SPECIES		REVERSING LOSSES OF RARE HABITATS	SUSTAIN-ABILITY / HABITAT-FORMING PROCESSES	ECO-SYSTEM-LEVEL EFFECTS	FEASIBILITY	TOTAL RESTORATION EFFECTIVENESS RATING
PROJEC	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	RER
Hat Slough Entrance	4	1	4	1	5	3	4	3	4	4	23
Mainstem H at Slough	3	2	2	2	3	2	4	2	3	3	14
South Pass	3	1	4	1	5	3	4	3	4	5	23
Old Stillaguamish Entrance	4	2	4	2	4	2	3	4	4	2	19
Cook Slough/Stillaguamish Confluence	4	1	4	1	3	3	4	3	4	3	20
Cook Slough Weir	4	1	4	1	3	0	2	3	4	4	22
Cook Slough/ N. Meander	4	1	4	1	3	3	4	2	4	2	18
Cook Slough/Thompson Slough	4	1	5	1	3	3	4	3	4	3	21
Norman Rd. Wetland	1	1	1	1	4	2	4	4	2	4	16
Lower SF. Trib 319	2	2	2	2	4	3	2	3	2	3	11
Trib 358C	2	2	3	2	3	2	2	4	2	3	13
NF Trib 138	4	2	4	2	3	3	2	3	3	4	16
Cloverdale Golf Course	4	2	4	2	4	3	3	3	3	5	19
Church Creek/Jorgensen Creek	3	2	3	2	3	2	2	2	2	3	12
Port Susan	3	2	4	2	4	2	4	3	3	2	17
26 Sites	2	1	3	1	3	1	1	2	2	4	14
Portage Creek	4	3	5	3	4	2	4	4	3	3	19
Hazel Slide	3	0	4	0	3	0	3	2	5	3	23
Gold Basin Slide	3	0	3	0	2	0	3	2	4	4	21

[1] *Restoration Effectiveness Rating (RER) = (S1-S2) + (S3-S4) + (S5-S6) + S7 + S8 + S9 + S10*

4.5.3 Preliminary Screening

Further field evaluations resulted in the elimination of 7 of the 19 sites from further consideration based upon considerations of feasibility and sponsorship. Church Creek/Jorgensen Slough (Site A) was dropped due to early identification of a lack of local landowner support that compromised the feasibility of the alternative). Sites H, I, J, K, and L (see Table 4-1) were dropped because local agencies voiced support to take immediate action on the sites without support from the Corps. These sites were generally smaller in scale than the other sites being considered and determined to be appropriate for local agency action. Site N, Old Stillaguamish Channel, was removed from further consideration in this study because it is being evaluated in a separate study through the Corps Section 1135 Continuing Authorities Program. Following the screening of these sites, 12 alternatives remained for detailed analysis.

4.6 Costs and Outputs of Final Restoration Alternatives

This section provides preliminary cost estimates and environmental output estimates associated with implementation of restoration measures at each of the remaining twelve sites. Preliminary cost estimates include construction, real estate requirements, disposal requirements, supervisory and administrative (S&A) support, preconstruction engineering and design (PED), monitoring, and operation and maintenance (O&M) costs. A summary cost estimate showing the cost breakdown for each site is provided in Table 4-4.

Table 4-4. Cost Breakdown of Alternatives

Code	Project	Construction Costs	Real Estate	Disposal	Disposal Admin.	PED	Const. Mgmt.	S & A	Present Value of Total O&M	Present Value of Monitoring	Total Cost
B	Cloverdale	$964,000	$ 68,750	$ -	$ -	$ 96,405	$ 165,217	$ 7,500	$18,732	$226,918	$1,547,522
C	Koch Slough Weir	$526,000	$ 9,375	$ -	$ -	$ 52,603	$ 90,149	$ 3,750	$156,956	$285,331	$1,124,164
D	Corps Revetments	$4,466,000	$ -	$ 8,214	$ 893	$ 446,623	$ 765,412	$ 6,250	$232,282	$243,198	$6,168,872
E	Gold Basin Slide	$732,000	$ 8,750	$ -	$ -	$ 73,204	$ 125,455	$ 3,750	$104,902	$317,034	$1,365,095
F	Hatt Slough Entrance	$847,000	$ 560,000	$ 8,214	$ 893	$ 84,704	$ 145,164	$ 6,250	$22,479	$272,301	$1,947,006
G	Hazel Slide	$1,572,000	$ 288,750	$ -	$ -	$ 157,208	$ 269,419	$ 35,000	$52,451	$380,441	$2,755,270
M	North Meander	$932,000	$ 35,000	$ 8,214	$ 893	$ 93,205	$ 159,732	$ 11,250	$37,465	$237,776	$1,515,535
O	Port Susan Habitat Islands	$1,016,000	$ 16,250	$ -	$ -	$ 101,605	$ 174,129	$ 6,250	$29,972	$270,220	$1,614,425
P	Portage Creek	$4,150,000	$ 777,500	$ 8,214	$ 893	$ 415,021	$ 711,254	$ 85,000	$97,409	$284,262	$6,529,553
Q	South Meander	$1,922,000	$ 113,750	$ 8,214	$ 893	$ 192,210	$ 329,405	$ 11,250	$37,465	$253,628	$2,868,814
R	South Pass	$1,616,000	$ 633,750	$ 8,214	$ 893	$ 161,608	$ 276,960	$ 10,000	$52,451	$272,301	$3,032,178
S	Stillaguamish Confluence	$926,000	$ 46,250	$ 8,214	$ 893	$ 92,605	$ 158,704	$ 7,500	$22,479	$243,198	$1,505,842
	TOTALS:	$19,669,000	$2,558,125	$ 57,500	$ 6,250	$ 1,967,000	$ 3,371,000	$ 193,750	$865,043	$3,286,607	$31,974,275

Cost estimates are in October 2000 price level.
Present values are caluculated using 6.875% federal interest rate.

The Restoration Effectiveness Ratings for the twelve remaining alternatives (See Section 4.5.3 Preliminary Screening) were converted to an index value between 0 and 1 and multiplied by the habitat area directly influenced by the site to derive "eco-units" for use in cost effectiveness and incremental cost analyses for comparison of alternative site costs and outputs, displayed in Table 4-5. These eco-units account for the quality and quantity of habitats supporting ecosystem function and salmon recovery. This approach was similar in structure to the common habitat suitability index models (such as the US Fish and Wildlife Service's Habitat Evaluation Procedures) but did not focus on a single species and was determined by the study team and sponsors to be more appropriate for this broadly focused ecosystem restoration study.

Table 4-5. Derivation of Eco-Units

Code	Project	Restoration Effectiveness Rating	Restoration Effectiveness Index Value	Affected Acreage	Output (Eco-Units)
B	Cloverdale	19	0.54	21.9	11.89
C	Koch Slough Weir	22	0.63	181.0	113.77
D	Corps Revetments	14	0.40	87.0	34.82
E	Gold Basin Slide	21	0.60	100.0	60.00
F	Hatt Slough Entrance	23	0.66	115.0	75.57
G	Hazel Slide	22	0.63	181.0	113.77
M	North Meander	18	0.51	110.0	56.57
O	Port Susan Habitat Islands	17	0.49	263.0	127.74
P	Portage Creek	19	0.54	220.0	119.43
Q	South Meander	21	0.60	110.0	66.00
R	South Pass	23	0.66	181.0	118.94
S	Stillaguamish Confluence	20	0.57	8.0	4.57

Index value calculated by dividing each sites restoration effectiveness rating by the best possible rating of 35.

Table 4-6 provides a summary of the costs and outputs for the twelve remaining sites.

Table 4-6. Cost and Output of Restoration at Final Sites

Cost and Output of Restoration at Final Sites			
Site		Output (eco-units)	Cost* ($1,000s)
B	Cloverdale	11.9	1,548
C	Koch's Slough Weir	113.8	1,124
D	Corps Revetments	34.8	6,169
E	Gold Basin Slide	60.0	1,365
F	Hatt Slough Entrance	75.6	1,947
G	Hazel Slide	113.8	2,755
M	North Meander	56.6	1,516
O	Port Susan Habitat Islands	127.7	1,614
P	Portage Creek	119.4	6,530
Q	South Meander	66.0	2,869
R	South Pass	118.9	3,032
S	Stillaguamish Confluence	4.6	1,506

**October 2000 price level, rounded.*

4.7 With- and Without-Project Changes in Fish and Wildlife Habitat

For the first three of the Restoration Effectiveness Ratings criteria (immediate benefits to salmonids, long-term benefits to salmonids, and benefits to other species), with- and without-project habitat quality rating scores were developed for each proposed site. Both absolute and percentage changes from the without- to the with-project condition were calculated for each site. The results of this analysis are presented in Table 4-7. All proposed alternatives provided an increase in fish and wildlife habitat, with the smallest increase being an increase of 63% over the without-project condition. (Note that these scores do not account for area affected, thus reflect change in quality of habitat more than change in quantity).

Table 4-7. With- and Without-Project Fish and Wildlife Habitat Scores

Site		With-Project Score	Without-Project Score	Change in Score	% Change
B	Cloverdale	12.00	7.00	5.00	71%
C	Koch's Slough Weir	11.00	2.00	9.00	450%
E	Gold Basin Slide	8.00	0.00	8.00	n.a. (without value =0)
F	Hatt Slough Entrance	13.00	5.00	8.00	160%
G	Hazel Slide	10.00	0.00	10.00	n.a. (without value =0)
M	North Meander	11.00	5.00	6.00	120%
O	Port Susan Habitat Islands	11.00	6.00	5.00	83%
P	Portage Creek	13.00	8.00	5.00	63%
Q	South Meander	12.00	5.00	7.00	140%
R	South Pass	12.00	5.00	7.00	140%
D	Corps Revetments	8.00	3.00	5.00	167%
S	Stilly Confluence	11.00	5.00	6.00	120%

4.8 Incidental Benefits

Incidental benefits are anticipated to result from the implementation of restoration measures at the sites. These benefits have not been quantified as part of the study, but are identified here to support informed decision-making. Anticipated incidental benefits include recreation benefits, water quality benefits and benefits to the recovery of threatened and endangered species.

Recreation. Recreation could be enhanced as a result of this plan because the primary goal of the plan is to restore the anadromous salmon assemblage. Opportunities for fishing and observing salmon would be enhanced as a result of this project, over the long-term. Some of the individual sites could incorporate passive recreational and educational opportunities into the site (i.e. interpretive signage and trails) without compromising the effectiveness of the restoration action.

Water Quality. Water quality will be improved as a result of this plan because most of the individual sites include restoration of riparian buffers and wetlands, which will filter agricultural and urban runoff and may incrementally reduce water temperatures. Two of the proposed sites address landslides, which will reduce turbidity and other sedimentation problems. Additionally, several of the sites will improve the flushing capability of sloughs and side channels.

Significance of Resources Restored. A primary goal of this plan is to restore the anadromous salmon assemblage, which includes two listed threatened species; chinook salmon and bull trout. It is likely that at least one more species of salmon will be listed in the near future: coho salmon. This plan will assist in the recovery of these species of national significance by providing critical habitat, particularly estuarine or intertidal marsh habitat that is extensively utilized by chinook salmon for rearing. Restoring all types of habitat (except ocean rearing habitat) for salmon species will ensure that all life history stages benefit from the restoration plan. When only one life history stage is restored, the gains in production can often be completely negated by losses at another life history stage (i.e. improving spawning habitat area or quality may be negated if rearing habitat is severely limiting for the increased number of fry/juveniles).

4.9 Cost Effectiveness and Incremental Cost Analyses

The cost and output information presented in the previous two sections is the input for cost effectiveness and incremental cost analyses to evaluate the relative effectiveness and efficiency of the different alternatives at producing environmental outputs.

To conduct the analyses, the procedures identified in the Corps procedures manual for conducting cost effectiveness and incremental cost analyses (IWR Report #95-R-1, USACE, May 1995) were followed. These steps include: 1) display costs and outputs of alternatives, 2) identify combinable alternatives, 3) derive combinations and calculate costs and outputs, 4) identify cost effective plans, 5) calculate and display most efficient alternatives through incremental cost analysis. The results of the steps are summarized below.

Step 1) Display Costs and Outputs of Alternatives: Table 4-8 provides a display of the costs and outputs associated with each site. The sites are sorted by the output they each provide.

Step 2) Identify Combinable Alternatives: Because each alternative under consideration is an individual independent site, all alternatives are combinable with all others. None of the sites are dependent on any other site being implemented for feasibility.

Step 3) Derive Combinations and Calculate Costs and Outputs: The Corps IWR-PLAN Version 3.0 software was used to derive all possible combinations of the final 12 alternative sites. The software computed the cost and output of each combination by combining the costs and outputs of its component sites. 8,192 possible combinations were derived. However, since the sites were all independent and there was only one option at each site, the sites could be ranked by their incremental cost for optimal sequencing of implementation.

Table 4-8. Costs and Outputs of Alternatives (sorted by output)

Code	Site	Site Cost*	Output Units (Eco-Units)
O	Port Susan Habitat Islands	$1,614,000	127.74
P	Portage Creek	$6,530,000	119.43
R	South Pass	$3,032,000	118.94
C	Koch Slough Weir	$1,124,000	113.77
G	Hazel Slide	$2,755,000	113.77
F	Hatt's Slough Entrance	$1,947,000	75.57
Q	South Meander	$2,869,000	66.00
E	Gold Basin Slide	$1,365,000	60.00
M	North Meander	$1,516,000	56.57
D	Corps Revetments	$6,169,000	34.82
B	Cloverdale	$1,548,000	11.89
S	Stillaguamish Confluence	$1,506,000	4.57

**October 2000 price level converted to present value using current federal discount rate of 6.875%, rounded. Cost includes PED, LERRDs, Construction, Const. Mgmt., Monitoring, S&A, and O&M.*

Step 4) Identify Cost Effective Plans: IWR-PLAN identified which of the 8,192 possible plans were cost effective. Plans were selected as cost effective if a) no other plan provided the same level of output for less cost, and b) no other plan provided more output for the same or less cost. The cost effectiveness analysis identified 51 cost-effective plans. However, since the sites were all independent and there was only one option at each site, the sites could be ranked by their incremental cost for optimal sequencing of implementation, resulting in 13 most efficient plans (including the no-action alternative).

Step 5) Calculate and Display Most Efficient Alternatives through Incremental Cost Analysis:
Incremental cost analysis was conducted to identify those cost-effective solutions that are the most efficient at producing environmental outputs. These most-efficient plans are referred to as "best-buys". They provide the greatest increase in eco-units for the least increase in cost per eco-unit. The analysis resulted in the identification of 13 best-buy plans (including the no-action plan), presented in Table 4-9.

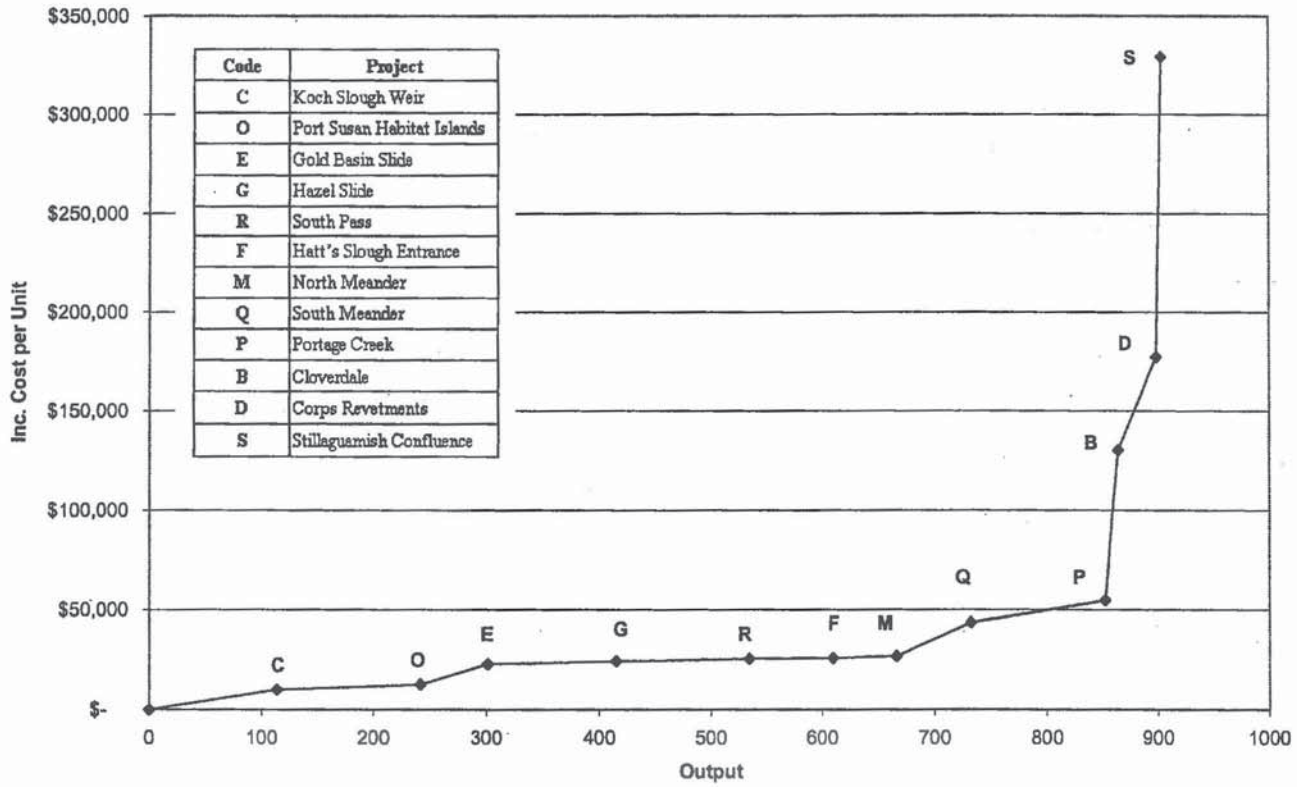
Table 4-9. Stillaguamish River Basin Restoration Incremental Cost Analysis

	Plan	Total Cost	Total Output	Change in Cost	Change in Output	Inc. Cost per Unit	Annual Cost
1	No Action	$ -	0.00	$ -	0.00	$ -	$ -
2	C	$ 1,124,164	113.77	$ 1,124,164	113.77	$ 9,881	$ 80,171.73
3	C+O	$ 2,738,589	241.51	$ 1,614,425	127.74	$ 12,638	$ 195,307.31
4	C+O+E	$ 4,103,684	301.51	$ 1,365,095	60.00	$ 22,752	$ 292,661.44
5	C+O+E+G	$ 6,858,954	415.29	$ 2,755,270	113.77	$ 24,218	$ 489,158.35
6	C+O+E+G+R	$ 9,891,132	534.23	$ 3,032,178	118.94	$ 25,493	$ 705,403.46
7	C+O+E+G+R+F	$ 11,838,138	609.80	$ 1,947,006	75.57	$ 25,764	$ 844,257.62
8	C+O+E+G+R+F+M	$ 13,353,672	666.37	$ 1,515,535	56.57	$ 26,790	$ 952,340.65
9	C+O+E+G+R+F+M+Q	$ 16,222,487	732.37	$ 2,868,814	66.00	$ 43,467	$ 1,156,935.17
10	C+O+E+G+R+F+M+Q+P	$ 22,752,039	851.80	$ 6,529,553	119.43	$ 54,673	$ 1,622,601.73
11	C+O+E+G+R+F+M+Q+P+B	$ 24,299,561	863.69	$ 1,547,522	11.89	$ 130,169	$ 1,732,965.96
12	C+O+E+G+R+F+M+Q+P+B+D	$ 30,468,433	898.50	$ 6,168,872	34.82	$ 177,185	$ 2,172,909.90
13	C+O+E+G+R+F+M+Q+P+B+D+S	$ 31,974,275	903.08	$ 1,505,842	4.57	$ 329,403	$ 2,280,301.68

Cost estimates are in October 2000 price levels (rounded).

The data in Table 4-9 is displayed graphically in Figure 4-1.

FIGURE 4.1: STILLAGUAMISH RIVER RESTORATION ALTERNATIVES



4.10 Plan Selection

Based upon the cost effectiveness and incremental cost analyses, Plan 11 (C + O + E + G + M + F + Q + R + P + B) is recommended as the most cost effective plan. Implementation of alternatives beyond this plan (addition of site D and S) provides lower increases in output at higher incremental costs. Plan 11 will provide significantly enhanced habitat throughout the basin. The plan addresses all limiting habitat needs for anadromous fish in the basin and distributes restored habitats where needed to address all riverine life stages. Table 4-10 provides a summary of the components, costs, and outputs of the selected National Ecosystem Restoration plan (Plan) and is followed by a discussion of the rationale for the selection or screening of components.

Table 4-10. Selected Plan Summary

PLAN 11* COMPONENTS:				
Code	Site	Total Cost (Present Value $)	Affected Area (Acres)	Environmental Output (Eco-units)
C	Koch Slough Weir	$ 1,124,000	181.0	113.77
O	Port Susan Habitat Islands	$ 1,614,000	263.0	127.74
E	Gold Basin Slide	$ 1,365,000	100.0	60.00
G	Hazel Slide	$ 2,755,000	181.0	113.77
M	North Meander	$ 1,516,000	110.0	56.57
F	Hatt Slough Entrance	$ 1,947,000	115.0	75.57
Q	South Meander	$ 2,869,000	110.0	66.00
R	South Pass	$ 3,032,000	181.0	118.94
P	Portage Creek	$ 6,530,000	220.0	119.43
B	Cloverdale	$ 1,548,000	21.9	11.89
PLAN 11* TOTALS:		$ 24,300,000	1,482.9	863.69

** "Plan 11" as identified in Table 4-6 (C+O+E+G+R+F+M+Q+P+B)*

The Plan addresses habitat requirements for all riverine life stages of anadromous fish that have been identified as limiting factors in the basin. The plan also provides a geographic distribution of restored habitats throughout the basin to support the needs of anadromous fish as they migrate through the system. The following paragraphs describe the rationale for the selection or screening of components for/from the Plan.

Estuarine Habitat Needs: Florence Island at the mouth of the Stillaguamish River and Hatt Slough historically had a significant system of distributary channels that provided critical habitat for downstream migrating juvenile anadromous fish. Because of agricultural practices the majority of this distributary

system has been filled in and diked. The incremental costs provided by each of the three estuarine sites were deemed to be worth their cost. These sites included Port Susan, South Pass, and Hatt Slough.

Rearing and Refugia Off-Channel Habitat Needs: Historically the Stillaguamish River was supplied with large woody debris from surrounding riparian forests. The debris resulted in a complex system of off-stream channels and diverse habitats required by juvenile anadromous fish for refuge and rearing. Due to timber practices in the upper basin and agricultural practices in the lower basin, the amount of off-stream habitat has been significantly diminished. Currently, there is almost no existing side channel or off-channel habitat in the middle reaches of the river. The North and South Meander sites provide off-channel refugia and rearing habitats in the middle basin. The incremental costs of both sites were deemed reasonable for the output provided and the significance of the need for these habitat types in the middle reaches of the river.

In-Stream Rearing and Refugia Habitat Needs: In-stream habitat has been degraded in large part from agricultural practices in the study area. Historically, stream habitat in the basin could be characterized by natural stream channels with riparian buffer zones and large woody debris. Much of the stream habitat today is characterized by straightened channels without riparian buffer zones and little, if any, woody debris. The Cloverdale site in the North Fork Stillaguamish watershed and Portage Creek in the lower watershed both address restoration of in-stream rearing and refugia habitats. The incremental cost of both sites was deemed reasonable based on the output provided and the significance of the need for these habitat types in these two reaches of the river. The Cloverdale site also reconnects the channel to side channel spawning and rearing habitat. Two sites, the Corps Revetments (26 sites) Site and the Stillaguamish Confluence Site were not selected for recommendation. Both sites were deemed to costly for the amount of output provided. While they both provided significant instream rearing and refugia habitat, they were significantly less cost effective at providing output than the Cloverdale and Portage Creek sites.

Upstream Migration Needs: Hydraulic modifications and transportation infrastructure have cut off significant portions of upstream and tributary habitats from the mainstem Stillaguamish River for some species. The Koch Slough Weir site provides a new fish ladder that will allow access to all anadromous fish in all seasons during their upstream migration to spawning areas. The Cloverdale site provides upstream access to spawning areas for adult fish and provides rearing and refugia for juvenile anadromous fish. The incremental cost of both sites were deemed to be worth the output they provided. The Cloverdale site also provided in-stream habitat restoration benefits.

Spawning Habitat Needs: Siltation resulting from mass wasting at two major landslides in the upper basin has had a significant negative effect on all spawning habitat downstream of the slide areas on the mainstem. The Hazel Slide site addresses siltation and its impacts on the North Fork and downstream.

The Gold Basin Slide site addresses siltation and its effects on spawning on the South Fork and downstream. The Gold Basin Slide also provides some off-channel rearing and refugia habitat. Both the Gold Basin Slide and Hazel Slide sites were determined to be worth their incremental cost based upon their outputs and the significance of the impact of the siltation on spawning in the watershed.

5. DESCRIPTION OF SELECTED PLAN

5.1 National Ecosystem Restoration Plan Features

The preliminary National Ecosystem Restoration (NER) Plan includes 10 individual sites. These sites are listed in Table 5-1. The total estimated project cost for this plan (including O&M) is $26,272,000 (October 2000 price level) with a present value of $24,300,000 (present value calculated using current 6.875% federal interest rate) to restore 1,483 acres of aquatic and riparian/ floodplain habitat, providing for an addition of 864 eco-units. The study estimates an increase of 400% in environmental habitat quality for salmon and other species with the recommended plan.

Table 5-1. Recommended Projects Summary

Project Code and Name		Total Project Cost*	Project Cost Present Value**	Environmental Output Eco-Units	Affected Area Acres
C	Koch Slough Weir	$ 1,541,000	$ 1,124,000	113.77	181
O	Port Susan Habitat Islands	$ 1,775,000	$ 1,614,000	127.74	263
E	Gold Basin Slide	$ 1,654,000	$ 1,365,000	60.00	100
G	Hazel Slide	$ 2,930,000	$ 2,755,000	113.77	181
M	North Meander	$ 1,639,000	$ 1,516,000	56.57	110
F	Hatt Slough Entrance	$ 2,055,000	$ 1,947,000	75.57	115
Q	South Meander	$ 2,995,000	$ 2,869,000	66.00	110
R	South Pass	$ 3,211,000	$ 3,032,000	118.94	181
P	Portage Creek	$ 6,837,000	$ 6,530,000	119.43	220
B	Cloverdale	$ 1,635,000	$ 1,548,000	11.89	22
NATIONAL ECOSYSTEM RESTORATION PLAN:		**$ 26,272,000**	**$ 24,300,000**	**863.69**	**1,483**

**Actual value in October 2000 price level (includes PED, LERRDs, S&A, Construction Mgmt., Construction, Monitoring, and O&M)*
***Future expenditures are discounted to year 2000 value using FY00 federal interest rate of 6.875% for water resources studies.*

The overall effect of the NER plan is best shown in the basin map showing the locations of all the sites as they are distributed in the watershed (see Plates 2-4). This plan will address the major environmental water resource problems in the watershed. This plan will provide significant restoration to limiting habitat conditions for endangered salmon including: tidally influenced marsh, side channel and other off-channel habitat, rearing and refugia habitats, and spawning habitats, and stream habitats. The plan further provides fish passage, addresses the worst sediment loading problems in the watershed, and significantly restores aquatic and terrestrial ecosystem connectivity.

5.2 Monitoring and Maintenance

5.2.1 Monitoring Plan

The role of project monitoring in environmental restoration activities is to guide the maintenance or modification of the site to realize intended site benefits and to collect information useful for further restoration efforts. Monitoring serves to ensure the ultimate success of the project and provide meaningful data to help in the design of future restoration projects (USACE, 1996 Planning and Evaluating Restoration of Aquatic Habitats.)

Corps policy states that post-construction monitoring should be designed to evaluate whether or not environmental measures are working as planned following their construction (USACE Policy Digest, *Chapter 19 Environmental Restoration and Protection*, 30 July 1999). Monitoring programs are guided by a monitoring plan. A monitoring plan will be completed and approved by the technical committee for this study prior to construction of the first sites, currently scheduled in 2002. This section outlines the approach that the monitoring plan will incorporate.

Monitoring is planned to occur on a site (or project) specific level as well as a river reach level and ecosystem (basin) level. Monitoring will be tied to the specific restoration goals of each specific site. Monitoring plans may be developed for single sites or for groups of sites.

Because there is much emphasis on restoring riverine processes where possible, geomorphic evaluation may be part of the monitoring plan. In such cases, analysis of sediment distribution, river cross-sections, flow depths and aerial photos will be used to evaluate how successful the sites have been.

The monitoring plan for each site or group of sites will address:

1) Specific Goals and Objectives

Goals and objectives for each site will be specified in measurable terms for evaluating site success.

2) Performance Criteria

Performance criteria will be specified and actions (if any) required for different performance ratings. The criteria will be based on program and site objectives.

3) Monitoring Methods

Monitoring and sampling methods will be specified in the monitoring plan. Specific methods under under consideration include:

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

4) Reporting Requirements

The monitoring plan will specify a schedule and medium for reporting the findings of the monitoring program. The Corps will maintain a database on the results of the monitoring program and issue a report every two years after monitoring has been initiated.

6) Feedback Mechanisms

The monitoring plan will identify trigger points to activate adaptive management that are passed upon the Goals and Objectives (Item 1, above) and Performance Criteria (Item 2, above). Project success, as determined by performance criteria, may result in either:

- No Action
- Adaptive management (physical actions to move the program or project towards the desired objectives)
- Modification of project goals and objectives

5.2.2 Monitoring Cost Estimate and Schedule

Individual sites will typically be monitored over a five-year period, although in only three of the five years. Several sites have a ten-year monitoring period, although monitoring occurs in only three of those ten years. For developing the feasibility cost estimate, monitoring costs and timing schedules were developed for each site. Table 5-2 displays the monitoring cost and timing information for each recommended site. The Table shows the annual cost that is incurred in each of three monitoring years for each site (including a 20% contingency). Per Corps policy, monitoring cost is apportioned at 65% federal, 35% non-federal sponsor cost.

Table 5-2. Monitoring Cost Estimates and Schedule

Project	Annual Cost	Monitoring Years	Total Monitoring Cost
Koch Slough	$ 108,000	1,3,5	$ 324,000
Port Susan	$ 120,000	2,5,10	$ 360,000
Gold Basin	$ 120,000	1,3,5	$ 360,000
North Meander	$ 90,000	1,3,5	$ 270,000
Hatt Slough	$ 108,000	2,4,5	$ 324,000
Hazel Slide	$ 144,000	1,3,5	$ 432,000
South Meander	$ 96,000	1,3,5	$ 288,000
South Pass	$ 108,000	2,4,5	$ 324,000
Portage Creek	$ 120,000	1,4,10	$ 360,000
Cloverdale	$ 90,000	2,4,5	$ 270,000
26 Sites	$ 108,000	2,5,10	$ 324,000
Confluence	$ 108,000	2,5,10	$ 324,000
	ALL PROJECTS:		$ 3,960,000

All costs are in October 2000 price level.

5.2.2 Operation and Maintenance

Snohomish County, as the local sponsor, will have the requirement to operate and maintain all of the proposed site-specific restoration sites. The County may sign inter-local agreements with the Stillaguamish Tribe or other agencies for some of these other entities to be responsible for operation and maintenance of the sites on their lands. However, ultimately, it will be the responsibility of the County to ensure the sites are appropriately maintained. It is the intent of the design of these sites to minimize the potential maintenance requirements as much as possible. And, the primary goal of this ecosystem restoration plan is to recreate natural ecosystem processes that change and create habitats over time. It is not expected that all of the sites will remain in their constructed form over the life of the project.

Expected maintenance activities include elements such as:

- All vegetation plantings will require initial watering and other maintenance such as removing noxious weeds in order to ensure appropriate survival of the plantings.
- Large Woody Debris sites will require some maintenance such as wood replacement in cases of extensive lost woody debris to ensure that project objectives are fulfilled
- Side channels and sloughs may experience sediment deposition or erosion depending on the level of flows that occur.
- Bioengineered levees and banks will likely require periodic replacement of rock or LWD.
- Culverts and tide gates will need to be periodically cleaned of debris.
- Fences required for elimination of livestock access to plated areas will require periodic survey for and replacement of damage

The total estimated cost for operation, maintenance, and replacement, which the local sponsor will be responsible for over the life of the project, is $2,047,500. The present value of this cost (annual expenditures brought back to year 2000 values using the current Federal interest rate for water resources projects, 6.875%) is $610,300, which has an average annual equivalent value of $43,600 for 50 years. Details of the annual maintenance and one-time replacement costs associated with the recommended projects are provided in Table 5-3.

Table 5-3. Operation, Maintenance and Replacement Costs

	Vegetation Management	LWD Maintenance	Sedimentation Management	Structural Maintenance	Fence Maintenance	Total Annual Maintenance	Total Replacement Cost (year)
Cook Slough Weir	$ -		$ 5,000	$ 5,000		$ 10,000	35,000(25)
Port Susan Habitat Islands	$ 2,000	$ -	$ -			$ 2,000	
Gold Basin Slide	$ 2,000	$ 5,000				$ 7,000	
North Meander	$ 500	$ 500	$ 1,500		$ 500	$ 2,500	
Hat Slough Entrance	$ 500	$ 1,000				$ 1,500	
Hazel Slide	$ 500	$ 3,000				$ 3,500	
South Meander	$ 500	$ 500	$ 1,000		$ 500	$ 2,500	
South Pass	$ 500		$ 500	$ 2,500		$ 3,500	
Portage Creek	$ 2,500	$ 1,000	$ 2,500	$ 500		$ 6,500	
Cloverdale	$ 250	$ 250	$ 500		$ 250	$ 1,250	
					ANNUAL MAINTENANCE:	**$ 40,250**	
					TOTAL MAINTENANCE OVER 50-YEAR PROJECT LIFE:	**$ 2,012,500**	
					TOTAL REPLACEMENT COSTS:	**$ 35,000**	
					TOTAL OPERATION, MAINTENANCE, AND REPLACEMENT COSTS:	**$ 2,047,500**	
					PRESENT VALUE OF O&M&R COSTS:	**$ 610,300**	
					AVERAGE ANNUAL EQUIVALENT COST:	**$ 43,600**	

All costs displayed in October 2000 price level. Present values and avg. annual costs calculated using FY00 federal discount rate of 6.875%.

5.3 Summary of Real Estate Requirements and Real Estate Cost Estimate

The footprints of the 10 proposed ecosystem restoration sites would require approximately 745 acres of land, of which 87 acres is owned by the Non-Federal Sponsor (NFS). This footprint includes a total of 12 environmental sites and 1 disposal site. The 12 environmental sites include a mix of public and private owners, for a total of approximately 149 private owners and 8 public owners. The NFS owns the disposal site. Standard estates to be acquired include fee interest, temporary work area easement, temporary disposal site easement, and permanent access easement. The Real Estate Plan (REP) (see Appendix C) also contains two estates specifically developed for this project. The first is a temporary access easement developed for access to the temporary disposal site for a 12-year period. The second estate is an environmental easement developed to accommodate landowners' desire to maintain fee ownership of their land. Both estates and rationale for using the two developed estates can be found in the REP under Sections 3.3 and 3.4, respectively.

Following execution of the Project Cooperation Agreement (PCA), the NFS will require approximately 4 to 48 months to complete its real estate activities, and certify the lands available to the Corps before advertising for project construction. Time requirement estimates are site-specific as noted in the REP in Table 8B. Following authorization for entry, the NFS will provide the District Real Estate Division with all supporting lands, easements, and rights-of-way credit documentation.

See Appendix C - Real Estate Plan for additional real estate information. See Exhibit A of Real Estate Plan for maps of the project area, ownership information, estates, and acreage. See Exhibit B of the Real Estate Plan for assessment of the NFS's real estate acquisition capability. See Exhibit C of the Real Estate Plan for the Certification of Lands and Attorney's Certificate.

Table 5-4 provides a summary of the real estate baseline cost estimate (in present dollars) for land value, Non-Federal Sponsor's administration costs, and Federal supervision, review and assistance costs (S&A) required to implement the recommended plan. Kline Farm, described further in the Real Estate Appendix, is the disposal site for discarded material from construction of other sites requiring disposal.

Table 5-4 Real Estate Baseline Cost Estimate

SITE NAME	TOTAL ACRES	LAND VALUES	NON-FEDERAL SPONSOR'S ADMINISTRATIVE COSTS	DISPOSAL NON-FED	NON-FEDERAL COST (LERRD)	FED S&A	DISPOSAL FED S&A
Cloverdale Site Plan	17.75	$ 43,750	$ 25,000	$ -	$ 68,750	$ 7,500	$ -
Koch Slough Weir	0.68	$ 625	$ 8,750	$ -	$ 9,375	$ 3,750	$ -
Gold Basin Slide Area	3.00		$ 8,750	$ -	$ 8,750	$ 3,750	$ -
Hatt Slough Entrance	144.52	$ 542,500	$ 17,500	$ 8,214	$ 568,214	$ 6,250	$ 893
Hazel Slide	35.97	$ 90,000	$ 198,750	$ -	$ 288,750	$ 35,000	$ -
North Meander	13.44	$ 17,500	$ 17,500	$ 8,214	$ 43,214	$ 11,250	$ 893
Port Susan Estuary Restoration	12.00	$ 7,500	$ 8,750	$ -	$ 16,250	$ 6,250	$ -
Portage Creek- Upper Reach	112.75	$ 81,250	$ 66,250	$ 8,214	$ 155,714	$ 13,750	$ 893
Portage Creek-Lower Reach	74.19	$ 186,250	$ 190,000	$ 8,214	$ 384,464	$ 38,750	$ 893
Portage Creek-Middle Reach	37.56	$ 105,000	$ 148,750	$ 8,214	$ 261,964	$ 32,500	$ 893
South Meander	20.80	$ 72,500	$ 41,250	$ 8,214	$ 121,964	$ 11,250	$ 893
South Pass	239.73	$ 600,000	$ 33,750	$ 8,214	$ 641,964	$ 10,000	$ 893
TOTALS:	**712.39**	**$ 1,746,875**	**$ 765,000**	**$ 57,500**	**$ 2,569,375**	**$ 180,000**	**$ 6,250**

All values are in 2000 price level and include 25% contingency.
Disposal and Disposal S&A costs per project (all associated with real estate requirements) are higher than displayed in Table 4-4 due to fewer projects requiring disposal to share cost.

Project implementation is anticipated to occur in three construction phases spanning from 2002 to 2013. Phase 1 construction, occurring between 2002 and 2013, currently includes the following proposed sites:

- Port Susan Habitat Islands
- Portage Creek

The NFS will need to make available the Kline Farms Disposal site for the Phase 1 sites. Currently it is anticipated that the Kline Disposal site is needed for a 12-year period.

Phase 2 construction, occurring between 2003 and 2005, currently include the following proposed sites:

- Koch Slough Weir
- Gold Basin Slide
- North Meander
- Cloverdale

Phase 3 construction, occurring between 2004 and 2006, currently include the following sites:

- South Pass,
- Hatt Slough
- Hazel Slide
- South Meander

Additional discussion of construction sequencing is provided in Section 6.4, including Table 6.1, of this report. Also see Table 8B, Construction Phase Summary on page 19 of the REP (Appendix C) for a breakdown of the currently proposed construction schedule.

5.4 Transportation/Access

Impacts on transportation will occur as a result of construction activities. Construction of the proposed sites will be phased over several years, which will minimize the impact each year, but extend the period of potential effects over a longer time. Primarily, the effect will be from truck traffic either hauling materials off-site or bringing in materials such as LWD. Temporary access roads will be needed at many of the sites. During the preconstruction engineering and design phase, access requirements and traffic effects will be determined for each site and the effects will be minimized.

5.5 Recreation

The Stillaguamish River basin is heavily utilized for recreation, although primarily in the upper half of the basin. During the preconstruction engineering and design phase, sites should be designed to allow educational and interpretive activities, or other passive recreation that will not compromise the functioning of the individual sites. The nature and scope of the ecosystem restoration plan will implement significant habitat restoration sites in the basin, providing increased opportunities for public access and passive recreation in many locations where access is currently limited. Additionally, since an expected effect of this plan will be to increase fish and wildlife populations, opportunities for fishing will likely be increased.

During construction, there could be temporary restrictions on recreation, particularly on the sites that are in existing parks or other recreation areas. The only potential long-term negative effect on recreation exists with the placement of LWD in the river.

5.6 Aesthetics

In general, this ecosystem restoration plan will restore significant portions of the Stillaguamish River and its riparian zone and floodplain to a more natural condition. This will include revegetating many areas along the river and removing or minimizing human built structures such as levees. This will tend to reduce broad views of the river in some locations where there is currently no riparian vegetation, but should create a more aesthetically pleasing riparian zone with a mix of native trees and shrubs. During

construction, there will be temporary effects on aesthetics with ground clearing, excavation work and other such activities. All construction work will be done in a manner to minimize removal of existing native vegetation, particularly trees to avoid effects on aesthetic and biological resources. All of the specific site locations will be revegetated as quickly as possible after construction work is complete.

5.7 Cultural Resources

The Corps will prepare a Programmatic Agreement (PA) with the Washington State Office of Archaeology and Historic Preservation for this ecosystem restoration plan, that will guide the design and construction activities to ensure the Corps will be in compliance with Section 106 of the National Historic Preservation Act (NHPA). During the preconstruction engineering and design phase, each site will be field checked by a qualified archaeologist to determine if any cultural or historic resources are on the site or will be affected. The ecosystem restoration plan is designed to recreate ecosystem level functions and processes that will lead to changes in the river channel location and morphology. This will be restoring a natural process that existed prior to the turn of the century, but may affect more recent historic sites or structures. The PA will address issues of how to minimize and mitigate for potential effects on cultural and historic resources. We believe that the cost of cultural resource inventory/mitigation will remain below the 1% level. If the initial field check and investigation finds a significant cultural resource at the proposed restoration site then the plan for restoration would be modified to minimize or eliminate the impact on cultural resources or if necessary the proposed restoration site would be moved to avoid the impact.

5.8 Cumulative Effects

In general, this ecosystem restoration plan is designed to have beneficial cumulative effects on the greater Stillaguamish River ecosystem for fish and wildlife, and to reverse some of the habitat degradation that has occurred in the past. Adverse cumulative effects that have previously occurred in the basin, which this plan seeks to remedy, include:

- Heavy sediment load due to logging on unstable slopes
- Loss/lack of LWD recruitment to the River
- Loss/lack of estuarine habitat
- Loss of channel diversity in the lower River from levees and other structures
- Disconnection between the River and its floodplain

- Loss/lack of side channel habitat

This plan is also designed to positively interact with other programs or plans for habitat restoration in the basin, including the WRIA 5 Planning Process for Chinook Salmon Recovery. In fact, this ecosystem restoration plan will likely implement major elements of the WRIA 5 Recovery Plan.

The construction process will be phased over two or more years to avoid significant cumulative temporary construction impacts and appropriate best management practices will be employed to minimize temporary impacts, particularly to water quality.

Indirect impacts could occur in localized situations, particularly as the river is allowed to naturally form and change aquatic habitats. In certain situations, an existing side channel or slough may become disconnected from the river or be taken over as the main channel of the river. This process is considered to be beneficial since naturally formed habitats are more robust and effective over time than human created habitats, but may be viewed initially by some to be a loss of habitat. Additionally, while the ecosystem restoration plan will provide beneficial effects for native fish and wildlife species, it may come at the expense of habitat which currently is utilized by non-native or generalist fish and wildlife species (i.e. anadromous salmon species may increase in population while cutthroat trout which do well in human modified streams may decline to a lower population level). The removal or setback of levees may make certain properties less attractive for development. During the preconstruction engineering and design phase, it will be important to consider potential indirect and cumulative effects of each site.

5.9 Project Performance

The expected project life is 50 years. In reality, it is expected that many of the sites will be viable over an indefinite time period, particularly the revegetated riparian zone and floodplain areas. A goal of the ecosystem restoration plan is to restore ecosystem functions and processes, which will indefinitely create and reform natural riverine habitats. This will likely mean that some channels constructed under this plan will be naturally reformed or disconnected unless artificially maintained by the local sponsor(s) or protected by levees. We consider this loss to be acceptable, since the created channels are in many cases designed to be a temporary measure providing immediate benefits until the ecosystem processes have time to create their own habitats. The sites will be monitored for up to ten years (most sites have 5 year monitoring period – see Section 5.2 and Table 5-2) following construction to determine the level of functioning for the sites and maintenance requirements.

6. PLAN IMPLEMENTATION

This chapter summarizes cost-sharing requirements and procedures necessary to implement the environmental restoration features of the recommended plan.

6.1 Study Recommendation

The recommended NER plan would implement 10 individual sites throughout the watershed from the lower estuary through the middle to the upper-middle basin. The plan would implement the most beneficial and cost-effective sites to address many of the major resource problems in the basin and provide maximum aquatic and terrestrial ecosystem connectivity.

6.2 Division of Plan Responsibilities

The WRDA of 1986 (PL 99-662) and various administrative policies have established the basis for the division of Federal and non-federal responsibilities in the construction, operation and maintenance of Federal water resources projects accomplished under the authority of the Corps. This is discussed in detail below. Sections 6.3 and 6.4 specify federal and non federal responsibilities during PED and Construction.

6.2.1 Federal Responsibilities

The Federal government is responsible for conducting and completing the preconstruction engineering and design phase (detailed plans and specifications), advertising and administering the construction contracts after authorization and receipt of federal and non-federal funds, and managing the construction phase. The Federal government will provide 65% of the cost sharing for Preconstruction Engineering and Design (PED), Construction, Construction Monitoring, and Supervisory and Administrative costs. Land, easements, rights-of-way and relocations are the responsibility of the local sponsor with the exception of the restoration site at Koch Slough Weir, which is recommended for full federal funding (see Section 6.6).

6.2.2 Non-Federal Responsibilities

The non-federal sponsor is responsible for acquiring all real estate interests required to implement the sites. The non-federal sponsor is not required to provide this real estate until after the PCA is executed. The non-federal sponsor will provide 35% of the cost sharing for the preconstruction engineering and design phase (PED), construction, construction management, monitoring, and supervisory/administrative costs (S&A). The non-federal sponsor will receive credit for all expenses to acquire sufficient real estate interest in the site locations. The non-federal sponsor is responsible for obtaining all non-federal permits and authorizations for the construction work. The non-federal sponsor is responsible for all future operation and maintenance of the restoration sites as deemed appropriate and necessary by the Corps and the County.

6.3 Preconstruction Engineering and Design Phase

This phase of project development encompasses all planning and engineering necessary for project construction, and may commence after release of the Division Engineer's Public Notice on a favorable preauthorization study. These studies are required to review the earlier study data, obtain current data, evaluate any changed conditions, establish the most suitable plan for accomplishment of the improvement and establish the basic design of the site features in final detail. Preconstruction planning and engineering studies for sites authorized for construction will be programmed as "continuing" activities. The results of preconstruction planning and engineering studies are presented in reports identified as "design memorandums." Preparation of design memorandums, and plans and specifications will be cost shared in accordance with the cost sharing required for project construction. Under Corps policy, the non-Federal sponsor should provide 25% of the cost of PED during this phase. Adjustments, if necessary, shall be made after initiation of the construction phase. Current engineering guidance respecting document preparation and approvals should be consulted. (ER 1110-2-1150) 9-2.

The non-Federal sponsor has requested that Congress give them the authority for in kind credit during the PED and construction phase of this project.

Negotiation of a Preconstruction Engineering and Design (PED) Agreement may begin after Division approval of the feasibility report and issuance on the Division Engineers public notice. After receiving Division approval of the project and an allocation of funds for the PED phase, the Seattle District will commence work in PED. If the non-federal sponsor has received congressional authority to perform in kind work during PED, the PED Agreement must be clear on the scope of the local sponsor's in-kind effort, up to a limit of 35%.

6.4 Construction Phase

6.4.1 Project Cooperation Agreement

Prior to the initiation of construction, the non-Federal sponsor and the government will enter into a binding agreement in the form of a Project Cooperation Agreement (PCA) as required by Section 221 of the Flood Control Act of 1970 (Public Law 91-611), as amended, and by Section 101(e) {Harbors} and Section 103(j) {Flood Control and Other Projects} of the Water Resources Development Act (WRDA) of 1986 (Public Law 99-662), as amended. The non-Federal sponsor has requested that congress authorize them to receive in-kind credit for work performed during the construction phase. If the local sponsor wants credit for in kind effort during construction and it is authorized, it must be specified in the PCA Agreement with the understanding that the sponsor's in kind contribution will only be credited toward their cash contribution and not their LERRD requirement.

If desired, separate PCA's may developed for separate sites or groups of sites included in the recommended plan. Each PCA must describe, among other things, all of the requirements and responsibilities relating to construction of the project including items of local cooperation required from the non-Federal sponsor. Local cooperation includes that the sponsor's cost share apportionment for the recommended NER plan.

In addition, a non-Federal sponsor must also provide all lands, easements, rights-of-way, and suitable borrow and dredged or excavated material disposal areas required for the project. (collectively referred to as LERRD requirements; see Section 101(a) and (e), Section 103(a) and (j) of P.L. 99-662). The value of the required LERRD provided by the non-Federal sponsor will be credited against the non-Federal sponsor's percentage share of the costs of construction. The portion of the non-Federal sponsor's required share of costs that remains after LERRD credit is afforded must be paid to the Government in cash, or if authorized by Congress, in in kind credit. If construction of the project will be completed within one fiscal year, the in kind credit (if authorized) or lump sum cash payment must be available prior to solicitation of the first construction contract. If construction of the project will not be completed within one fiscal year, the non-Federal sponsor must provide in kind credit (if authorized) and/or cash payments each fiscal year in proportion to the Government's estimated financial obligations for construction in each fiscal year. (ER 1165-2-131; Chapter 12, ER 405-1-12).

The PCA for a project will be negotiated between representatives of the district and the non-Federal sponsor. Once the project is authorized for construction, the budget/appropriations process drives the PCA process. Current policy dictates that PCAs will not be executed until: (1) the project document has been approved by HQUSACE; (2) the project is budgeted as a new construction start or construction funds are added by Congress, apportioned by OMB, and their allocation approved by ASA(CW); (3) documentation of compliance with the National Environmental Policy Act (NEPA) and other associated environmental laws and statutes in the PCA checklist has been furnished; and (4) the draft PCA has been reviewed and approved by ASA(CW).

All Civil Works projects are managed, planned, and executed under the Life Cycle Project Management System (LCPM) (ER 5-1-11). Consistent with ER 5-1-11, the forecast final cost estimate to be entered into PCAs for all specifically authorized new starts is based on the most current cost estimate prepared in accordance with the Micro-Computer Aided Cost Estimating System (M-CACES) in the Code of Accounts format.

Under the terms of the PCA, when the Government determines that the entire project, or functional portion thereof, is complete, the Government will provide written notice to the non-Federal sponsor of such determination and furnish an Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) Manual to the non-Federal sponsor. The non-Federal sponsor is then responsible for the OMRR&R of the project, or functional portion. After completion and notice to the non-Federal sponsor, authority is considered to expire for expenditure of Federal funds for construction of additional improvements on the project or for maintenance thereof.

6.4.2 Project Construction

Construction is intended to occur over a period of ten years (2002 –2012). A total of 10 restoration sites will be constructed. The non-federal sponsor must provide all of their cost-sharing funds and real estate and documentation of in kind (if authorized by Congress) at the beginning of construction (prior to award of construction contracts) unless they specifically request a change to the PCA to allow provision of funds in a phased manner similar to the construction schedule.

For sequencing construction of specific sites, it would make most biological sense to construct sites that will provide habitat that is currently most limited first, such as the estuarine sites. Then, move on to sites which will affect a significant area of the basin, such as the weir and the two landslides; and then finally, constructing the sites that will provide more localized benefits or will provide habitats that are not as limited. None of the sites depend on construction of the other sites, however, the benefits that will be realized as a result of synergistic effects among all the sites will far outweigh the sum of benefits from

each individual site. In actuality, the sites that are on land already owned by the Corps, the County or other partners will be constructed first, followed by sites on sites with easily acquired land, followed by sites that will take longer to acquire the land. The following construction sequence (Table 6.1) shows the estimated construction schedule, subject to Congressional funding.

Table 6-1. Construction Sequencing

Construction Phase	Site Name	Construction Start	Construction End	Real Estate Acquisition & Certification Period
Phase 1 Construction 2002-2013	Port Susan Habitat Islands (1 owner)	2002	2011	4 months
	Portage Creek			
	a. Upper (7 owners)	2003	2005	12months
	b. Middle (18 owners)	2005	2007	24 months
	c. Lower (23 owners)	2008	2012	36 months
	Kline Farms Disposal (2 owners)	2002	2013	6 months
Phase 2 Construction 2003 to 2005	Koch Slough Weir (1 owner)	2003	2003	6 months
	Gold Basin Slide (2 owner)	2003	2003	6 months
	North Meander (2 owners)	2003	2005	10 months
	Cloverdale Site (3 owners)	2003	2005	10 months
Phase 3 Construction 2004 to 2006	South Pass (4 owners)	2004	2005	13 months
	Hatt Slough (2 owners)	2004	2005	10 months
	Hazel Slide (24 owners)	2005	2006	28 months
	South Meander (5 owners)	2004	2006	12 months

6.5 Cost Allocation

Cost allocation is the practice of allocating the separable costs of a project to the project purpose that they serve. For this project, all costs have been allocated to the purpose of National Ecosystem Restoration (NER).

6.6 Cost Apportionment

Cost sharing for construction of this project will be in keeping with current Corps of Engineers policy for ecosystem restoration projects, whereby the non-federal share will be 35 percent of the project implementation costs and/or in kind (if authorized)(PED and construction, including monitoring) . For this project, it is recommended that the Corps fund the Koch Slough Weir Modification site 100% federal, and apply 65/35 cost sharing for all other sites. The existing Koch Slough Weir is currently operated and maintained by the Corps of Engineers with 100% federal funding. It is likely that the Koch Slough Weir modification will be required by NMFS under the requirements of the Endangered Species Act, whether or not the Stillaguamish project is implemented. Biological Opinions from NMFS in similar situations have required these types of modifications as reasonable and prudent measures. Without the Stillaguamish project, this requirement would require 100% federal funding for the Koch Slough Weir. Thus, 100% federal funding for this feature is deemed justifiable. If a Biological Opinion does not require that the Koch Slough Weir modification be made, then traditional cost-sharing will apply.

The non-federal sponsor will provide 100% of the necessary lands, easements, rights-of-way, relocations and disposal areas (LERRDs), and conduct all future operation, maintenance, repair, rehabilitation and replacement (OMRR&R) activities for all recommended sites with the exception of the Koch Slough Weir Modification. If the LERRD value for the remaining sites exceeds the 35 percent share required from the non-federal sponsor, the sponsor will be reimbursed for the value of the LERRD that exceeds the 35 percent share. If this situation is estimated prior to executing the PCA, no additional credit will be given to the sponsor for in-kind services (if in-kind services are authorized). Table 6-2 below provides a summary of the estimated cost apportionment between the Federal and non-federal interests for the preliminary recommended plan.

Table 6-2. Ecosystem Restoration Project Costs Apportionment

COST APPORTIONMENT

	Federal	Non-Federal	Total
TOTAL IMPLEMENTATION COST	$ 16,097,050	$ 8,125,950	$ 24,223,000
KOCH SLOUGH WEIR MODIFICATION (100% FEDERAL COST)	$ 1,006,000	$ -	$ 1,006,000
OTHER ECOSYSTEM RESTORATION (65% FEDERAL, 35% NON-FEDERAL)	$ 15,091,050	$ 8,125,950	$ 23,217,000
LERRD'S VALUE (100% NON-FEDERAL)	$ -	$ 2,570,000	$ 2,570,000
CASH CONTRIBUTION	$ 16,097,050	$ 5,555,950	$ 21,653,000

**October 2000 price level (rounded) - Implmentation Cost is Project Cost less O&M.*

6.7 Institutional Requirements

The items that the local sponsor will need to require are as follows:

Provide 35 percent of the separable project costs allocated to environmental restoration as further specified below:

- Enter into an agreement that provides, prior to execution of a project cooperation agreement for the project, 25 percent of design costs and/or in kind (if authorized);

- Provide, during construction, any additional funds needed to cover the non-federal share of design costs and/or in kind (if authorized);

- Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

- Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

- Provide, during construction, any additional costs and/or in kind (if authorized) as necessary to make its total contribution equal to 35 percent of the separable project costs allocated to environmental restoration.

For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in accordance with applicable Federal and State laws and any specific directions prescribed by the Government.

Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

Assume responsibility for operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project or completed functional portions of the project, including mitigation features without cost to the Government, in a manner compatible with the project authorized purpose and in accordance with applicable Federal and State laws and specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

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

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

Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

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

Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project.

To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the ecosystem restoration, hinder its operation and maintenance, or interfere with its proper function, such as any new development on project lands or the addition of facilities which would degrade the benefits of the project.

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

Comply with all applicable Federal and State laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army".

Provide 35 percent of that portion of total cultural resource preservation mitigation and data recovery costs attributable to environmental restoration that are in excess of one percent of the total amount authorized to be appropriated for environmental restoration.

Not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

6.8 Environmental Requirements

There are many federal, state, tribal and local laws, regulations and treaties that may be applicable to certain features of this ecosystem restoration plan. Developed along with this Feasibility Report is a Environmental Assessment and Finding of No Significant Impact (FONSI) that satisfy NEPA requirements. Attached to this report is a Fish and Wildlife Coordination Act Report that satisfies the requirements of the Fish and Wildlife Coordination Act . Site specific supplemental Environmental Assessments (EA) will be developed prior to site construction. Seattle District personnel have discussed the different process and sequencing for this study relative to Section 7 consultation with the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) (Services). Both agencies expressed support for the restoration effort. Both agencies also expressed concern over how the Corps would be able to assure future compliance with ESA on this project given the fact that most sites won't be constructed for several years, and designs could change in the interim. These concerns were verbally expressed by FWS to Seattle District personnel. At that time, Seattle District's ESA Coordinator, discussed with the FWS representative a potential solution to this dilemma that would allay his concerns with ESA compliance. This is simply to hold annual meetings to address sites scheduled to be constructed in the following year, and assure their consistency with the PBA. Seattle Districts ESA Coordinator revisited these issues with representatives of the FWS and of the NMFS. Both expressed support for the project and are comfortable with ESA compliance provided we regularly consult on future sites prior to their construction. The formal process for doing this still needs to be defined, and Seattle District will be working with the Services in the near future to develop the process. Seattle District has been involved in numerous restoration sites and has had very little problem in successfully working with the FWS and the NMFS on implementation of these sites.

Some of the sites being investigated will require the completion of a 404(b)(1) analysis under the Clean Water Act prior to construction. In all cases where a 404(b)(1) is needed, it will be fully developed on a site-specific basis prior to construction. The applicability of Nationwide Permit No. 27 for satisfying requirements of Section 404(b)(1) for the majority of the sites being investigated was coordinated with the Office of Counsel and Regulatory Branch and they could see no reason why the Nationwide permit could not be used. There are a few sites that are of large enough scale or associated impacts with the restoration activities may make the use of this Nationwide somewhat tenuous. Those sites that do not seem suitable for the Nationwide permit are: North and South Meander, and the Hazel Slide site. It appears at the present time, a total of three sites do not meet the criteria for the Nationwide permit. Prior to any of these sites going to construction, if they do not qualify for a Nationwide permit, a site specific 404(b)(1) analysis will be completed as well as other pertinent regulatory requirements. At this point in time, the remaining sites seem to qualify for Nationwide permit #27. The Corps is in coordination with the State Department of Ecology to obtain Section 401 state water quality certification. Certification is usually done during PED (about 90% design level) when necessary information is developed. The Corps

has requested a letter of support from the Department of Ecology. Table 6-3 below shows that status and responsibility for compliance with the applicable laws, regulations and treaties.

Table 6-3. Status of Compliance with Environmental Laws/Regulations/Treaties

Law/Regulation/Treaty	Status of Compliance	Responsibility
National Environmental Policy Act (NEPA)	Complete after EA and FONSI are approved	Corps
Endangered Species Act	Consultation on-going	Corps
National Historic Preservation Act	Consultation on-going	Corps
Clean Water Act	A 404(b)(1) analysis will be prepared in PED where appropriate nationwide permit 27 may apply to many sites. Obtain 401 water quality certificate in PED. And NPDES construction permits where appropriate.	Corps
Clean Air Act	In compliance	Corps
Coastal Zone Management Act	Will be in compliance through maximum consistency	Corps
Fish and Wildlife Coordination Act	In compliance	Corps
Marine Mammal Protection Act	In compliance	Corps
Migratory Bird Treaty Act	In compliance	Corps
Executive Order 12898, Env. Justice	In compliance	Corps
Executive Order 11990, Protection of Wetlands	In compliance	Corps
Executive Order 11988, Floodplain Management	In compliance	Corps
Indian Treaty Rights	Will be in compliance through public review process	Corps
State Environmental Policy Act	Will be in compliance following review of EA	Snohomish County
Shoreline Management Act	Will apply for permit during Plans and Specs	Snohomish County
Washington Hydraulic Code	Will apply for permit during Plans and Specs	Snohomish County
Water Quality Certification	Will apply for permit during Plans and Specs	Corps/ Snohomish County
Growth Management Act	In compliance	Snohomish County
Model Toxics Control Act	Will be in compliance	Snohomish County
State Aquatic Lands Management Laws	Consultation on-going	Corps/ Sno. County
Snohomish County Regulations	Will be in compliance through permitting process	Snohomish County
City Regulations and Ordinances	Will be in compliance through permitting process	Sno. County or Cities

6.9 Sponsorship Agreements

The non-federal sponsor (Snohomish County) has provided a letter of intent acknowledging sponsorship requirements of the Stillaguamish River Ecosystem Restoration Project. Prior to the award of construction contracts, the sponsor will be required to execute the Project Cooperation Agreement and provide required funds. The County may enter into inter-local agreements with other entities to become sub-sponsors on specific sites. However, Snohomish County will retain the ultimate responsibility as the non-federal sponsor for all future OMRR&R.

7. SUMMARY OF COORDINATION, PUBLIC VIEWS, AND COMMENTS

7.1 Non-Federal Views and Preferences

The non-Federal views and preferences regarding environmental restoration measures, and the problems they addressed, in general were obtained through coordination with the local sponsor and with the other various local and regional public agencies, community activists, resource conservation groups, and the general public. These coordination efforts consisted of multiple meetings of the Stillaguamish River Environmental Committee, public workshops and Corps attendance at all WRIA meetings.

7.2 Views of the Non-Federal Sponsor

The sponsor has provided a strong partnership with the Corps over the past four years. Fifty percent of the overall requirements of the study (35% cash and 15% in-kind work) were contributed by the sponsor. In-kind products such as public outreach, coordination with other resource agencies and tribes, surveying and hydraulic modeling. The sponsor has indicated their willingness to continue their support during the implementation phase of this project. The sponsor also requests that they be allowed to perform and get credit for in kind services during the PED and Construction phases.

Issues which the non-federal sponsor would like to have addressed further by the Corps prior to signing a Project Cooperation Agreement include:

- adaptive management throughout the construction period
- monitoring program
- sponsor's ability to contribute in-kind services for PED and construction

7.3 Sponsor's Financial Plan and Capability Assessment

Snohomish County is one of 29 counties in the State of Washington. The County was created in 1861. The County is a government entity with powers of eminent domain and the ability to levy property and sales taxes within the County. The Washington State Auditor annually conducts financial and legal compliance audits. Snohomish County operates under a Home Rule Charter adopted by a vote of the citizens of Snohomish County in 1979, amended through the charter review process effective January 1, 1997. Independently elected administrative officials include the County Executive, the Prosecuting

Attorney, the Sheriff, the Auditor, the Clerk, the Treasurer, and the Assessor who are elected at-large. A five-member council, elected by district, constitutes the legislative body. Elected officials serve four-year terms, council member elections are staggered. For 2000, approximately 24% of the County's total revenues are expected to come from taxes. For the County's General Fund, about 58% of its revenues will come from taxes; one-third of the revenues will come from property tax. A letter from the County discussion their financial capability for this recommended plan is included at the rear of this chapter.

The 1999 tax revenues of the County totaled $136,173,502. The financial position of the County is such that bonds issued in 1998 and 1999 received Aa3 ratings from Moody's investment Services and AA- ratings from Standard and Poor's Corporation on both revenue and general obligation bonds. These ratings are considered excellent among Counties. Based on 1999 assessed values this source of funds could provide up to $1,000,000 annually by a vote of the County Council, without a public vote. Table 7-1 shows funding requirements by fiscal year to implement the recommended National Ecosystem Restoration Plan.

Table 7-1. Construction Cost Sharing By Fiscal Year

Year (FY)	Federal	Non Federal	Total
2002	$ 370,000	$ 130,000	$ 500,000
2003	$ 740,000	$ 260,000	$ 1,000,000
2004	$ 1,665,000	$ 585,000	$ 2,250,000
2005	$ 1,850,000	$ 650,000	$ 2,500,000
2006	$ 1,850,000	$ 650,000	$ 2,500,000
2007	$ 1,850,000	$ 650,000	$ 2,500,000
2008	$ 1,850,000	$ 650,000	$ 2,500,000
2009	$ 1,850,000	$ 650,000	$ 2,500,000
2010	$ 1,480,000	$ 520,000	$ 2,000,000
2011	$ 1,110,000	$ 390,000	$ 1,500,000
2012	$ 925,000	$ 325,000	$ 1,250,000
2013	$ 557,050	$ 95950	$ 653,000
Total	**$ 16,097,050**	**$ 5,555,950**	**$ 21,653,000**

All costs are in October 2000 price level.

7.3.1 Assessment of Financial Capability

Further project engineering, design, and construction will be conducted in accordance with the cost-sharing principles provided by the Water Resources Development Act of 1986, as amended. The Local Sponsor has indicated their ability and willingness to participate in the planning, engineering and design of the recommended plan, and to participate in the construction of the project.

In accordance with ER 1105-2-100, paragraph 6-184.b, a preliminary financing plan and statement of financial capability has been prepared by the local sponsor. The District has reviewed the plan and asseses the sponsor's understanding of the budgetary issues related to financing of the proposed project to determine if the local sponsor has the capability to fund their portion of implementation responsibilities. The financing plan and statement of financial capability is provided at the end of this chapter.

7.4 Summary of Study Management, Coordination, Public Views and Comments

The study team was a multi-disciplinary group that consisted of several functional elements of the Corps and the Local Sponsor, and included study and project managers, planners, civil design engineers, hydrologists and hydraulic engineers, environmental specialists, cost estimators, real estate specialist, economists, materials and geotechnical specialists. The Corps, sponsor, and interested parties conducted numerous public and interagency workshops. Much of the coordination efforts have focused on scoping the study to a cost level affordable to the County.

7.5 Independent Technical Review

7.5.1 Background

Technical review of this feasibility study has been completed. An independent technical review was accomplished in accordance with Corps of Engineers policy prior to release of the final draft feasibility report for agency and public review. This formal ITR was conducted by the Corps of Engineers and Corps' contractors. In addition to the formal ITR process, additional review has been provided by the local sponsor, Corps technical staff, Corps' contractors, and peer review from resource agencies and other interested parties. Members of the Corps of Engineers study team and review team, and the other non-Federal members involved in the review process are listed below:

Table 7-2. Study and Review Team

LIST OF PERSONNEL FOR THE STUDY TEAM ANDTECHNICAL REVIEW TEAM							
STUDY TEAM				REVIEW TEAM			
Name	Grade	Discipline		Name	Grade	Discipline	
N. Gilbrough	GS-12	Plan Form/Project Manager	PM-PL	M. Williams	N/A	Plan Form/Team Lead	Contractor
M. Purser	Snohomish County	Project Manager	SPONSOR	M. Martz	N/A	Biologist	Contractor
P. Cagney	GS-12	Environmental Coordinator	PM-PL-ER	D. Lantz	N/A.	Hydraulic Engineer	Contractor
R. Malmgren	GS-12	Hydraulic Engineer	EC-TB-HH	K. Price	N/A	Civil Engineer	Contractor
N. Skjelbreia	GS-12	Civil Engineer	EC-DB	M. Gorecki	N/A.	Economist	Contractor
R. Robinson	N/A	Economist	Contractor	D. Lantz	N/A	Cost Engineer	Contractor
B. Garrott	GS-12	Cost Engineer	EC-CB	A.E. Hamilton	GM-13	Real Estate	RE
W. Gentry	GS-12	Real Estate	RE				
B. Blake	Stillaguamish Tribe	Biologist					

Corps of Engineers (COE)

Local Sponsor (LS)

- Snohomish County Public Works

Resource Agencies (RA)

- U.S. Fish and Wildlife Service
- U.S.D.A. Forest Service
- Washington Department of Fish and Wildlife
- Stillaguamish Indian Tribe
- Tulalip Tribes of Indians

Other Interested Parties (OIP)

- Private Property Owners

Snohomish County

County Executive's Office

Robert J. Drewel
County Executive

M/S #407
3000 Rockefeller Avenue
Everett, WA 98201
(425) 388-3460
FAX (425) 388-3434
TTY/TDD (425) 388-3700
county.executive@co.snohomish.wa.us
www.co.snohomish.wa.us

October 30, 2000

Col. Ralph Graves
Commander
Seattle District
U.S. Army Corps of Engineers
Post Office Box 3755
Seattle, Washington 98154

Re: Stillaguamish Ecosystem Restoration Project

Dear Col. Graves:

Snohomish County, the local sponsor for the project, acknowledges that its financial participation in the full estimated project cost of $30,131,000 could be $10,141,000, or 35 percent of the total project cost, minus the one project that is recommended to be fully federally-funded. It is estimated that approximately $7,419,000 of the local match will be provided in cash or in-kind services, with the remainder provided as land rights, easements, utility relocation, and engineering services. This estimate is based on the most recent fully-funded cost estimated by the U.S. Army Corps of Engineers.

It is anticipated that engineering and construction agreements will be prepared and agreed to between Snohomish County and the Corps of Engineers in such a way as to be most beneficial to Snohomish County within the legal authority of the Corps of Engineers. Snohomish County also intends to work cooperatively with other interested parties, such as the Stillaguamish Tribe of Indians, the Tulalip Tribes, the Stillaguamish Flood Control District, Snohomish Conservation District, and other interested landowners throughout the project area.

In preparing the cost estimates, the U.S. Army Corps of Engineers included costs for the first five years following construction of maintenance and other activities needed to assure survival and maintenance of planted material. Also included in these estimates are the costs for monitoring and reporting of the project in order to provide for adaptive management during the first five years of post-construction project implementation. It is understood by Snohomish County that any maintenance required after the initial five year establishment period will be the responsibility of the local sponsor.

It is Snohomish County's desire to implement these projects in the most cost-effective way. To that end, Snohomish County will seek salmon recovery and other grants to assist in providing our local match to the project, as well as funding from interested parties listed above. Other constraints, such as limitations on land acquisition, may also limit the County's ability to implement some projects, depending on willingness of landowners.

Snohomish County's funding for implementation of this project is likely to come from several existing sources—local, state and others. Potential local funds include the County's Real Estate Excise Tax, Conservation Futures, and Stillaguamish Clean Water District Funds (for those projects inside the Clean Water District). Snohomish County will also seek grants from the Washington State Salmon Recovery Funding Board and other grant sources to provide the local share for these projects, as well as funding and in-kind support from the Stillaguamish Tribe of Indians, the Tulalip Tribes, the Conservation District, and the Stillaguamish Flood Control District. Snohomish County's ability to participate with the Corps of Engineers is contingent upon appropriation of funds by the County's governing body.

Sincerely,

Robert J. Drewel
Snohomish County Executive

cc: Barbara Cothern, Council Chair
David Brock, Chair, Stillaguamish Clean Water District
Chuck Hazelton, Stillaguamish Flood Control District
Pat Stevenson, Stillaguamish Tribe of Indians
Curt Nelson, Tulalip Tribes

Post-it™ Fax Note 7671	Date 9/31/00	# of pages ▶ 2
To Mona King	From Laura Nelson	
Co./Dept.	Co.	
Phone #	Phone # 425-388-3645	
Fax # 206-764-4470	Fax #	

7.5.2 Review Milestones and Documentation

During the course of the Feasibility phase study, there has been on-going, independent technical review of the major report products as they have become available. These include:

- Project Designs
- Incremental Cost Analysis
- Hydrology and Hydraulics
- Environmental Analysis
- Real Estate Plan

The review process has been documented in a review documentation report and a certification of technical and legal review on file with the Corps of Engineers project manager.

8. CONCLUSION AND RECOMMENDATION

8.1 Conclusion

Of the 19 sites initially considered for restoration, 10 are recommended for implementation as the NER plan. Sections 4 and 5 fully describe the analysis and rationale for recommending this plan. This plan is a cost-effective solution to address habitat degradation in the Stillaguamish River Basin and addresses a complete range of limiting habitat factors in the basin. Based on the comparison of aquatic and riparian benefits associated with each individual site, it appears that the recommended plan provides the best opportunity for maximizing ecosystem restoration (NER) benefits. The plan as formulated will restore or reconnect access to approximately 1,480 acres of aquatic and riparian habitat and will benefit species listed as threatened under the Endangered Species Act.

8.2 Recommendation

I recommend that the plan described herein for environmental restoration purposes be authorized for implementation as a Federal project. The total implementation cost of the project is currently estimated at $24,223,000 (October 2000 Price Level). The Federal share is currently estimated at $16,097,050 and the non-Federal share is $8,125,950 (including cash requirement of $5,555,950 and LERRD of $2,570,000).

.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual sites. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

_____

Colonel, Ralph H. Graves
U.S. Army Corps of Engineers
District Engineer, Seattle District

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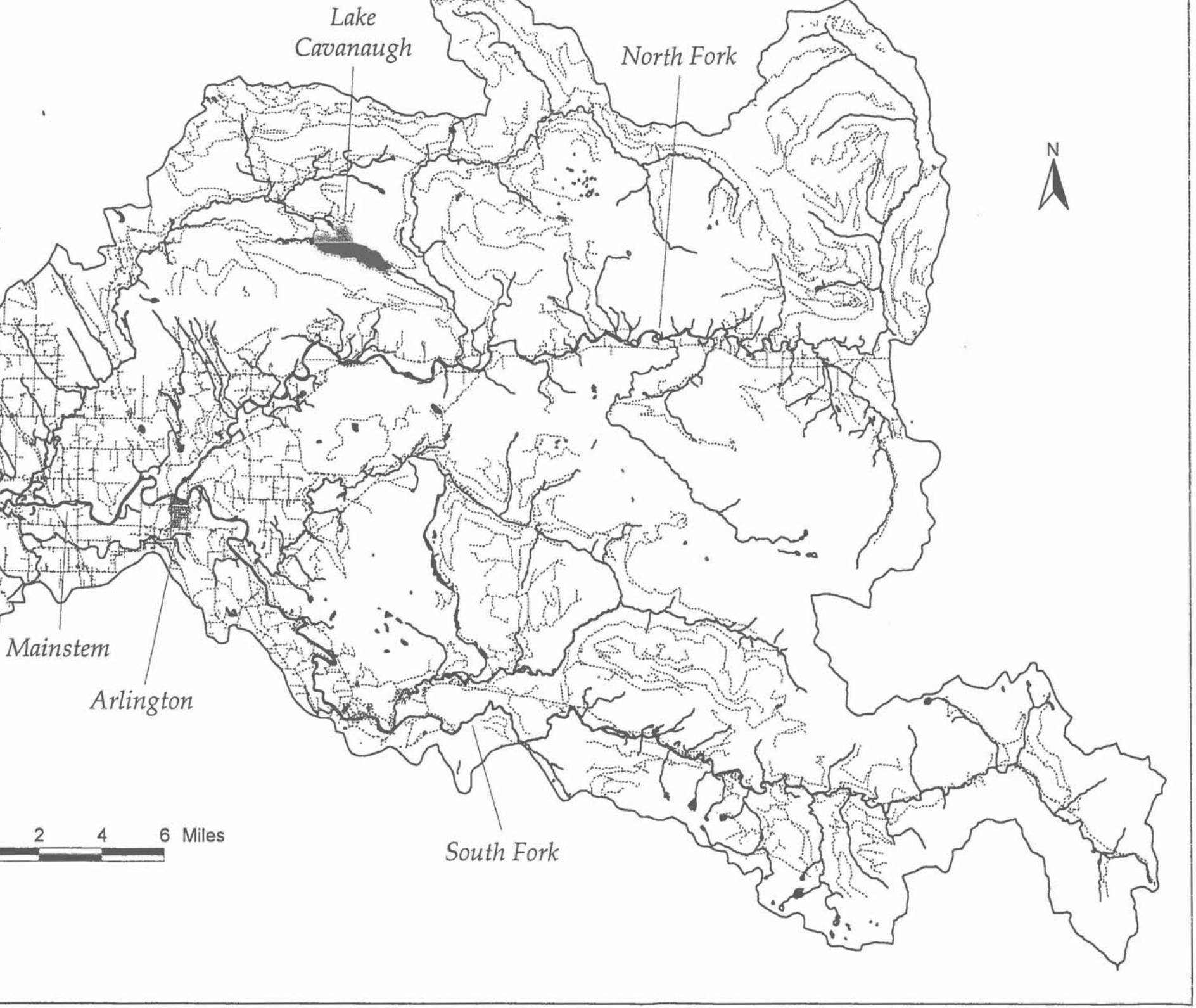
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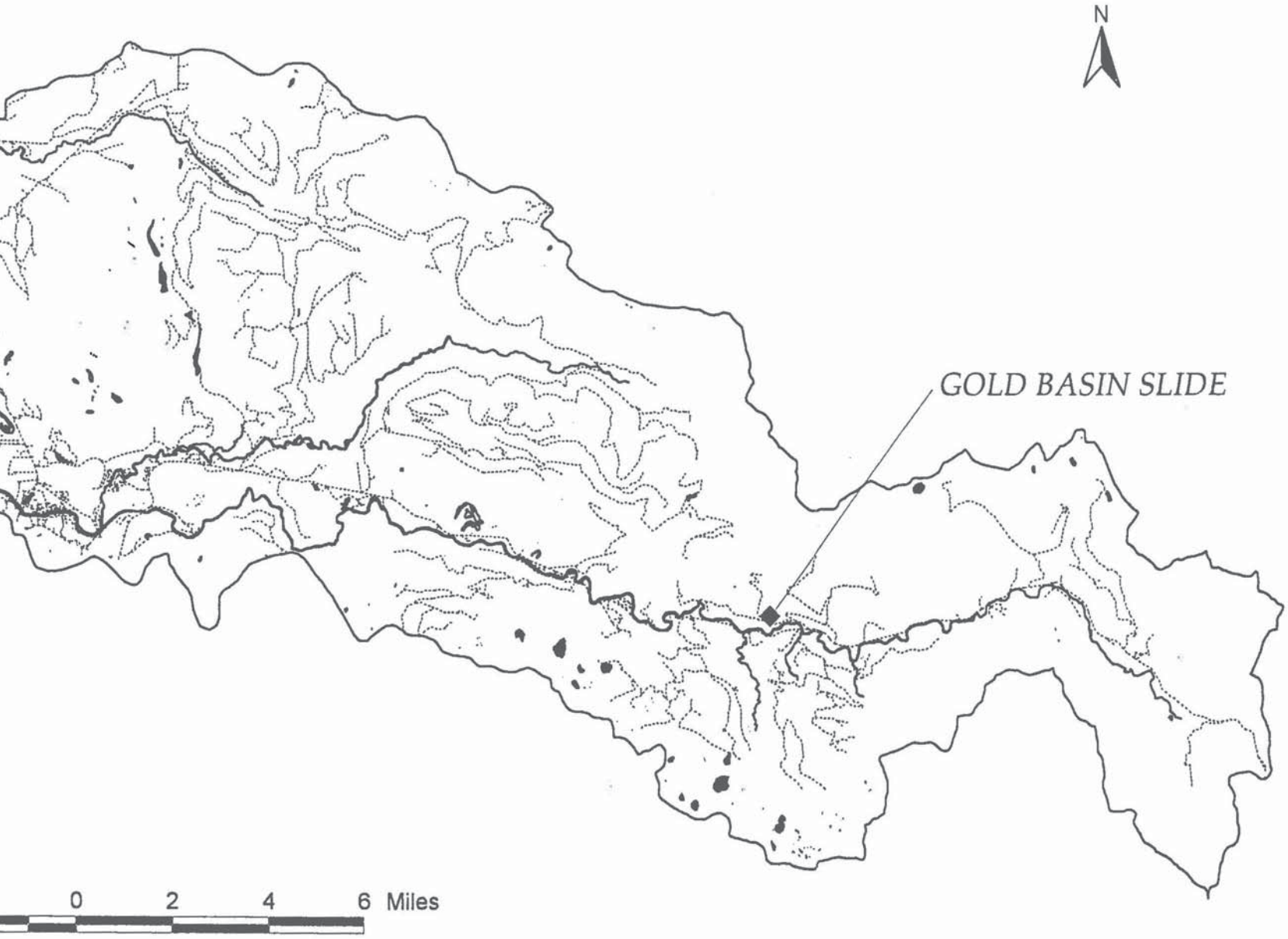
Sources

River information obtained from Snohomish County.
City Boundaries, Roads and additional data provided by TIGER Census.
Site location information provided by Seattle District Corps of Engineers.



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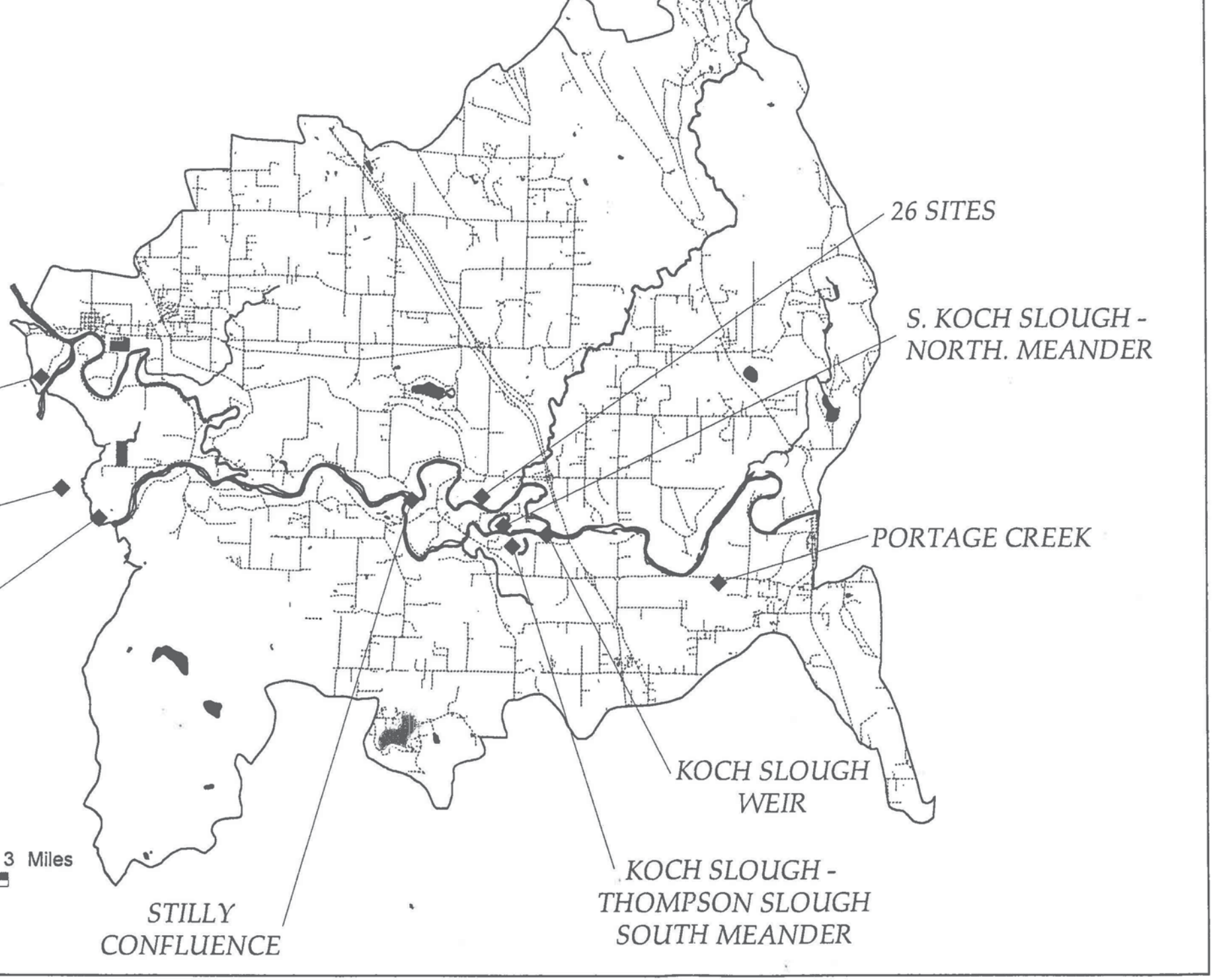

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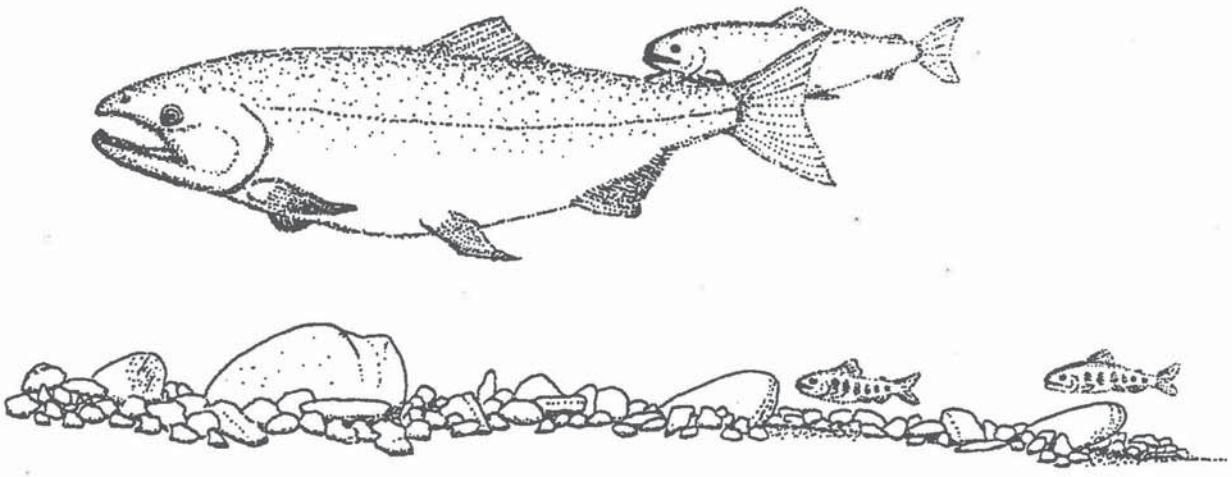
APPENDIX A

U.S. FISH AND WILDLIFE SERVICE

COORDINATION ACT REPORT

Stillaguamish River Basin
Ecosystem Restoration Project

FISH AND WILDLIFE
COORDINATION ACT REPORT



U.S. Fish and Wildlife Service
Western Washington Office

September 2000

U.S. Fish and Wildlife Service

Fish and Wildlife Coordination Act Report

STILLAGUAMISH RIVER BASIN ECOSYSTEM RESTORATION PROJECT

Prepared for
U.S. Army Corps of Engineers
Seattle District

Prepared by
Gwill Ging, Biologist
Western Washington Office
Lacey, Washington

September 2000

TABLE OF CONTENTS

INTRODUCTION

This Coordination Act Report (CAR) presents the U.S. Fish and Wildlife Service's (USFWS) conclusions on the effects of the proposed Stillaguamish Basin Ecosystem Restoration Project. This report is based on the project description and the related information provided in the Corps of Engineers' (Corps) reconnaissance report, 35 percent design reports, and on site visits to the projects on June 18, 1999 and on February 23, 2000. This CAR is being provided under the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended: 16 U.S.C. 661, et seq.) and fulfill Section 2(b) of this Act.

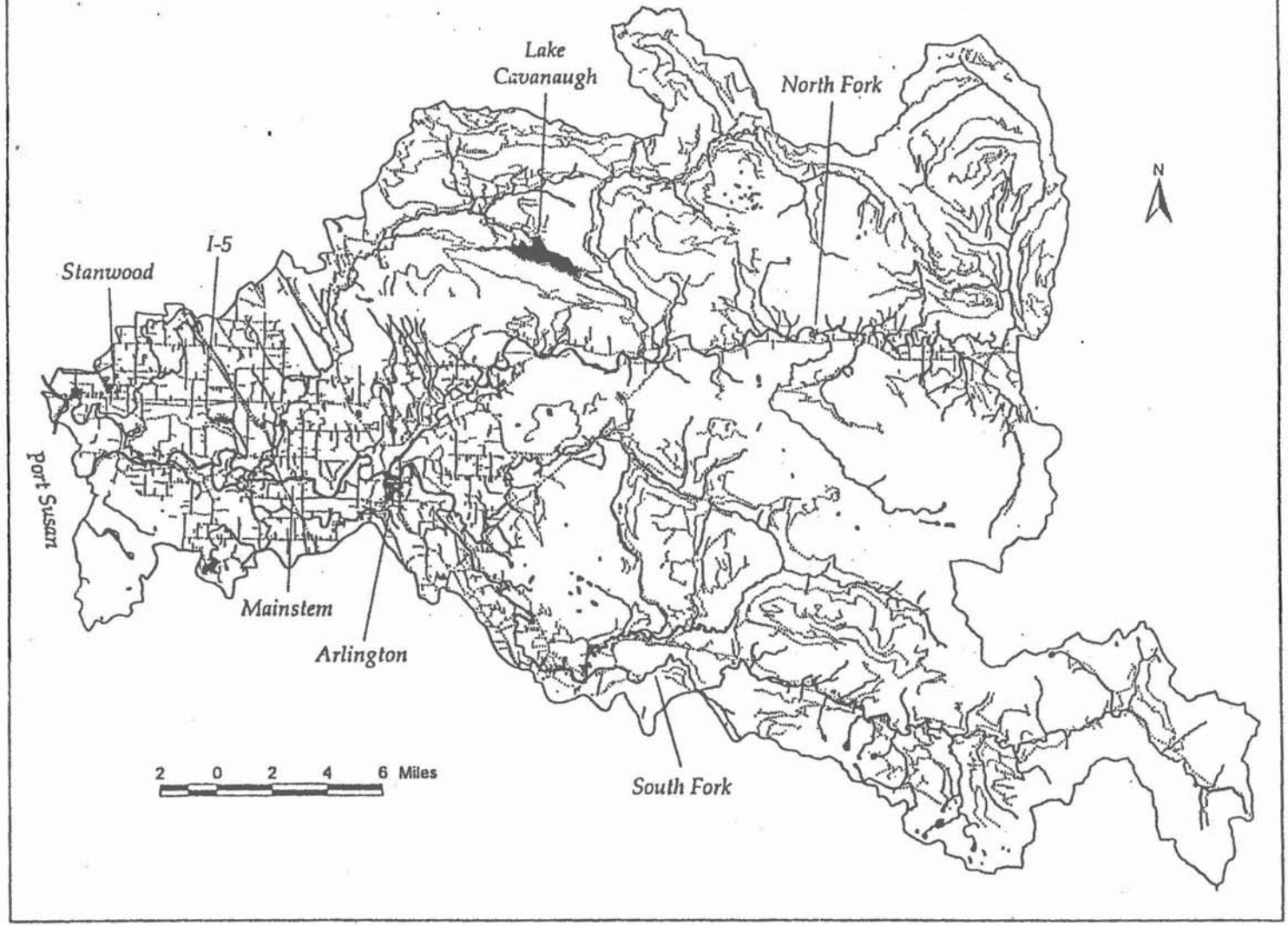
The U.S. Fish and Wildlife Service (Service) strongly supports the restoration of the Stillaguamish River Basin ecosystem. We believe many species of fish and wildlife would benefit significantly from the implementation of most of the actions proposed under this project scope. A couple of the proposed actions, however, involve issues that would need to be resolved before we could support these project elements.

PROJECT LOCATION

The Stillaguamish River system consists of two main tributaries: the North and South Forks. Each fork, in turn, has numerous tributaries. The basin contains over 975 linear miles of mainstem and tributary streams (Williams et al. 1975), draining an area of 684 square miles. The basin is located almost entirely within Snohomish County, with a small portion of it lying in Skagit County (Figure 1). The upper watershed of both forks have their origins in Mount Baker National Forest. The terrain is steep and densely forested, and stream velocities are rapid with many cascades. Pool and riffle complexes are lacking at the higher elevations, increase in the middle reaches as the channel broadens and the gradient decreases, and are relatively frequent toward the lower end. As both streams approach their confluence at Arlington, the river valleys become more gradually sloped. Evergreen forests are replaced with deciduous forests which give way to cleared agricultural lands.

Below Arlington, the Stillaguamish River valley is almost completely agricultural. Small towns like Stanwood, Florence, and Norman are situated along the river. Much of the river has been leveed, confining the river to its meandering channel except during periods of extreme runoff. The lower mainstem is best described as a pool-riffle system. Side channels and sloughs split off from the river several times as it flows west from Arlington to its mouth at Port Susan, a distance of roughly 18 miles. The last several miles are subject to tidal influence and provide a crucial zone as juvenile anadromous fish acclimate to the marine environment.

Eleven of the proposed projects are located in the lower basin, downstream of Arlington, and are shown in figure 2. The remaining three projects are located in the upper basin. See figures 3 and 4.



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- Basin Boundary
- Rivers & Streams
- Roads

U.S. Army Corps of Engineers
Seattle District

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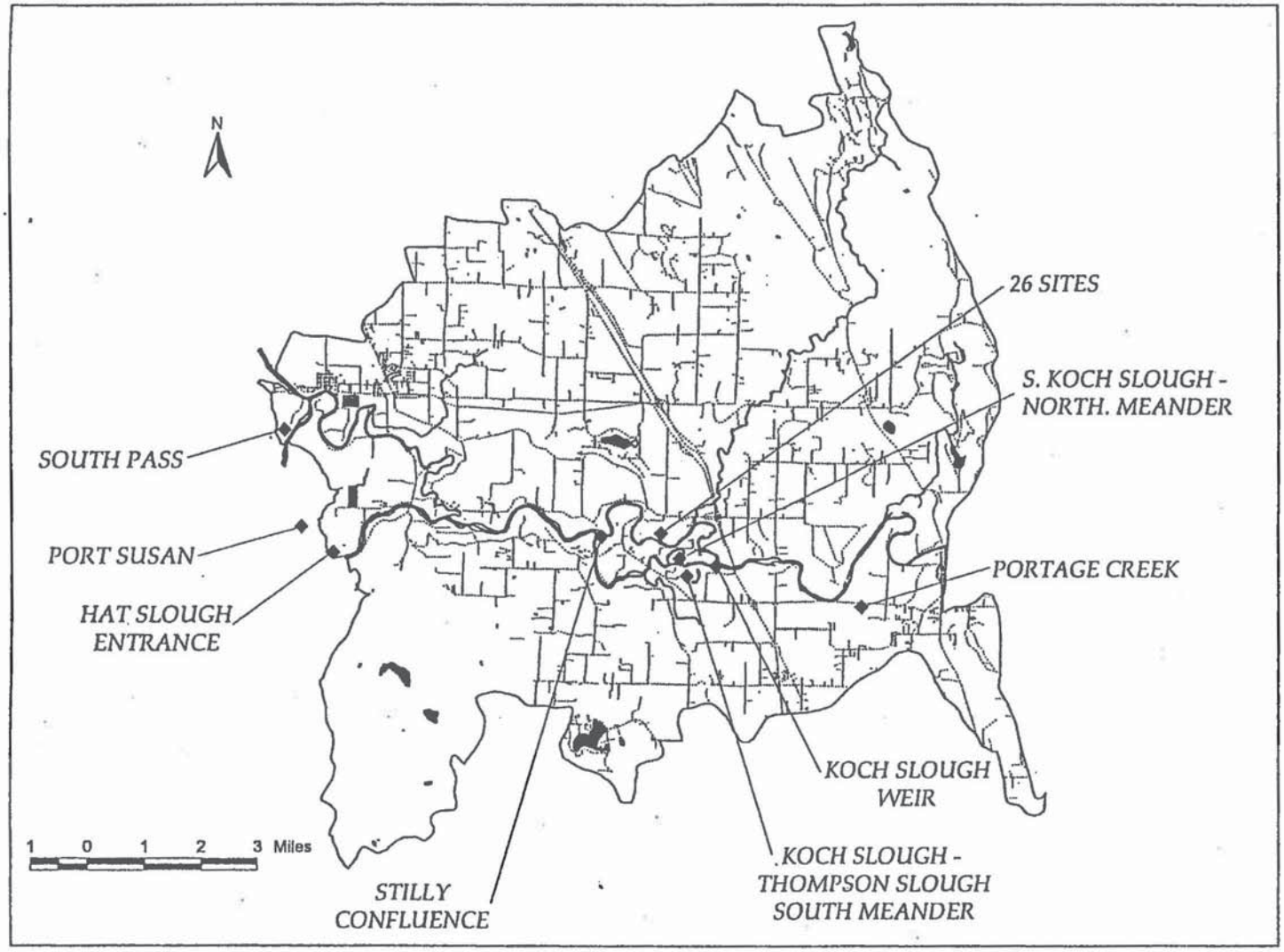
Sources

River information obtained from Snohomish County.
City Boundaries, Roads and additional data provided by TIGER Census.
Site location information provided by Seattle District Corps of Engineers.

Figure 1

Location Map

Stilliguamish River Basin



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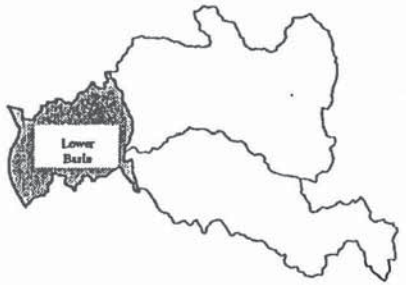
- Basin Boundary
- Restoration Sites
- Rivers & Streams
- Roads



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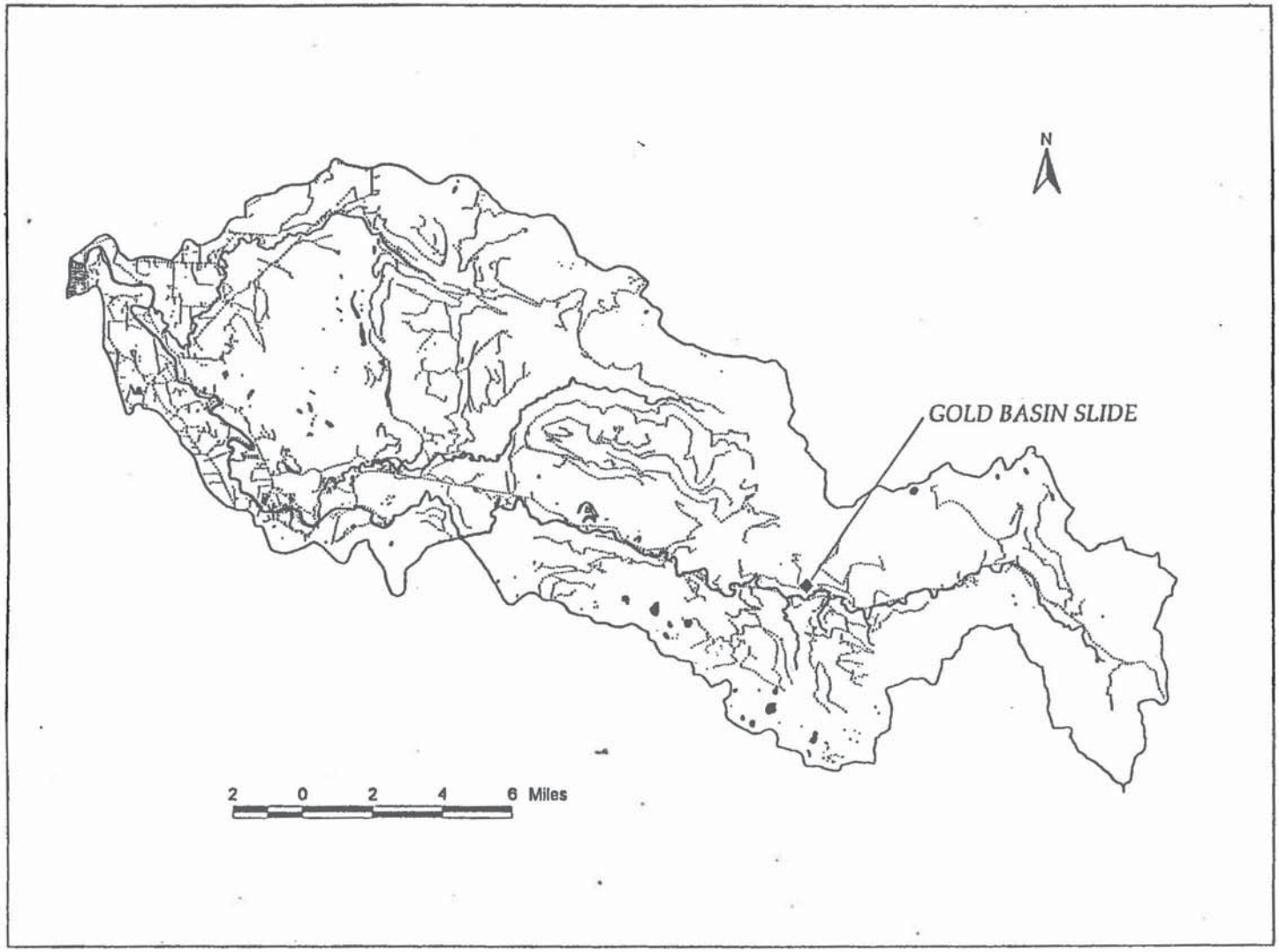
Site location information provided by Seattle District Corps of Engineers.

Figure 2

Restoration Sites

Stilliguamish River - Lower Basin



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- Basin Boundary
- Restoration Sites
- Rivers & Streams
- Roads

U.S. Army Corps of Engineers
Seattle District

DFF 08/07/00

Sources

River information obtained from Snohomish County.
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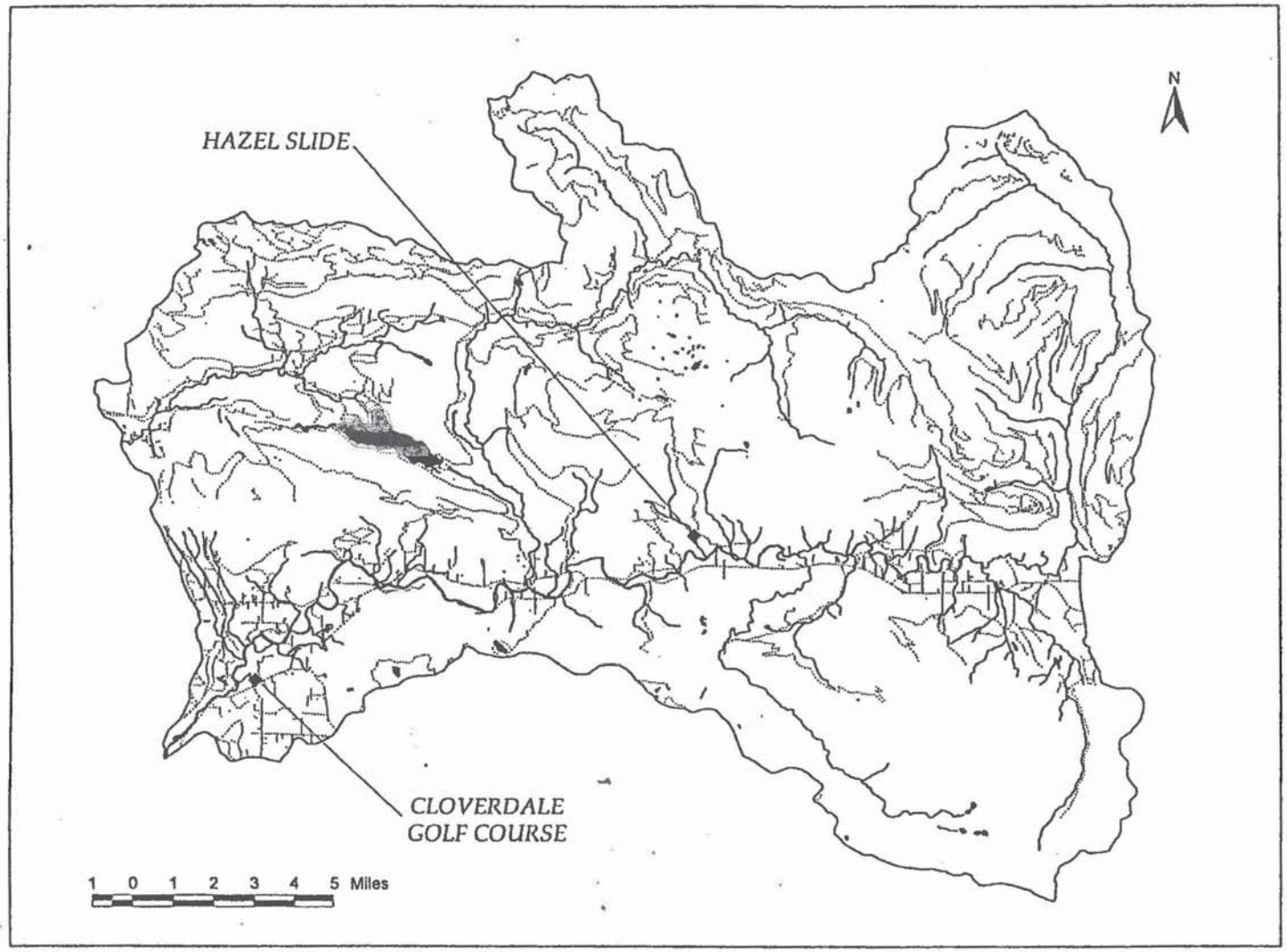
Site location information provided by Seattle District Corps of Engineers.

Figure 3

Restoration Sites

Stilliguamish River - South Fork



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- Basin Boundary
- Restoration Sites
- Rivers & Streams
- Roads

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Seattle District

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Sources

River information obtained from Snohomish County.
City Boundaries, Roads and additional data provided by TIGER Census.
Site location information provided by Seattle District Corps of Engineers.

Figure 4

Restoration Sites

Stilliguamish River - North Fork

PROJECT PURPOSE

The project purpose is to restore the ecological processes that are directly associated with, or directly dependent on, the hydrologic regime of the watershed that has been adversely affected by historic changes. Urbanization, road construction, timber harvesting, extensive diking, rock revetment projects, weir construction, gravel extraction, large woody debris removal, eradication of beavers, and landslides have all negatively influenced the natural flow regime and channel forming processes of the Stillaguamish basin. The resulting problems that have been identified include the following:

- Lack of habitat in the lower Stillaguamish estuary,
- Changes in sediment loads and transport,
- Changes in streamflows,
- Loss of channel complexity and in-channel structure,
- Water quality degradation,
- Barriers to fish passage,
- Flood plain disconnectivity,
- Habitat fragmentation,
- Degradation and loss of wetlands,
- Degradation and loss of fish and wildlife habitat and rare species habitats,
- Changes in forest structure and composition,

PROJECT AUTHORITY AND SCOPE

The authority for the restoration investigation is Section 209 of Public Law 87-874, Puget Sound and Adjacent Waters. Funding for the study was provided by the 1995 Energy and Water Development appropriations bill. The Stillaguamish Ecosystem Restoration Study has been evaluated in the context of the Corps of Engineers Ecosystem Restoration Program as described in Engineering Circular (EC) 1105-2-210 (June 1 1995). The document sets forth guidelines regarding the identification and evaluation of projects that may be appropriate for inclusion in the Ecosystem Restoration Program.

The Corps' reconnaissance report (1997) provides a good basis for understanding the program, problems, constraints, and potential options for restoring processes, structure, and function to the degraded ecosystem. A total of twenty-seven project proposals have been submitted to the Corps. Many of these projects were a result of meetings between local, state, tribal, and federal representatives who have a mutual interest in restoring the Stillaguamish River. This group, the Stillaguamish Implementation Review Committee, produced a draft document that identified restoration strategies for 13 sub-basins in the Stillaguamish watershed. A preliminary evaluation of these 27 project proposals occurred during field trips to the sites. Thirteen projects are recommended for further consideration and analysis in the next planning phase.

PROJECT DESCRIPTION

The Corps of Engineers (federal sponsor) and Snohomish County (local sponsor) are recommending thirteen habitat restoration projects within the Stillaguamish Basin to be implementation over a ten year period. Each of the projects include one or more of the following restoration measures: (1) the restoration or creation of estuarine emergent marshes; (2) the acquisition of protective riparian buffers and replanting of native trees and shrubs in the riparian zone; (3) the construction of off-channel habitat; (4) the reconnection of side channels and cutoff meander bends; (5) the addition of large woody debris; (6) the control and reduction of fine sediments from entering the river; (7) and the installation of a fishway.

A brief description of each of the individual projects is presented below. More detailed information is provided in the Corps' document, "Stilliguamish River ecosystem restoration - feasibility report and engineering appendix."

Port Susan Habitat Islands There are twelve proposed sites on the intertidal flats of Port Susan Bay near the mouth of Hat Slough. The purpose of the project is to promote the development of emergent marsh habitat and provide additional habitat complexity in the estuary. The project involves the placement of twelve large woody debris structures, each about 0.5 acres in size, within the intertidal zone to promote the deposition of sediments and the subsequent establishment of emergent marsh vegetation at these locations. Sediments from the adjacent intertidal flats would be dredged and placed within the structures and riprap would be added along the sides for stability. Estuarine emergent vegetation would be planted. This project is considered experimental, and full implementation would depend on satisfactory results from a pilot study.

Hat Slough Entrance This project is located on the right bank of Hat Slough as it enters Port Susan Bay. The purpose of this project is to improve the habitat value for fish and wildlife by restoring the tidal hydrology to up to 200 acres of land that are separated from Port Susan Bay by a sea dike and are presently used for agriculture. The project involves the breaching of the sea dike at multiple locations and the construction of short tidal channels. To protect adjacent private property from flooding, a new cross levee would be constructed.

South Pass The project purpose is to restore the tidal hydrology to up to 150 acres of land that was converted to agricultural production in the late 1800's. Project features include the excavation of a tidal channel, the removal of sea dikes, and the planting of emergent marsh vegetation. A cross levee would also be constructed to prevent the flooding of property adjacent to the restoration site.

Old Stillaguamish Channel This project includes the Stillaguamish Channel between Port Susan Bay and its confluence with Hat Slough, a distance of about 8 miles. The project purpose is to improve the habitat for juvenile salmonid rearing and foraging by increasing flows in the channel and enhancing the riparian corridor. A major portion of the project includes the acquisition of riparian buffers and the planting of native trees and shrubs along this 8 mile reach. Another

project element involves the construction of a reversible tide gate that would be used to restrict the inflow to the old Stillaguamish Channel from the Hat Slough end, which would increase the rate of water exchange and improve water quality.

Koch Slough/Stillaguamish Confluence The project is located immediately upstream of the Koch Slough and Stillaguamish River confluence. The goal is to increase channel complexity and off-channel rearing habitat. The project includes the construction of engineered log jams in Koch Slough, the excavation of a 500 foot-long side channel along the left bank of the Stillaguamish River channel, the placement of large woody debris within the constructed channel, and the planting of trees and shrubs on the river bank.

Koch Slough Weir Site The project site is located on Koch Slough immediately downstream from its split from the Stillaguamish River. The project goal is to improve upstream fish passage for pink salmon and other species that are unable to effectively use the existing fish ladder. The project involves the construction of a new fishway near the center of the existing weir.

Koch Slough North Meander This project is located on an old meander channel of Koch Slough, which was cut off for the purpose of flood control during the 1930's. The length of the meander bend is about 7,500 feet. The project goal is to provide high flow refuge for juvenile salmonids which would be accomplished by constructing a connection with the Stillaguamish River channel.

Koch Slough/Thompson Slough The project is located on an old meander channel between Koch Slough and Portage Creek. The length of this cutoff channel segment is about 7,500 feet. The goal of this project is to provide additional salmonid winter and summer rearing habitat, high flow refuge habitat, and higher value wildlife habitat. The project involves the construction of a connection with Portage Creek, the planting of native trees and shrubs along the bank, and the placement of large woody debris in the channel.

Mainstem Maintenance This project includes 26 sites that were originally constructed as part of the 1926-1937 Works Project Administration. Maintenance at these sites currently involves the brushing and removal of small trees and the protection of the bank through the placement of riprap. The purpose of the restoration project is to restore channel complexity and enhance the riparian zone. The project consists of using bioengineering methods to stabilize the bank instead of riprap, adding large woody debris to the channel, and eliminating some of the sites from the maintenance program, if their protection is no longer needed.

Portage Creek The proposed actions would occur along three contiguous reaches of Portage Creek, totaling about 6 miles in length. The primary objectives of the project are to restore and enhance channel complexity and riparian habitat in the lower and middle reaches of Portage Creek, and to create a forested wetland and coho rearing environment in the upper reach. Project elements include planting native trees and shrubs in the riparian zone, removing reed canary grass, placing small and large woody debris within the stream channel, installing fencing, and excavating a new meandering channel and dendrites.

Cloverdale Farm Site This project site is located on an unnamed tributary to the North Fork of the Stillaguamish River near State Route 530 and 115th Avenue NE. The project purpose is to restore channel complexity and diversity, and access to upstream spawning habitat. Project elements include riparian plantings, installation of a culvert, and excavation of a meandering channel.

Hazel Slide The project location is on the North Fork of the Stilliguamish River at river mile 20, near the community of Hazel. The project objective is to stabilize a large active landslide and prevent the sediments from entering the river. Excessive imputs of fine sediments have adversely impacted downstream spawning, rearing and holding habitat. The project involves the construction of a series of engineered log revetments to direct the river away from the toe of the slide and to provide a number of settling ponds to retain the fine sediments that sluff off the slide face.

Gold Basin Slide The project location is on the South Fork of the Stilliguamish River at river mile 46, near the community of Verlot. The project objective is to stabilize a large landslide and prevent the sediments from entering the river. The project involves the construction of a series of engineered log revetments to direct the river away from the toe of the slide and to provide a settling pond to retain the fine sediments.

AFFECTED RESOURCES

FISHERY RESOURCES

Anadromous Fish

The Stillaguamish River supports runs of chinook, coho, chum, and pink salmon, steelhead and cutthroat trout and native char. Populations of all of these species have declined dramatically in response to habitat loss, habitat degradation, and overfishing. Several stocks for each species are found in the Stillaguamish River system and are differentiated based on spawn time and/or geographical differences (WDFW 1994). Chinook salmon are divided into two distinct stocks; summer and fall. Chum salmon are also divided into two distinct stocks but separated geographically into the North and South Fork stocks. Stillaguamish coho are also differentiated geographically into the Stillaguamish and Deer Creek stocks. The two pink salmon stocks are divided based on geographical and spawn timing differences into the North and South Fork stocks. There are four distinct stocks of steelhead in the Stillaguamish River system. The summer runs are geographically divided into the Deer Creek, South Fork, and Canyon Creek stocks. The Stillaguamish River also has a wild winter run of steelhead. Sea-run cutthroat and bull trout/Dolly Varden also occur in the system, but information is very limited on their abundance and distribution.

The WDFW (1994, 1998) considers the status of Stillaguamish River fall chinook, summer chinook and coho salmon and Deer Creek summer steelhead stocks to be depressed; Stillaguamish winter steelhead and South and North Fork Stillaguamish chum and pink salmon

stocks to be healthy; and the Deer Creek coho salmon, South Fork Stillaguamish and Canyon Creek summer steelhead, and Stillaguamish bull trout/Dolly Varden stocks to be unknown. The WDFW and Stillaguamish Tribe are presently reviewing and updating the status of the Stillaguamish Basin anadromous fish stocks.

The Stillaguamish Tribe operates a hatchery for chum and chinook salmon and the Washington State Department of Fish and Wildlife operates its hatchery for summer and winter steelhead.

Hat Slough, South Slough, and the lower mainstem of the Stillaguamish provide a transportation corridor to and from the marine environment. The lower reach, i.e., up to river mile 4, provides particularly important rearing habitat for juvenile salmon, steelhead and native char while they acclimate to the marine environment (Williams et al. 1975). Some spawning by pink and chum salmon occurs in the lower reaches, but the better spawning habitat in the mainstem occurs upstream of river mile 6. Tributaries entering this reach provide spawning habitat for pink, chum, and coho salmon, and steelhead and cutthroat trout (Williams et al. 1975).

Both the Stillaguamish River North and South Forks provide spawning and rearing habitat for chinook, coho, pink and chum salmon, steelhead trout and native char. Spawning, rearing and adult holding habitat has been adversely impacted by major landslides on both forks.

Estuarine/Marine Fish

Many estuarine and marine fish use the mudflats, sandflats, tidal sloughs, and lower reaches of the Stillaguamish River within the vicinity of the proposed project. Representative fish species that use these habitats include starry flounder, English sole, Pacific tomcod, Pacific herring, Pacific sandlance, shiner perch, snake prickleback, staghorn sculpin, and three-spine stickleback.

Resident Fish

Resident rainbow, cutthroat and native char (bull trout/Dolly Varden) occur throughout the mainstem and the North and South Forks (Williams et al. 1975). Non-game species include mountain whitefish, large-scale sucker, prickly and torrent sculpins, peamouth chub, speckled dace, redside shiner, and Pacific, river and western brook lampreys.

WILDLIFE AND BOTANICAL RESOURCES

Historically, extensive saltwater and brackish marshes, freshwater wetlands, tidal sloughs and a broad riparian forest occupied the lower Stillaguamish River Basin. Most of these habitats have since been converted to farmlands or altered for the conveyance of flood flows. The small amount of estuarine emergent wetlands that remains occurs mainly as a fringe along the levees bordering Port Susan Bay, Hat Slough and mouth of the Stillaguamish River. Lyngby's sedge, seaside arrowgrass, Pacific silverweed, pickleweed, and salt grass are the dominant plant species. Representative wildlife include the bald eagle, black brant, widgeon, trumpeter swan, kestrel, Savannah sparrow, striped skunk, raccoon, muskrat, Townsend vole, and garter snake.

Sandflat and mudflat habitats have been impacted to a much lower degree by agricultural conversion. Consequently, these habitats are still abundant and in good condition. Plant species include eelgrass and sea lettuce. Representative wildlife include the harbor seal, great blue heron, glaucous-winged gull, western grebe, white winged scoter and western sandpiper.

The Stillaguamish River, tributaries and flood plain within the valley bottom have also been heavily affected by agricultural conversions and flood and erosion control measures. The river channel has been straightened, armored with riprap, or confined by levees. The riparian zone has been greatly reduced, typically occurring as narrow bands between the river's edge and the levee or adjacent farmland. Red alder, black cottonwood, big leaf maple, and western red cedar are the dominant tree species. Understory species include salmonberry, snowberry, and sword fern. Representative wildlife includes the black-tailed deer, raccoon, red-tailed hawk, marsh hawk, American crow, song sparrow, garter snake and Pacific chorus frog. The lower river also includes a number of leveed reaches where riparian trees and shrubs are lacking. At these locations, the dominant vegetation is typically Himalayan blackberry and/or a combination of grass species. Common wildlife using this area include the marsh hawk, robin, Brewer's blackbird, meadowlark, killdeer, tree swallow and Savannah sparrow.

Several of the proposed projects are located on abandoned farmlands that were formerly estuarine or freshwater wetlands. These sites presently support mostly grass and weed species. Typically wildlife include the coyote, striped skunk, Townsend's vole, snow goose, marsh hawk, short-eared owl, crow, Savannah sparrow, and garter snake.

Two of the proposed projects are located on the two main forks of the Stillaguamish River where active landslides input large quantities of sediment to the river channel. There is presently little use of these highly unstable and unvegetated slide areas by wildlife. Adjacent riparian forests support big leaf maple, red alder, western red cedar, Douglas fir, willow, salmonberry and sword fern, and could be affected by the migration of the river channel. Representative wildlife includes the black-tailed deer, black bear, raccoon, dipper, rufous sided towhee, song sparrow, violet green swallow, Oregon ensatina, and red-legged frog.

FEDERALLY LISTED SPECIES

The species that have been listed pursuant to the Endangered Species Act of 1973 that may occur within the vicinity of the proposed projects include the gray wolf, grizzly bear, bald eagle, marbled murrelet, northern spotted owl, bull trout, and chinook salmon. The Corps is in the process of preparing a biological assessment that discusses the occurrence of listed species, their use of the project area and the expected effect of the project on them.

WITHOUT THE PROJECT CONDITION

Under the "without-the-project" condition, the thirteen habitat restoration projects would not be implemented under the Corps' ecosystem restoration authority. It is likely that most or all of the larger and more costly projects (e.g., Hat Slough Entrance, Portage Creek, Hazel Slide and Gold

Basin Slide) would be deferred indefinitely, or at least not implemented in the near term. Some of the smaller projects (e.g., South Pass, Cloverdale Farm Site) or those that could be scaled back (e.g., Old Stillaguamish Channel) could possibly be implemented through other federal and non-federal funding sources. The results from a basin restoration perspective would be essentially the same, i.e., too little effort to be of significance. In addition, the value that these projects would have had on public awareness and education would be lost, and therefore, would not lead to the implementation of other restoration actions. Without a significant and long term effort toward restoring the compromised riverine processes and degraded habitats, we believe the fish and wildlife resources in the Stillaguamish River Basin would continue to decline or at best, remain at the current levels.

WITH THE PROJECT CONDITIONS

The implementation of the proposed restoration projects represents a significant effort at restoring degraded habitat and riverine functions that have been compromised due to anthropogenic causes. We believe it is appropriate to view the proposed actions as part of a larger and continuing effort (present and future) toward restoring fish and wildlife resources within the Stillaguamish River Basin. In addition, we believe the restoration actions being pursued under the Corps' ecosystem restoration authority will encourage and lead to other efforts to protect and restore habitat within the basin.

The implementation of all thirteen restoration projects would improve or restore about 140 acres of estuarine emergent marsh and tidal flats, protect or restore about 100 acres of riparian forest along 14 miles of river channel, reconnect and improve about 50 acres of instream habitat, and reduce the input of large amounts of fine sediment to 80 miles of the North Fork, South Fork and mainstem Stillaguamish River. These estimates are preliminary and are expected to change in response to project design refinements that will be made during the advance engineering and design phase. For example, the Corps will be determining if their maintenance practices can be eliminated or changed (e.g., vegetation removal and the use of bioengineering methods instead of riprap) at one or more of the twenty-six sites along the Stillaguamish River. The potential to restore the riparian zone (length and width) along the 8-mile long reach of Old Stillaguamish Channel will be largely determined by the willingness of the landowners to grant conservation easements on their property. At the Hat Slough and South Pass properties, there are competing waterfowl enhancement objectives that could limit the amount of agricultural lands that are converted back to estuarine emergent marsh habitat. There are also hydrology, biological, engineering and economic issues to address during the advanced engineering and design phase.

DISCUSSION

The restoration projects being proposed under the Corps' ecosystem restoration authority are a very important step toward restoring degraded estuarine, in-channel and riparian habitats as well as the fluvial processes that are important for maintaining channel complexity and habitat diversity. These projects alone cannot be expected to reverse the losses of habitat structure and

functions that have occurred over the last 150 years. Nor can they be expected to have much of an effect on a basin-wide scale unless they become an integral part of a larger and long term restoration effort.

We are optimistic that the proposed project will have a significant effect because of the heightened public awareness about the need to protect and restore our natural resources, including the Stillaguamish River's anadromous fish stocks.

Stillaguamish Estuary

The conversion of salt and brackish marshes and tidal sloughs to agricultural lands as well as the confinement and straightening of delta channels for flood control have led to loss of most of these habitats within the Stillaguamish Estuary. As a result, many of the functional values of the estuary have been adversely impacted.

Estuaries are highly productive and provide a wide variety of habitats that support many species of fish and wildlife. Phytoplankton production is dominant in the spring and summer, with the detritus based food web becoming increasingly important during the late summer and fall (Proctor et al. 1980). Food webs are complex and interrelated and also include species from terrestrial, riverine and marine environments.

The importance of estuaries to anadromous fish is well documented in the literature, and has been summarized in several reviews (Shepard 1981; Thorp 1994; and Aiken 1998). Estuarine habitats are used by returning adult salmonids for staging and freshwater acclimation, and by juveniles for foraging, saltwater acclimation, and refuge from predators and high flows. Tidal flats, distributary channels and emergent marshes support detritus-based food webs on which many epibenthic prey items for juvenile salmonids depend (Sibert 1979, Proctor 1980, Healey 1982). These habitats are nutrient rich and highly productive. The highest growth rates for juvenile chinook and chum salmon have been found in estuaries (Kjelson et al. 1982; Healey 1982; Simenstad et al. 1982). Rapid growth has important implications because survival appears to be positively correlated with smolt size. The diversity of habitats within the estuary, i.e., distributary channels, emergent marshes and mudflats, provide juvenile salmonids with refuge from high flow and predators (Levy et al. 1979; MacDonald et al. 1987; Levings and Nishimura 1997). In addition, the varying salinity gradients of the estuary serve as a critical transition zone where juvenile salmonids can undergo the physiological changes needed to live in the marine environment (Hoar 1976; and McCormack 1994).

Estuaries also provide important foraging, rearing, and/or nesting habitat for migratory waterfowl (e.g., snow geese, widgeon, scoters), wading birds and shorebirds (e.g., great blue heron, western sandpiper), songbirds (e.g., song sparrow, marsh wren), small mammals (e.g., river otter, raccoon, deer mouse), shellfish (e.g., Dungeness crab, soft shell clam, and snails).

For the above reasons, we strongly support the restoration of estuarine habitats, including emergent marshes, tidal sloughs, mudflats and sandflats. The breaching of dikes and the

excavation of tidal sloughs at the South Pass and Hat Slough Entrance sites represents a small but very important step toward recovering these habitats. Although these agricultural lands presently are of value to a number of wildlife species (e.g., snow geese, marsh hawk and raccoon), their conversion back to estuarine emergent marsh, tidal slough and mudflat habitats would have much greater value to more species of wildlife and would restore important rearing and foraging habitat for marine and anadromous fish.

Riparian Forest

The Service strongly supports protection and restoration of riparian forests, as well as their associated wetlands, because of the high value of this habitat to many species of fish and wildlife, the important processes and functions they provide, and because only a small amount of this habitat still remains in the lower Stillaguamish Basin. Riparian forests provide important breeding and foraging habitat, as well as a migration corridor for many species of wildlife.

The riparian zone functions both as a producer and a temporary trap for the recycling of nutrients. The decomposition of forest litter produced onsite and the trapping of leaves, detritus and other organic material from upstream sources during floods makes the riparian zone highly productive and of great importance to wildlife. As a consequence of losing much of the riparian forests within the basin to agricultural development, and the separation from the river by levees, significantly less nutrients are produced, intercepted from upstream sources, and made available in usable forms for both the terrestrial and aquatic food chains.

The riparian zone also benefits fish and other aquatic resources by reducing fluctuation in water temperature through solar shading, by providing a refuge from high water velocities during flood events, by increasing flows during the summer low flow period through the gradual release of flood waters that have percolated into the flood plain, and by its contribution of large woody debris. Besides the structural value of large woody debris as fish and wildlife habitat, it is also an important component in channel formation and the maintenance of channel complexity and diversity. The construction of levees and the removal of much of the riparian forests within the basin has greatly impaired all of the above processes and values.

We strongly support the proposed restoration projects that involve the acquisition of riparian buffers and the replanting of the riparian zone for the reasons described above.

Channel Complexity and Habitat Diversity

Significant human caused alterations to the Stillaguamish River channel and its tributaries have occurred since the mid 1850's when the construction of levees in the lower river began. Other direct modifications include riverbank armoring, channel straightening, the construction of a flow control weir at river mile 10, and the filling or blocking off of side channels. Channel complexity and habitat diversity have also been reduced by the cutting of the riparian forest, removal of large woody debris from the channel and the large sediment inputs from landslides and road building related to timber harvest.

The productivity of the Stillaguamish River Basin is directly linked to the complexity and diversity of its habitats, and its ability to provide for the life requisites of the organisms it supports. For example, salmonids need pools for adult holding; riffles with gravel containing only small amounts of fine sediment for spawning; side channels, backwaters and channel margins with structure and hiding for juvenile rearing; suitable conditions for the production of their prey resources (overhanging and emergent vegetation, low energy zones for detritus accumulation and clean surfaces for the attachment of aquatic insects); and clean, cold and well oxygenated water. The importance of habitat complexity and diversity within and adjacent to the channel is well documented in the literature, and therefore will not be reiterated in this report. Spence et al. (1996) provide a good summary of the life requisites of salmonids and how they are affected by channel morphology, structure, sediment inputs, etc.

Eleven of the thirteen proposed projects involve measures to restore fish access or to improve channel complexity and habitat diversity by controlling the input of sediment from landslides, reconnecting former meander channels, adding structure to the channel, improving water quantity, or enhancing the riparian zone through conservation easements and the planting of trees and shrubs.

The Hazel and Gold Basin projects have the potential to reduce the input of sediment coming from two active landslides on the North Fork and South Fork of the Stillaguamish, respectively. Sediment from these landslides has been identified as the primary factor limiting anadromous fish production in the North Fork and South Fork (Williams et al. 1975). The implementation of these projects could significantly improve spawning, rearing and adult holding habitat and the production of aquatic insects used by juvenile salmonids.

A number of the proposals (e.g., Old Stillaguamish Channel, Mainstem Maintenance and Portage Creek) involve restoring at least a narrow riparian zone along several channel reaches where few trees and shrubs presently occur. Native trees and shrubs would be planted and unwanted vegetation, including reed canary grass and Himalayan blackberry would be removed or controlled. Potentially, the riparian zone along more than 20 miles of the Stillaguamish River mainstem and its tributaries could be enhanced, but the actual length will depend on the willingness of landowners to grant conservation easements and on the Corps' ability to modify or eliminate its practices at the twenty six sites it maintains between the Stillaguamish River mouth and river mile 23. The value of these reaches for fish and wildlife would be significantly improved by the increase in structure, shading, input of detritus, etc.

Several projects (e.g., Koch Slough Weir, North Meander, South Meander, Portage Creek and the Cloverdale Farm Site) involve restoring or improving fish passage by connecting cut off meander bends, installing a fish ladder at Koch Weir, and reconstructing ditched or degraded channels. Implementation of these projects would improve accessibility to about two miles of rearing habitat. Passage conditions would also be improved at Koch Weir which presently delays migrating adult pink salmon during low flow periods.

Other projects (e.g., Hat Slough Entrance, Confluence and South Meander) address the scarcity

of in-water structure and habitat diversity in the lower Stillaguamish River through the construction of engineered log jams, the placement of large woody debris and/or the excavation of side channels.

Federally Listed Species

Habitat loss within the basin has caused significant impacts to a number of federally listed species including chinook salmon, bull trout, bald eagle, marbled murrelet, northern spotted owl, gray wolf and grizzly bear. Of these, chinook salmon, bull trout, bald eagle and marbled murrelet are species that would benefit the most from the proposed project. Chinook salmon and bull trout would benefit from the improvements in habitat and restored fluvial processes previously discussed in this report. Bald eagles would benefit from the increase in their prey resources, e.g., salmon and waterfowl, and in the long term from the greater number and size of trees within the riparian zone for perching and nesting. Marbled murrelets would benefit from the improvements in estuarine productivity that increase forage fish abundance, e.g., herring and sandlance.

Although the proposed projects are expected to benefit federally listed species in the long term, project construction could adversely affect the bald eagle, bull trout or chinook salmon in the short term, depending on the timing and the manner in which the projects are constructed. The Corps will be addressing the potential impact of the proposed actions on listed species in their programmatic biological evaluation. It is our expectation that the Corps will meet with us and with the NMFS annually to discuss the final design refinements for the projects scheduled for implementation during the next construction window. We would determine at these annual meetings if the projects still fall within the scope of the programmatic biological assessment, or if further Section 7 consultation is necessary.

OTHER ISSUES

Monitoring and Adaptive Management

We strongly support the inclusion of monitoring (both compliance and effectiveness) and adaptive management as essential components of the project. Habitat restoration, unlike the construction of roads or dams, should be viewed as a dynamic process. The desired habitat, along with its biological community, rarely occurs at the time of project construction but develops over time in response to physical, hydrologic and biological interactions. Consequently, the need for project maintenance or modifications should be expected and included as part of the project design. We believe the success of the project can be greatly improved by developing a detailed monitoring plan and using the monitoring results to adaptively manage both the normal maintenance of the sites and the implementation of remedial actions. This approach is recommended by the Corps (1996) in its report, "Planning and evaluating restoration of aquatic habitats from and ecological perspective." In that document the Corps states, "Successful restoration of ecosystems is uncertain, and management of the restored system requires a continuous source of information. A monitoring program reduces uncertainty

and forms the cornerstone of the assessment of the progress of the system." With regard to the role of adaptive management, the Corps states, " In a restoration project, the active adaptive method may provide the most meaningful information for making decisions that will ensure the ultimate success of the project and provide meaningful data that will help in the design of future projects."

Prioritization

The prioritization and implementation of the individual projects should be periodically updated to address important changes in project design, location, feasibility or other assumptions that may occur as the project details are refined. For example, re-prioritization would be desirable to address changes in project cost, expected effectiveness, and risk from competing uses that may preclude restoration if implementation is delayed. In addition, flexibility should be added to allow for the addition of new projects to replace projects on the current list that cannot be implemented because of landownership, feasibility or other reasons.

Port Susan Habitat Islands

We presently have very serious reservations about the conversion of mudflat and sandflat habitat to emergent marsh habitat, which would occur with the implementation of the Port Susan Islands proposal. These habitats are already highly productive, are used by many species of fish and wildlife, and a large amount of these habitats would need to be altered to have a meaningful effect. The sites where the islands are proposed did not historically support emergent marshes, which we believe increases the risk of failure, the need for costly and frequent maintenance (i.e., dredging and the placement of additional rock, large woody debris and fill) and further disturbances to adjacent habitats. The project design, which includes armoring the interlocking large woody debris structure with riprap, underscores the expected difficulty of protecting the structures from the force of the tides and storm waves.

We strongly support emergent marsh restoration, but believe it should done in those areas where it historically occurred, does not impact fully functioning habitats, and involves methods that are less risky, such as the removal of dikes.

Old Stillaguamish Channel and Reverse Tide Gates

We have strong concerns with the proposal to install a set of tide gates on the Old Stillaguamish Channel to direct more flow down this channel during an outgoing tide. While we support the concept of improving the water quality and juvenile rearing habitat within the Old Stillaguamish Channel, we have concerns about its effect on adult fish passage. Unless the tide gate structure allows for fish passage, adult salmon, steelhead and bull trout that migrate up the Old Stillaguamish Channel would be blocked at the proposed structure until the next incoming tide, potentially leading to poaching and predation problems. In addition, the quality of the water (e.g., temperature and dissolved oxygen levels) in the Old Stillaguamish Channel during extreme low flow periods may not be sufficient to sustain salmon, trout or char during the periods that the

tide gates are closed. Consequently, we believe the design of the tide gate or its supporting structure must provide for fish passage at all times, even if it reduces the effectiveness of the structure for increasing the exchange of water in the Old Stillaguamish Channel.

CONCLUSIONS

We believe the implementation of the projects being proposed under the Corps' ecosystem restoration authority would benefit many species of fish and wildlife, including a number of federally listed species, and would begin to address a number of the ecological processes that have been impacted by development in and along the flood plain. Although the proposed project by itself cannot be expected to reverse the adverse effects of development, we consider it the main component of the larger effort to restore anadromous fish and other natural resources within the Stillaguamish River Basin.

We also believe that the implementation of a satisfactory monitoring program is essential for the success of the ecosystem restoration program. We concur with the Corps that the successful restoration of ecosystems is uncertain and that the management of restored systems require the ongoing collection of good information. Further, we believe adaptive management is a a useful approach for making mid-course corrections, as may be indicated by the monitoring results, and for addressing project uncertainties.

We strongly support the Corps' restoration approach, and believe we will be able to support nearly all of the individual restoration proposals, pending the satisfactory resolution of any remaining fish and wildlife resource issues during the advanced engineering and design phase. It is our expectation and understanding that we will have further opportunities to review and comment on the detailed plans when they are developed.

RECOMMENDATIONS

1. The project sponsors should follow through with their commitment to develop and include as part of the project a detailed monitoring plan that clearly identifies the objectives and goals to achieve for each of the individual restoration projects and the use of adaptive management in the maintenance and implementation of corrective actions. This plan should contain both compliance and effectiveness monitoring elements for the purpose of verifying that each of the projects has been constructed as designed and the attainment of properly functioning habitat is being achieved. For defining properly functioning habitat, we recommend using NMFS' matrix of pathways and indicators approach, but tailored for the Stillaguamish River Basin (NMFS 1996). In addition, the plan should define the adaptive management approach, including time lines, targets, etc. We would like to participate in the development of the monitoring and adaptive management plan.

2. The project sponsors should provide a commitment to monitor the projects for a minimum of ten years, along with the provision to adjust the monitoring period to reflect the degree of project uncertainty. The actual monitoring period for some projects could be shortened if the goal is

being met and the project site has reached a level of stability, i.e., dynamic equilibrium, that indicates the goal will continue to be met. For example, the fish passage improvement at the Koch Slough Weir may take less than ten years of monitoring to establish its effectiveness. For some other projects, however, the monitoring period may need to be longer than ten years because of the higher level of uncertainty and the more dynamic site conditions. Projects that are likely to require more than ten years to determine their long term effectiveness include the Gold Basin and Hazel landslide stabilizations, the engineered log jams, and the Port Susan habitat islands.

3. The prioritization of the pending projects should be updated annually to reflect new or refined information, including the effectiveness monitoring results, additional risks to the project site from competing land use interests, changes in upper watershed influences, design constraints or necessary modifications due to landownership, hydrology, soils, hazardous waste, and updated cost estimates. In addition, a mechanism should be included to allow for the replacement of project elements that are dropped because of land ownership, feasibility or other reasons.

4. Annual meetings should be held at least during the ten year project implementation period to facilitate discussions on the monitoring results and on the projects that are scheduled for construction within the next 12 months. These meetings would be useful in updating the project reviewers on the project changes and refinements that have occurred.

5. The Corps should meet with the USFWS and NMFS at least on an annual basis to discuss the project design refinements for the projects that are proposed for construction within the following year. The purpose of these meetings would be to confirm that the final design of these projects still fall within the scope of the programmatic biological assessment and are covered under the related Section 7 consultations.

6. The USFWS should be funded in the next project phase so that we can continue to participate in the review of the updated project plans and help resolve any remaining fish and wildlife issues in a timely manner.

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Appendix A. Common and scientific names of bird species mentioned in this report that are known or expected to occur within the vicinity of the proposed project.

Common Name	Scientific Name
Crow	*Corvus brachynchos*
Robin	*Turdus migratorius*
American widgeon	*Mareca penelope*
Bald eagle	*Haliaeetus leucocephalus*
Black brant	*Branta nigricans*
Brewer's blackbird	*Euphagus cyanocephalus*
Dipper	*Cinclus mexicanus*
Dunlin	*Calidris alpina*
Glaucous-winged gull	*Larus glaucescens*
Great blue heron	*Ardea herodias*
Killdeer	*Charadrius vociferus*
Mallard	*Anas platyrhynchos*
Marbled murrelet	*Brachyramphus marmoratus marmoratus*
Marsh hawk	*Circus cyaneus*
Meadowlark	*Sturnella neglecta*
Northern spotted owl	*Strix occidentalis caurina*
Osprey	*Pandion haliaetus*
Pileated woodpecker	*Dryocopus pileatus*
Rufous-sided towhee	*Pipilo erythropthalmus*
Savannah sparrow	*Passerculus sandwichensis*
Short-eared owl	*Asio flamneus*
Snow goose	*Chen caerulescens*
Song sparrow	*Melospiza melodia*
Trumpeter swan	*Olor buccinator*
Tree swallow	*Tachycineta bicolor*
Violet-green swallow	*Tachycineta thalassina*
Western grebe	*Aechmophorus occidentalis*
Western sandpiper	*Ereunetes mauri*
White-winged scoter	*Melanitta fusca*

Appendix B. Common and scientific names of fish in this report that are known or expected to occur within the vicinity of the proposed project.

Common Name	Scientific Name
Chum salmon	*Oncorhynchus keta*
Coho salmon	*O. kisutch*
Chinook salmon	*O. tshawytscha*
Pink salmon	*O. gorbuscha*
Steelhead trout	*O. mykiss*
Cutthroat trout	*O. clarki*
Dolly Varden	*Salvelinus malma*
Bull trout	*S. confluentus*
Mountain whitefish	*Prosopium williamsoni*
Largescale sucker	*Catastomus macrocheilus*
Pacific lamprey	*Lampetra tridentata*
Western brook lamprey	*Lampetra richardsoni*
River lamprey	*Lampetra ayresi*
Speckled dace	*Rhinichthys osculus*
Redside shiner	*Richardsonius balteatus*
Peamouth	*Mylocheilus caurinus*
Prickly sculpin	*Cottus asper*
Torrent sculpin	*Cottus rhotheus*
Pacific herring	*Clupea harengus pallasi*
Threespine stickleback	*Gasterosteus aculeatus*
Pacific tomcod	*Microgadus proximus*
Starry flounder	*Platichthys stellatus*
English sole	*Parophrys vetulus*
Pacific sandlance	*Ammodytes hexapterus*

Appendix C. Common and scientific names of reptiles and amphibians mentioned in this report that are known or expected to occur within the vicinity of the proposed project.

Common Name	Scientific Name
Common garter snake	*Thamnophis sirtalis*
Ensatina	*Ensatina eschscholtzii*
Pacific chorus frog	*Pseudacris regilla*
Red-legged frog	*Rana aurora*

6pF

Appendix D. Common and scientific names of mammal species mentioned in this report that are known or expected to occur within the vicinity of the proposed project.

Common Name	Scientific Name
Beaver	*Castor canadensis*
Black bear	*Ursus americanus*
Black-tailed deer	*Odocoileus hemionus*
Coyote	*Canis latrans*
Gray wolf	*Canis lupus*
Harbor seal	*Phoca vitolina*
Muskrat	*Ondatra zibethica*
Raccoon	*Procyon lotor*
River otter	*Lutra canadensis*
Striped skunk	*Mephitis mephitis*
Townsend's vole	*Microtus townsendii*
Deer mouse	*Peromyscus maniculatus*

Appendix E. Common and scientific names for the plant species mentioned in this report that occur within the vicinity of the proposed project.

Common Name	Scientific Name
Big-leaf maple	*Acer macrophyllum*
Black cottonwood	*Populus trichocarpa*
Douglas fir	*Pseudotsuga menziesii*
Eelgrass	*Zostera marina*
Himalayan blackberry	*Rubus discolor*
Lyngby's sedge	*Carex lyngbyei*
Pacific silverweed	*Potentilla pacifica*
Pickleweed	*Salicornia virginica*
Red Alder	*Alnus rubra*
Reed canary grass	*Phalaris arundinacea*
Salmonberry	*Rubus spectabilis*
Saltgrass	*Distichlis spicata*
Sea lettuce	*Ulva lactuca*
Seaside arrowgrass	*Triglochin maritimum*
Snowberry	*Symphoricarpus albis*
Sword fern	*Polystichum munitum*
Western red cedar	*Thuja plicata*
Willow	*Salix* sp.

APPENDIX F

Agency Responses to the Draft Coordination Act Report

State of Washington
DEPARTMENT OF FISH AND WILDLIFE

Mailing Address: 600 Capitol Way N • Olympia, WA 98501-1091 • (360) 902-2200, TDD (360) 902-2207
Main Office Location: Natural Resources Building • 1111 Washington Street SE • Olympia, WA

June 20, 2000

Mr. Gerry Jackson, Manager
United States Department of the Interior
Fish and Wildlife Service
510 Desmond Drive Southeast, Suite 102
Lacey, Washington 98503

Dear Mr. Jackson:

Subject: Draft Fish and Wildlife Coordination Act report for the Stillaguamish River Basin Ecosystem Restoration Program, Snohomish County, Washington

We have reviewed the above referenced report and offer the following comments. We concur with the findings of this report and also believe that the US Army Corp of Engineer's (Corps) ecosystem restoration program is a major commitment to reversing some of the environmental stressors that have impacted fish and wildlife habitat within the Stillaguamish River Basin. Please note that no part of the Stillaguamish Basin is in King County as reported on page 1.

All of the projects have been designed to achieve positive environmental benefits. However, several of the individual projects will require significant work in the channel or intertidal areas currently utilized by salmonids. The Hazel and Gold Basin Slides, Portage Creek, and Port Susan Habitat Islands are examples of these type projects. In order to ensure that negative impacts to existing habitat is avoided or minimized during and after construction, we recommend that close coordination between the Corps and all permitting agencies take place as the plans develop.

Where possible, the projects should be designed to performance criteria that restores habitat conditions to levels indicative of high quality. The Washington Department of Fish and Wildlife's (WDFW's) Wild Salmonid Policy suggests performance goals for habitat conditions. The National Marine Fishery Service has also published goals for properly functioning habitat. Another source of habitat recovery goals are those being developed by the local WRIA 5 Technical Salmonid Recovery Committee. Having specific design goals that are indicative of high quality habitat should result in projects that are more successful than projects designed to lesser

standards. For example, the number of pieces of large woody debris (LWD) recommended for streams in the WDFW Wild Salmonid Policy are much higher than the Corps proposes for most of their projects.

The Portage Creek project proposes creation of several dendritic channels connected to the main channel. Dendritic channels are common in estuarine deltas but we are unfamiliar with a similar, natural analog in the freshwater environment. We have concerns that these dendritic channels may cause stranding of juveniles, increase predation, and may increase stream temperatures. Further analysis will be required before we are convinced that these channels will enhance salmonid productivity. We suggest that some off-channel wetland ponds may be more appropriate for this site to increase salmonid productivity.

We appreciate the opportunity to review and comment on this document. If you have any questions, please contact Mike Chamblin from my staff at (425) 379-2304.

Sincerely,

Greg Hueckel, Assistant Director
Habitat Program

GH:TM:kam

cc: Ted Muller
Mike Chamblin

APPENDIX B

LETTERS FROM LOCAL CONSTITUENTS

Stillaguamish Flood Control District

P.O. Box 2512
Stanwood, WA 98292
(360) 652-9233

Col. Ralph Graves
U.S. Army Corps of Engineers
Seattle District — CENPS-EN-PL
P. O. Box 3755
Seattle, Washington 98124-3755

25 October, 2000

Dear Sir:

The Stillaguamish Flood Control District would like to express its support for the USACOE Stillaguamish River Ecosystem Restoration Study, to identify potential restoration projects within the basin. We appreciate the Corps' willingness to listen to local landowners and cooperate with small districts like ours.

We look forward to working in partnership with the Corps, as restoration projects within the District are implemented.

Sincerely,

Chuck Hazleton
Chairman, SFCD

cc: Pat Stevenson, Stillaguamish Tribe
Aaron Waller, Snohomish County SWM

Stillaguamish Tribe

Natural Resources Department

October 30, 2000

Col. Ralph Graves
USACE Seattle Dist.
P.O. Box 3755
Seattle WA 98124-3755

Dear Col. Graves,

The Stillaguamish Tribe is in strong support of the Ecosystem Restoration Project in the Stillaguamish watershed. The Tribe has been involved with the project since it's inception three years ago. We feel that the projects being considered in the current feasibility study would go a long way toward restoring salmon habitat. We will continue to offer our technical and financial support when necessary. The Corps projects, combined with our efforts to secure critical habitat, restore and decommission forest roads, fence livestock out of streams and plant riparian vegetation, will increase the likelihood of any meaningful ecosystem restoration effort. The Tribe is looking forward to working with the Army Corps in the future to complete the Ecosystem Restoration Project.

Sincerely,

Pat Stevenson

Pat Stevenson
Environmental Coordinator
Stillaguamish Tribe

22712 6th Avenue NE
360 435 2755

Arlington WA 98223
Fax: 360 435 3605

PO Box 277
Scan: 425 257 1628

APPENDIX C

REAL ESTATE PLAN

Stillaguamish River General Investigation
Ecosystem Restoration Project

REAL ESTATE PLAN

Prepared for:

US ARMY CORPS OF ENGINEERS, SEATTLE DISTRICT
P.O. Box 3755
Seattle, WA 98124-3755

Prepared by:

HDR ENGINEERING, INC.
500 – 108th Avenue NE
Suite 1200
Bellevue, WA 98004-5538

HDR Project No. 08048-306-002

July 19, 2000

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1.0 INTRODUCTION

1.1 Real Estate Plan Purpose

The purpose of this real estate plan is to: 1) identify the lands, easements and right-of-ways (LER) that will be required to support the recommended ecosystem restoration plan described in the Stillaguamish River Ecosystem Restoration Feasibility Report, 2) to outline the costs and real estate considerations associated with project implementation, and 3) to assess the Non-Federal Sponsor's (NFS) capability for LER acquisition. Snohomish County, Washington is the NFS for this project.

1.2 General Project Description

The Stillaguamish River Basin Restoration Feasibility Study was authorized by Section 209 of the Flood Control Act of 1962 to address environmental and economic problems within the Stillaguamish basin. This study examined environmental problems and opportunities in the basin, developed and evaluated alternative solutions and recommends an ecosystem restoration plan. The proposed ecosystem restoration plan recommends restoration at 13 sites within the basin that would provide critical salmon habitat, restoring and reestablishing in-stream, riparian, wetland, and tidal habitats.

1.3 Specific Feasibility Study Objectives:

The objective of the feasibility study is restoration of fish and wildlife habitat that was lost as a result of human activities throughout the watershed. The overall goal of the project is to restore diverse and sustainable riverine habitats within the study area. The project focuses on restoring estuarine, salmon spawning, juvenile rearing and overwintering habitats and rehabilitating tributaries.

1.4 Reconnaissance Report

The reconnaissance study for this project was funded under the 1995 Energy and Water Appropriations Act. The reconnaissance report was completed and approved in December 1997. No real estate plan was developed in the reconnaissance phase. The original project purpose and plan formulation has remained the same.

2.0 PROJECT LOCATION

The project's 13 restoration sites and one temporary disposal site are located north of Everett, Washington within the Stillaguamish River watershed, in Snohomish County, Washington. Major towns within the basin include Arlington and Stanwood, Washington. The restoration sites are located throughout the basin and include sites on the Stillaguamish River, Cook Slough, and Portage Creek, Port Susan Estuary, and other mainstem tributaries.

3.0 DESCRIPTION OF ESTATE TYPES

3.1 Standard Estates

The Standard Estates from ER 405-1-12, Chapter 5, Change 7 of 8 Feb79 that will be required for implementation of the recommended plan are described below. Underlining and strikethrough show non-material deviations. It should be noted that the NFS will acquire a fee interest in the property wherever possible.

1. **Fee:** The fee simple title to the land shown on Exhibit "A" attached, subject, however, to existing easements for public roads and highways, public utilities, railroads, and pipelines.

2. **Permanent Access Easement.** A perpetual and assignable easement and right-of-way in, on, over, and across ~~(the land described in Schedule A) (Tracts Nos. ____, ____, and ____)~~ the lands of the Grantor delineated in Exhibit A for the location, construction, operation, maintenance, alteration, and replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell, and remove therefrom all trees, underbrush, obstructions, and other vegetation, structures, or obstacles within the limits of the right-of-way;(reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule b)[1]; subject, however, to existing easements for public roads and highways, public utilities, railroads, and pipelines.

3. **Temporary Work Area Easement.** A temporary easement and right-of-way in, on, over, and across ~~(the land described in Schedule A) (Tracts Nos. ____, ____, and ____)~~ the lands of the Grantor delineated in Exhibit A, for a period [to be determined based on site specific needs], beginning with date possession of the land is granted to ~~United States~~ Snohomish County, Washington for use by the United States, its representatives, agents, and contractors as a work area, including the right to deposit fill, and waste material thereon, move, store, and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Stillaguamish River Ecosystem Restoration Project, together with the right to trim, cut, fell, and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject however, to existing easements for public roads and highways, public utilities, railroads, and pipelines.

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[1] Parenthetical clause may not apply to every road easement proposed for acquisition, and could be deleted as necessary.

4. **Temporary Disposal Easement.** A temporary easement and right-of-way in, on, over, and across ~~(the land described in Schedule A) (Tracts Nos. ____, _____, and _____)~~ the land of the Grantor delineated in Exhibit A, for a period not to exceed 12 years beginning with date possession of the land is granted to the ~~United States~~ Snohomish County, Washington, for use by the United States, its representatives, agents, and contractors as a work area, including the right to borrow and/or deposit fill, and waste material thereon, move, store, and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Stillaguamish River Ecosystem Restoration Project, together with the right to trim, cut, fell, and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject however, to existing easements for public roads and highways, public utilities, railroads, and pipelines.

3.2 Temporary Access Easement Estate

The following Temporary Access Estate is being provided for review and for use by the NFS in cases where temporary site access is needed for project implementation. The format of the proposed estate follows the general format of Estate No. 11, Road Easement, found in Chapter 5 of ER 405-1-12. Since only temporary access is necessary across private property to the Kline disposal site, the standard road estate is modified to show the term of the temporary easement. The underlined text shows non-substantial deviations to the standard estate language.

Temporary Access Easement. A temporary and assignable easement and right-of-way in, on, over, and across the land described in Exhibit A for a period not to exceed twelve years, beginning with the date possession of the land is granted to the Snohomish County, for use by the United States, its representatives, agents, and contractors for the location, construction, operation, maintenance, alteration and replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell, and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

3.3 Environmental Estate

The following Environmental Estate is being provided for review and approval for use by the NFS in cases where they are unable to obtain fee interest.

Environmental Easement. A perpetual and assignable right and easement in, on, and across the lands of the Grantor delineated in Exhibit A attached hereto to construct, operate, maintain, repair, alter, rehabilitate, remove, replace and monitor project features; plantings; and any other improvements within and adjacent to the stream or shore for grade control, channel, bank, and /or shore, and bank stabilization, fish and wildlife

habitat improvements, and other environmental improvements, including the removal of structures or obstructions including levees; the placement of materials or structures in the bed, banks, or shorelines that influence stream velocity or channel form, the removal or placement of gravels, cobbles, and boulders, and other structures, or conveyances to recharge or maintain flow to existing wetlands; reserving, however, to the owners, their heirs and assigns, all other rights and privileges that may be used without interfering with or abridging the enumerated rights and easement hereby conveyed and acquired; all subject to existing easements for public roads and highways, public utilities, railroads and pipelines.

3.4 Justification for Acquiring Environmental Easements in Lieu of Fee Interest
Snohomish County along with the Stillaguamish Tribe, the Stillaguamish Diking District and the Corps of Engineers has conducted a series of landowner public workshops in the Lower Stillaguamish River Basin. Almost 100% of the landowners have expressed positive interest in the proposed project but not interest in selling the County a fee interest. Based on workshop input, the landowners are interested in maintaining fee ownership of their land but will consider an Environmental Easement. Some of these landowners have been on the same land for four generations and are not interested in selling their land to anyone for any reason. Based on the input received from the workshops and individual contacts, if the County aggressively pursued a fee ownership policy it would turn the landowners from being in favor of the overall project, and individual site-specific restoration actions, to one of opposition. This would probably kill any opportunity for ecosystem restoration in the lower basin. For the above reasons Snohomish County desires using an Environmental Easement for acquiring real estate interest in lands within the lower Stillaguamish Basin. The Seattle District is in agreement with the NFS regarding use of this estate, when and where fee acquisition is not possible.

4.0 SECTION DESCRIPTION OF LANDS, EASEMENTS AND RIGHTS OF WAY BY SITE

4.1 Bank Maintenance Sites

The bank maintenance effort on the Stillaguamish River involves 26 Corps' bank maintenance sites. The lands for these 26 bank protection sites are part of the Federal Stillaguamish River Flood Control project. Existing USACE bank maintenance procedures will be modified at these sites, within the existing footprint of the original project. As such, no additional LER acquisition is necessary and all costs associated with project implementation are Federal costs.

Exhibit A shows the general location of the sites, which are currently maintained by the USACE. The lands were acquired between 1937 and 1938 in connection with the Work Program Administration (WPA) projects on the Stillaguamish River. Easements were acquired from private property owners for various bank maintenance sites. The rights,

without exception, grant rights over private property ownership without definition of exact areas. The rights run to the United States Engineer Department.

See Table 8A of this report for an estimate of Federal administrative costs.

4.2 Cloverdale Site

Proposed site activities include restoration of a forested wetland, creation of a naturally meandering tributary channel for tributary, and installation of fish-accessible culvert connections to the Stillaguamish River. The recreation benefit included as part of this ecosystem restoration project does not require additional lands, and does not conflict with ecosystem purposes. The Cloverdale site footprint, shown in Exhibit A, encompasses 17.75 acres of land. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Fee	15.17	$30,000
Permanent Access Easement	2.58	$5,000
TOTALS	**17.75**	**$35,000**

The NFS will need to acquire approximately 15.17 acres in fee and a 2.58-acre permanent access easement that will provide a permanent access connection off of 15th Avenue NE. It is estimated that the NFS will require 10 months to acquire and certify the necessary interests available. All temporary staging will be conducted within the project footprint. All excavated material will be either reused or disposed onsite.

The NFS and 2 private entities currently own required project lands. The former BNSF railroad embankment area is assumed to be under private ownership. The current highest and best use of this land is open space. Approximately 1.28 acres are owned by the NFS. Federal appraisal principles for determining fair market value for crediting purposes apply to lands owned by the NFS prior to the date of Congressional authorization. The NFS will need to acquire the remaining 16.47 acres from two private owners.

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.3 Confluence Site

Proposed activities at this site, also known as the Stillaguamish Confluence, will involve installation of large woody debris jams, side channel excavation and revegetation of the riparian zone. The Confluence site footprint, shown in Exhibit A, encompasses 29.22 acres of land. Lands required by the project are currently owned by 2 private entities. The current highest and best use of this land is agriculture. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	0.82	$8,200
Temporary Work Area Easement[2]	1.04	$1,500
Environmental Easement	27.36	$13,300
TOTALS	**29.22**	**$23,000**

The site will require 27.36-acre environmental easement. A 1.04-acre temporary work area easement is required for temporary staging within the project footprint for a three-year period. Access to the site is from Larson Road. A 0.82-acre easement will be required to establish permanent access from Larson Road to the project site. Some excavated material will be reused on site and the remainder will be transported offsite to the Kline Farm disposal site. LER descriptions for this disposal site are provided in Section 4.7 of this document. The NFS will require approximately a 10-month LER period for acquisition and land certification.

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.4 Gold Basin Slide

The Gold Basin Slide site's proposed restoration activities include placement of LWD jams to protect the toe of the landslide and revegetation. The project footprint is on United States Forest Service (USFS) land near a campground. The NFS must obtain a special use permit or a similar agreement from the USFS to allow the USACE to advertise for construction. It is estimated that the NFS needs approximately six months to obtain the necessary agreement and certify that the land is available.

The NFS will not receive credit for the value of LER acquired from the USFS for this 3-acre project. However, credit may be given for the NFS's documented incidental costs of acquiring such interest, subject to review for reasonableness, allocability, and allowability. See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.5 Hat Slough Entrance

The proposed Hat Slough site restoration involves removal of dikes, excavation of tidal channels, revegetation with marsh species, and construction of a new dike to protect upland areas. The Hat Slough Entrance site footprint, shown in Exhibit A, encompasses 144.52 acres of land. Lands required by the project are currently owned by 2 private entities. The current highest and best use of this land is agriculture/open space. Appraised LER values by estate type are summarized in the table below.

[2] Assumes $500 per annum for 3 years.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	0.52	$2,000
Environmental Easement	144.00	$432,000
TOTALS	**144.52**	**$434,000**

The site will require 144-acre environmental easement. Access to the site is via Boe Road, which is under private ownership. A 0.52-acre permanent access easement is required for ongoing access. Temporary staging will be conducted within the project footprint. Material will be disposed offsite at the Kline Farm Disposal site. LER descriptions for this disposal site are addressed in Section 4.7. The NFS will require approximately a 10-month LER acquisition and land certification period.

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.6 Hazel Slide

Proposed activities at Hazel Slide include moving the river channel away from the existing landslide area, and placing large woody debris jams to protect the toe of landslide. The Hazel Slide site footprint, shown in Exhibit A, encompasses 35.97 acres of land. Appraised LER values by estate type are summarized in the table below. Individual lots shown in Exhibit A cannot be developed as a result of previous landslide damage; therefore the NFS believes they will be able to acquire the necessary lands to implement this project. Clearing title to the proposed project lands could take some time, so the actual construction date may change to accommodate title clearing.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Fee	35.33	$70,000
Permanent Access Easement	0.64	$2,000
TOTALS	**35.97**	**$72,000**

The site will require that 35.33 acres of land be obtained in fee. Temporary staging will be conducted within the project footprint. Access to the site is from an existing private road requiring a 0.64-acre permanent access easement to be established. Material will be disposed onsite.

Required project lands are currently owned by the NFS and 21 private entities. The current highest and best use of this land is open space/residential. Approximately 0.66 acres are owned by the NFS. Federal appraisal principles for determining fair market value for crediting purposes apply to lands owned by the NFS prior to the date of Congressional authorization. The NFS will need to acquire the remaining 35.31 acres from private ownership. The NFS will require approximately a 28-month period to acquire and certify the necessary interests available.

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.7 Kline Farms Disposal

The Kline Farms Disposal site is an exiting disposal site, located primarily on County land. The site footprint, shown in Exhibit A, encompasses 3.11 acres of land. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Temporary Access Easement[3]	0.87	$5,000
Temporary Disposal Easement[4]	2.24	$27,000
TOTALS	**3.11**	**$32,000**

This estimate assumes that the disposal site will be used for 12 years, requiring a temporary disposal easement for that period. A 12-year temporary access easement will be required and a road will be constructed to provide less intrusive access to the site.

Approximately 0.3 acres of the project footprint is under one private ownership; the NFS owns the remaining 2.81 acres of land. The highest and best use of the land is agriculture. Federal appraisal principles for determining fair market value for crediting purposes apply to lands owned by the NFS prior to the date of Congressional authorization. The NFS will need to certify the disposal site available for the first construction site requiring a disposal site. Based on the proposed construction schedule set out in Table 8B of this report, the disposal site would need to be certified available by the NFS before or with the lands for the Upper Portage Creek site. All necessary lands must be certified in advance of the COE advertising for construction.

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.8 Koch Slough Weir

Installation of a new fish passage facility is recommended at the Koch Slough Weir project site, also known as the Cook Slough Weir site. Koch Slough weir is part of an existing Federal project, and costs incurred to change the weir are 100% Federal costs. The proposed project footprint, shown in Exhibit A, is primarily within the existing Federal project and requires only a 0.68-acre temporary work area easement including temporary access from one private ownership. The highest and best use of lands within the project footprint is open space.

The NFS will need to acquire a one-year temporary work area and construction access easement to the project site to modify the weir. A road will need to be built to the site providing temporary access for weir modification work and a temporary staging area will

[3] Assumes $500 per acre per annum for 12 years.
[4] Assumes $1,000 per acre per annum for 12 years.

be needed for up to one year. The total appraised LER value for this temporary access easement is $500. All work must be completed in the July to August time frame. Long-term access for operation and maintenance will be on existing Federal project lands or right-of-ways. Therefore, no permanent access easement is required. There is no disposal site required to implement restoration activities at this site. The NFS will require approximately a 6-month period to acquire and certify the necessary interests available.

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.9 North Meander

North Meander site activities involve reconnection of a historic side channel with the Stillaguamish River and revegetation of a narrow riparian buffer. The site footprint, shown in Exhibit A, encompasses 13.44 acres of land. Lands required by the project are currently owned by two private entities. The current highest and best use of this land is agriculture/ hobby farm. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	1.01	$3,000
Temporary Work Area Easement[5]	0.82	$2,000
Environmental Easement	11.61	$9,000
TOTALS	**13.44**	**$14,000**

The site will require an 11.61-acre environmental easement. An additional 0.82-acre temporary work area easement is required for temporary staging during the construction period for approximately 4 years. Access to the site is from Hevly Road. A 1.01-acre permanent access easement will be required to establish permanent access to the site. Material will be disposed offsite at the Kline Farm Disposal site. LER descriptions for this disposal site are addressed in Section 4.7. The NFS will require approximately a 10-month period to acquire and certify the necessary interests available.

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.10 Old Stillaguamish

The Old Stillaguamish site is also known as the Old Stillaguamish Channel site. Proposed project activities include installation of tide gates to impound water in the old channel during high tides, with slow release during low tides and establishing 50-foot buffers on both side of the channel from its entrance to where it empties into South Pass. Buffer widths for the project was adjusted as needed to avoid need to relocate residences or other structures.

[5] Assumes $500 per annum for 3 years.

The site footprint, shown in Exhibit A, encompasses 100.6 acres of land. Lands within the project footprint are currently owned by the City of Stanwood and 66 private entities. The current highest and best use of this land is agriculture/hobby farm /residential. The City of Stanwood owns 3 parcels totaling approximately 1.84 acres within the project footprint. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	7.33	$54,500
Temporary Work Area Easement	3.86	$13,500
Environmental Easement	89.41	$357,500
TOTALS	**100.60**	**$424,000**

The site will require an 89.41-acre environmental easement and 3.86 acres for 4 separate temporary work area easements for staging. Access to the site is obtained from multiple locations. A 7.33-acres permanent access easement will be required to maintain permanent access to the site off of existing public roads. No disposal area is needed for this project.

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

This project will be constructed in three phases. LER acreage and values by construction phase is noted below.

4.10a Old Stillaguamish – Phase I (sheet 1)

The Phase I site footprint, shown in Exhibit A, encompasses 19.8 acres of land. Lands within the project footprint are currently owned by the City of Stanwood and 10 private entities. The current highest and best use of this land is agriculture/hobby farm /residential. The City of Stanwood owns 2 parcels totaling approximately 1.04 acres within the project footprint. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	1.21	$13,500
Temporary Work Area Easement[6]	1.13	$4,500
Environmental Easement	17.46	$70,000
TOTALS	**19.80**	**$88,000**

The site will require a 17.46-acre environmental easement and a 1.13-acre temporary work area easement for onsite staging. The temporary work area easement will be needed for approximately 9 years. Access to the site is obtained from multiple locations.

[6] Assumes $500 per annum for 9 years.

A 1.21-acre permanent access easement will be required to maintain permanent access to the site off of existing public roads. No disposal area is needed for this project.

4.10b Old Stillaguamish – Phase II (sheet 2)

The Phase II site footprint, shown in Exhibit A, encompasses 41.21 acres of land. Lands within the project footprint are currently owned by 29 private entities. The current highest and best use of this land is agriculture/hobby farm /residential. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	2.84	$8,000
Temporary Work Area Easement[7]	1.82	$6,000
Environmental Easement	36.55	$146,000
TOTALS	**41.21**	**$160,000**

The site will require a 36.55-acre environmental easement and a 1.82-acre temporary work area easement for onsite staging. The temporary work area easement will be needed for approximately 6 years. Access to the site is obtained from multiple locations. A 2.84-acres permanent access easement will be required to maintain permanent access to the site off of existing public roads. No disposal area is needed for this project.

4.10c Old Stillaguamish – Phase III (sheet 3)

The site footprint, shown in Exhibit A, encompasses 100.60 acres of land. Lands within the project footprint are currently owned by the City of Stanwood and 27 private entities. The current highest and best use of this land is agriculture/hobby farm /residential. The City of Stanwood owns one 0.8-acre parcel within the project footprint. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	3.28	$33,000
Temporary Work Area Easement[8]	0.91	$3,000
Environmental Easement	35.40	$141,500
TOTALS	**39.59**	**$177,500**

The site will require a 35.4-acre environmental easement and a 0.91-acre temporary work area easement for onsite staging. The temporary work area easement will be needed for approximately 3 years. Access to the site is obtained from multiple locations. A 3.28-acres permanent access easement will be required to maintain permanent access to the site off of existing public roads. No disposal area is needed for this project.

[7] Assumes $500 per acre per annum for 6 years.
[8] Assumes $500 per annum for 6 years.

4.11 Port Susan Habitat Islands

The restoration of 12 Port Susan habitat islands involves construction of wooden cribs to trap sediment and promote natural colonization of vegetation (marsh restoration) The site footprint, shown in Exhibit A, encompasses 12-acres of land with an estimated value of $6,000. The current highest and best use of this land is submerged lands.

Lands required by the project are currently owned by two public agencies: the NFS and the Washington Department of Natural Resources (DNR). The site will require a 12-acre environmental easement from the DNR for work on the habitat islands, which are classified as submerged lands. No temporary work area easement is required, as mobilization, demobilization and stockpiling will occur at the contractor's yard. The Federal appraisal principles for determining fair market value for crediting purposes apply to lands owned by the NFS prior to the date of Congressional authorization. Access to the sites will be by barge over navigable waters. No disposal site is needed. The NFS will require approximately a 4-month period to acquire and certify the necessary interests available.

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.12 Portage Creek

The project involves restoration of the upper, middle and lower reaches of Portage Creek. The site footprint, shown in Exhibit A, encompasses 224.45 acres of land. The current highest and best use of this land is open space in the upper reach and hobby farm/residential in the middle and lower reaches. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Fee	112.09	$57,000
Permanent Access Easement	2.62	$15,000
Temporary Work Area Easement[9]	0.52	$7,000
Environmental Easement	109.22	$219,000
TOTALS	**224.45**	**$298,000**

Lands required by the project are currently owned by 3 public and 45 private entities. Public ownership includes approximately 83.9 acres owned by the NFS, 3.49 acres owned by the City of Arlington, and 2.98 acres owned Washington DNR. The Federal appraisal principles for determining fair market value for crediting purposes apply to lands owned by the NFS prior to the date of Congressional authorization. The NFS will need to acquire the remaining 140.55 acres from the other ownerships.

The site will require a 109.22-acre environmental easement and 112 acres obtained in fee. A 0.52 acres temporary work area easement will be required for approximately 3 years

[9] Assumes $500 per annum for 14 years.

for temporary staging in the upper reach. Access to the site is provided by permanent access easement that will be established at multiple locations along the project footprint. These permanent access easements connect to existing public roads. Material will be disposed offsite at the Kline Farm Disposal site. LER descriptions for this disposal site are provided in Section 4.7 of this document.

4.12a Portage Creek – Upper Reach

The Portage Creek upper reach site footprint, shown in Exhibit A, encompasses 112.75 acres of land. Appraised LER values by estate type are summarized in the table below. The highest and best use of this land is open space. The NFS owns 83.9 acres of land within the project footprint, and the City of Arlington owns 3.49 acres. The Federal appraisal principles for determining fair market value for crediting purposes apply to lands owned by the NFS prior to the date of Congressional authorization. The remaining 25.36 acres of property is owned by 5 private entities.

The site will require that 112.09 acres be obtained in fee. A 0.52-acre temporary work area easement is required for temporary staging for approximately 14 years during a planting and construction period. Access to the site is from a 0.14-acre permanent access easement connecting to Cemetery Road. Material will be disposed offsite at the Kline Farm Disposal site. The NFS will require approximately a 12-month period to acquire and certify the necessary interests available. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	0.14	$1,000
Temporary Work Area Easement[10]	0.52	$7,000
Fee	112.09	$57,000
TOTALS	**112.75**	**$65,000**

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.12b Portage Creek – Middle Reach

The Portage Creek middle reach site footprint, shown in Exhibit A, encompasses 37.56 acres of land. The current highest and best use of this land is hobby farm/residential.

Lands required by the project are currently owned by 2 public and 18 private entities. Public ownership includes approximately 0.69 acres owned by the City of Arlington and 2.98 acres owned by Washington DNR.

[10] Assumes $500 per annum for 3 years.

The site will require a 36.5-acre environmental easement and 1.47 acres for permanent access easements that connect to existing public roads at several different locations. Material will be disposed offsite at the Kline Farm Disposal site. The NFS will require approximately a 24-month period to acquire and certify the necessary interests available. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	1.06	$11,000
Environmental Easement	36.50	$73,000
TOTALS	**37.56**	**$84,000**

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.12c Portage Creek – Lower Reach

The Portage Creek lower reach site footprint, shown in Exhibit A, encompasses 74.14 acres of land. The current highest and best use of this land is hobby farm/residential.

Lands required by the project are currently owned by 1 public and 22 private entities. Public ownership includes approximately 0.6 acres owned by NFS's Public Utility District No.1. The Federal appraisal principles for determining fair market value for crediting purposes apply to lands owned by the NFS prior to the date of Congressional authorization.

The site will require 72.72-acres environmental easement and 1.42 acres for permanent access easements that connect to existing public roads at several different locations. Material will be disposed offsite at the Kline Farm Disposal site. The NFS will require approximately a 36-month period to acquire and certify the necessary interests available. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	1.42	$3,000
Environmental Easement	72.72	$146,000
TOTALS	**74.14**	**$149,000**

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.13 South Meander

Proposed South Meander site activities include reconnection of an old meander bend to Portage Creek, large woody debris and spawning gravel placement, and revegetation of the riparian zone. The site footprint, shown in Exhibit A, encompasses 20.8 acres of land that is entirely under private ownership by 5 entities. The current highest and best use of

site lands is agriculture/hobby farm. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	0.8	$8,000
Environmental Easement	20.0	$50,000
TOTALS	**20.8**	**$58,000**

The site will require a 20-acre environmental easement. Temporary staging will be conducted within this easement. Access to the site is will be provided by a 0.8-acre permanent access easement that connects to a public road. Material will be disposed offsite at the Kline Farm Disposal site. The NFS will require approximately a 12-month period to acquire and certify the necessary interests available. LER descriptions of this disposal site are provided in Section 4.7 of the report.

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

4.14 South Pass

This site is also known as the Smith Farm site. Restoration activities at the South Pass site include removal of dikes, excavation of a former slough channel, reconnection of this channel to Port Susan Bay, and revegetation with marsh species. The site footprint, shown in Exhibit A, encompasses 239.73 acres of land. The current highest and best use is agriculture/open space. The NFS will require approximately a 13-month period to acquire and certify the necessary interests available. Appraised LER values by estate type are summarized in the table below.

ESTATE TYPE	ACREAGE	ESTIMATED FAIR MARKET VALUE
Permanent Access Easement	2.23	$5,000
Environmental Easement	237.50	$475,000
TOTALS	**239.73**	**$480,000**

The site will require a 237.5-acre environmental easement and a 2.23-acre permanent access easement to provide access to the site off of an existing public road. Disposal will occur onsite.

Lands required by the project are currently owned by 2 public and 2 private entities. Public ownership includes approximately 181.22 acres owned by the Washington Department of Game and 57.23 acres owned by the Washington Department of Fish and Wildlife (WDFW).

WDFW has indicated that it is willing to grant the NFS an environmental easement for this project. However, the granting of this easement requires internal WDFW coordination and external coordination with the agency managing the lands and federal and state agency contributors who funded WDFW's purchase of this site and final granting by the State F&WL Commission. The proposed acquisition and certification schedule considers the approximate time period necessary for WDFW's to coordinate internally and externally the granting of an environmental easement to the NFS.

See Table 8A for a cost estimate summary for this site, including non-Federal Sponsor administrative cost and Federal review and assistance costs.

5.0 PUBLIC LAW 91-646 AND ACQUISITION

5.1 NFS Land Acquisition Capability

The NFS has been advised of Public Law 91-646 as amended. The NFS has land acquisition experience and is fully capable of acquiring any lands necessary for the project. Exhibit B provides a detailed assessment of the NFS's real estate acquisition capability. Exhibit B, Section IV a., notes the USACE has previously encountered difficulties with the NFS's legal staff that have complicated project implementation.

Before advertisement for construction for each site, the NFS will make all lands, other than USACE owned lands, necessary for the project available to the Federal Government by a Certification of Lands and Authorization for Entry and an Attorney's Certificate as presented in Exhibit C. The NFS will provide the USACE, within 180 days after authorization of entry for construction, supporting LERRD credit documentation, including credit appraisals for lands made available for the project.

5.2 Zoning

There are no zoning ordinances proposed in lieu of or to facilitate acquisition in connection with this project.

5.3 Relocation Assistance Benefits

No relocation assistance benefits are anticipated to be required for the implementation of the project. There are no families or businesses that will temporarily or permanently be displaced.

5.4 Mineral Interests

At this time the USACE is not aware of any outstanding mineral interests in the vicinity of the project that may affect implementation of the project.

5.5 Hazardous and Toxic Wastes

The USACE performed an investigation to identify the presence of hazardous and/or toxic wastes for the preferred ecosystem restoration sites, and to estimate to volume of any contamination. The initial screening included searching records and databases from EPA, Washington's Department of Ecology, and METRO for information regarding known or suspected contaminated sites. Public groundwaters supply wells, CERCLA,

RCRA, EPCRA sites, and PCS facilities were also noted.

It was determined that HTRW concerns in the Stillaguamish River area are low with the exception of an area immediately south of Arlington and adjacent to Portage Creek. This area may impact project plans because of the potential for restoration sites to be located near a hazardous water release site. Further investigation may be required by the NFS during project implementation to determine the existence and extent of hazardous substances. See paragraph 5.6 of the Ecosystem Restoration Report for more detail on the USACE's investigation of contaminants regulated by CERCLA, RCRA, and TCI.

5.6 Landowner's Views and Public Opposition
Landowners that have attended the five public meetings and workshops held to date have accepted all the proposed restoration projects. No public opposition has been noted to date.

5.7 Outstanding Third Party Interests
All property interest acquired in support of the proposed project must take priority over any third party interests such as: public roads and highways, public utilities, railroads, and pipelines. Any third party interests that could defeat or impair the NFS's title to the property or interfere with construction, operation and maintenance of the project must be cleared from the title or subordinated to the interest made being available for the project. As stated in paragraph 6.0 of the report, there are no utility or facility relocations anticipated at this time.

5.8 Risks Associated with Advanced Land Acquisition
The NFS was advised of the risks (summarized below) associated with advance land acquisition activities. The District supports the NFS's desire to move ahead with land acquisition activities in advance of signing the Project Cooperation Agreement, and will provide the NFS with Federal review and assistance.

A summary of risks associated with advance land acquisition activities include, but is not limited to the following:

- Congress may not appropriate funds to construct the proposed project.
- The proposed project may otherwise not be funded, or approved for construction.
- A Project Cooperation Agreement (PCA) mutually agreeable to the NFS and the Government may not be executed and implemented.
- The NFS may incur liability and expense by virtue of its ownership of contaminated lands, or interests therein, whether such liability should arise out of local, state, or Federal laws or regulations including liability arising out of CERCLA, as amended.
- The NFS may acquire interests or estates that are later determined by the Government to be inappropriate, insufficient, or otherwise not required for the project.

- The NFS may initially acquire insufficient or excessive real property acreage which may result in additional negotiations and/or benefit payments under Public Law 91-646 as well as the payment of additional fair market value to affected landowners which could be avoided by delaying acquisition until after PCA execution and the Government's notice to commence acquisition and performance of their lands, easements, and rights-of-way activities.

- The NFS may incur costs or expenses in connection with its decision to acquire or perform their lands, easements and rights-of-way activities in advance of the signing of the PCA and the Government's notice to proceed which may not be creditable under the provisions of Public Law 99-662 or the PCA.

6.0 UTILITY AND FACILITY RELOCATIONS

No utility and facility relocations are anticipated to be required.

7.0 NAVIGATIONAL SERVITUDE

Navigational servitude will not be exercised for any of the project sites, although portions of the project are within navigable waters of the United States as defined by the Regulatory Branch of the Corps of Engineers. Navigational servitude considerations do not apply to environmental projects because there is no nexus to navigation.

8.0 COST ESTIMATE FOR LANDS EASEMENTS AND RIGHTS-OF-WAY

8.1 Baseline Cost Estimate

The baseline cost estimate presented in Table 8A (see page 20) includes a breakdown of the estimated fair market value of project lands, the NFS's acquisition costs, and Federal review and assistance costs. NFS acquisition costs include incidental acquisition costs such as title, survey and appraisal, and negotiation costs; recording fees; and legal fees. Federal review and assistance costs include those costs associated with providing the NFS with LERRD requirements, review of acquisitions and crediting appraisals, coordination meetings, review of right-of way documents, legal support, and crediting activities. The total cost of LER acquisition is estimated to be approximately $3,947,000.

8.2 LER Cost Estimate by Construction Phase

It is anticipated that the proposed project will be constructed in three phases spanning from 2002 to 2013. These construction phases are summarized in Table 8B. Phase 1 construction, occurring between 2002 and 2013, will include work on the Old Stillaguamish, Port Susan Habitat Islands, Bank Maintenance, Portage Creek, and Kline Farms Disposal sites. Phase 2 construction, occurring between 2003 and 2005, will address the Koch Slough Weir, Gold Basin Slide, Confluence, North Meander, and Cloverdale project sites. Phase 3 construction, occurring between 2004 and 2006, will complete restoration work on the South Pass, Hat Slough, Hazel Slide and South Meander project sites. A cost estimate breakdown by construction phase is provided in Tables 8C, 8D and 8E.

Table 8A. Baseline LER Cost Estimate Summary

SITE NO.	SITE NAME	TOTAL ACRES	LAND VALUES	NON-FEDERAL SPONSOR'S ADMINISTRATIVE COSTS	FEDERAL GOV'T REVIEW & ASSISTANCE COSTS	TOTAL LAND COSTS PER SITE
1	Bank Maintenance Sites				$ 5,000	$ 5,000
2	Cloverdale Site Plan	17.75	$ 35,000	$ 20,000	$ 6,000	$ 61,000
3	Confluence Site Plan	29.22	$ 23,000	$ 14,000	$ 6,000	$ 43,000
4	Gold Basin Slide Area	3.00	USFS LANDS - NO	$ 7,000	$ 3,000	$ 10,000
5	Hat Slough Entrance	144.52	$ 434,000	$ 14,000	$ 5,000	$ 453,000
6	Hazel Slide	35.97	$ 72,000	$ 159,000	$ 28,000	$ 259,000
7	Kline Farm Disposal Site & Acc	3.11	$ 32,000	$ 14,000	$ 5,000	$ 51,000
8	Kock (Cook) Slough Weir	0.68	$ 500	$ 7,000	$ 3,000	$ 10,500
9	North Meander/Cook Slough	13.44	$ 14,000	$ 14,000	$ 9,000	$ 37,000
10	Old Stillaguamish Channel	100.61	$ 424,000	$ 443,000	$ 43,000	$ 910,000
11	Port Susan Estuary Restoration	12.00	$ 6,000	$ 7,000	$ 5,000	$ 18,000
12 a.	Portage Creek- Upper Reach	112.75	$ 65,000	$ 53,000	$ 11,000	$ 129,000
12 b.	Portage Creek-Lower Reach	74.19	$ 149,000	$ 152,000	$ 31,000	$ 332,000
12 c.	Portage Creek-Middle Reach	37.56	$ 84,000	$ 119,000	$ 26,000	$ 229,000
13	South Meander/Thomsen Slough	20.80	$ 58,000	$ 33,000	$ 9,000	$ 100,000
14	South Pass (Smith Farms)	239.73	$ 480,000	$ 27,000	$ 8,000	$ 515,000
SUBTOTALS		**845.33**	**$ 1,876,500**	**$ 1,083,000**	**$ 203,000**	**$ 3,162,500**
	25% CONTINGENCY		$ 469,125	$ 270,750	$ 50,750	$ 790,625
GRAND TOTAL			**$ 2,345,625**	**$ 1,353,750**	**$ 253,750**	**$ 3,953,125**

Table 8B. Construction Phase Summary

	Project Name	Construction Start	Construction End	NFS Acquisition & Certification Period
Phase 1 Construction 2002 to 2013	Port Susan Habitat Islands (1 owner)	2002	2011	4 months
	Bank Maintenance Sites (Existing Federal Project)	2002	2011	Assumes no acquisition. All work within existing Federal project footprint
	Kline Farms Disposal (2 owners)	2002	2013	6 months
	Portage Creek			
	a. Upper (7 owners)	2003	2005	12 months
	b. Middle (18 owners)	2005	2007	24 months
	c. Lower (23 owners)	2008	2012	36 months
	Old Stillaguamish			
	a. Sheet 1 – Phase I (17 owners)	Feb. 2004	2012	24 months
	b. Sheet 2 – Phase II (26 owners)	Feb. 2007	2012	36 months
	c. Sheet 3 – Phase III (24 owners)	Feb. 2007	2012	48 months
Phase 2 Construction 2003 to 2005	Koch Slough Weir (1 owner)	2003	2003	6 months
	Gold Basin Slide (1 owner)	2003	2003	6 months
	Confluence Site (2 owners)	2003	2005	10 months
	North Meander (2 owners)	2003	2005	10 months
	Cloverdale Site (3 owners)	2003	2005	10 months
Phase 3 Construction 2004 to 2006	South Pass (4 owners)	2004	2005	13 months
	Hat Slough (2 owners)	2004	2005	10 months
	South Meander (5 owners)	2004	2006	12 months
	Hazel Slide (24 owners)	2005	2006	28 months

Table 8C. LER Cost Estimate for Phase I Construction (2002 – 2013)

Land Values	$760,000
NFS Administrative Costs	$788,000
Federal Review and Assistance Costs	$126,000
Subtotal	$1,674,000
25% Contingency	$418,000
Total Phase I	**$2,092,500**

Table 8D. LER Cost Estimate for Phase II Construction (2003 – 2005)

Land Values	$72,500
NFS Administrative Costs	$62,000
Federal Review and Assistance Costs	$27,000
Subtotal	$161,500
25% Contingency	$41,000
Total Phase II	**$202,500**

Table 8E. LER Cost Estimate for Phase III Construction (2004 – 2006)

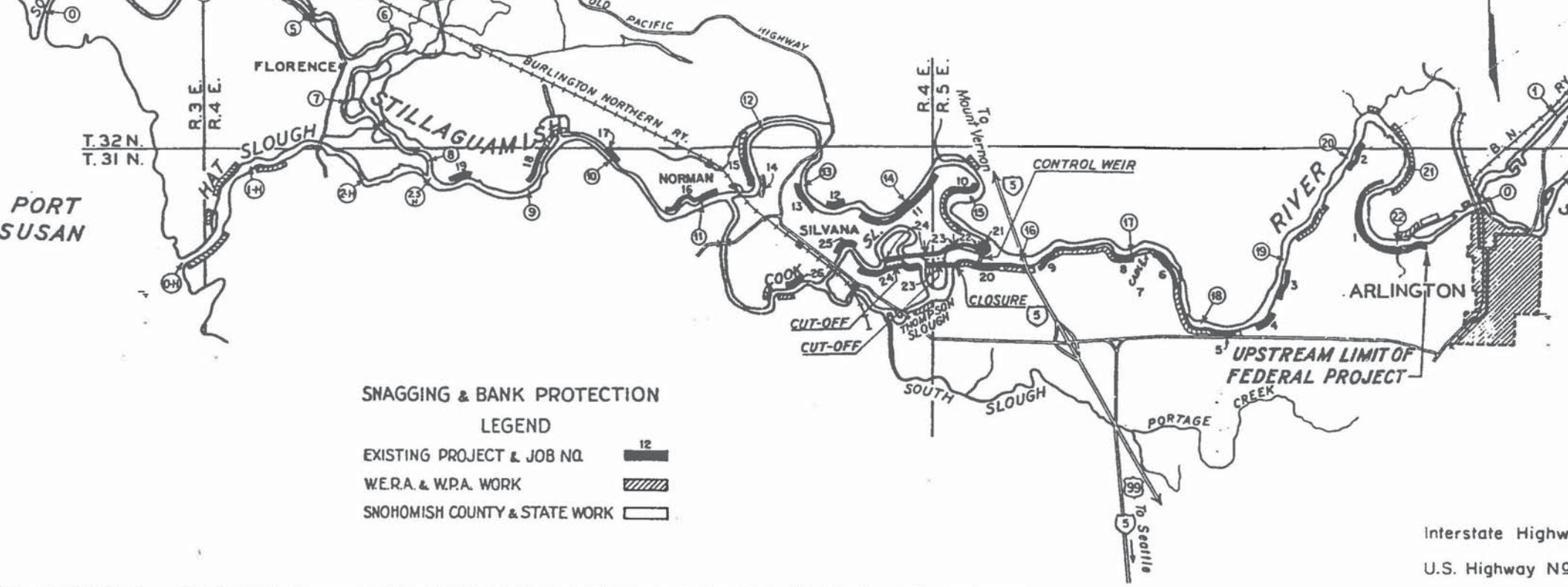
Land Values	$1,044,000
NFS Administrative Costs	$233,000
Federal Review and Assistance Costs	$50,000
Subtotal	$1,327,500
25% Contingency	$332,000
Total Phase III	**$1,659,500**

EXHIBIT A

REAL ESTATE DRAWINGS

DRAFT

July 19, 2000



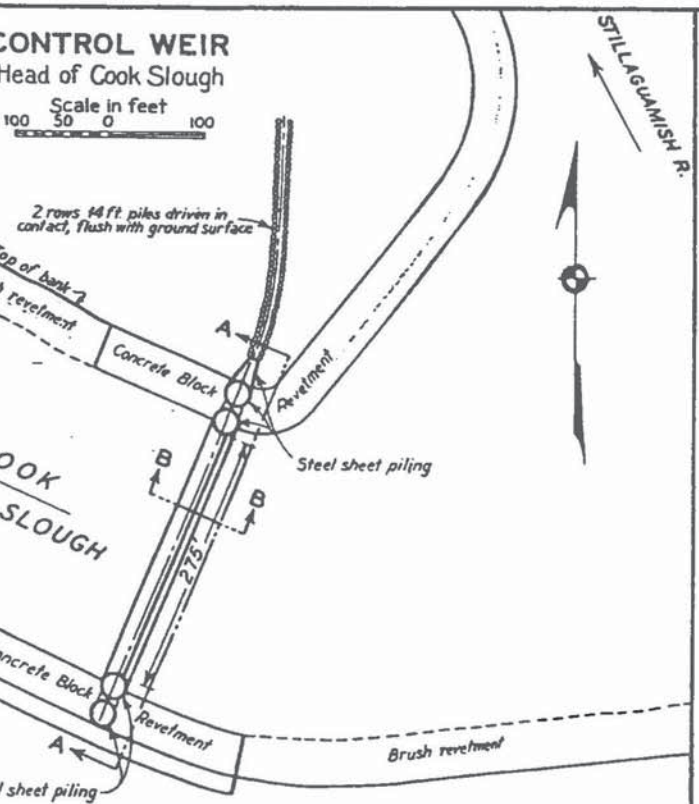
Interstate Highw
U.S. Highway N9
State Highway

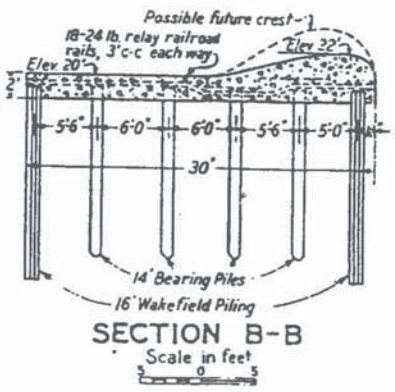
STILL

U.S. A

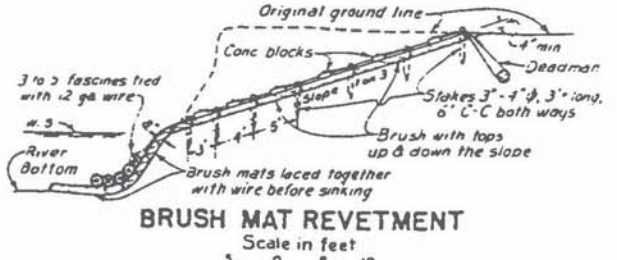
CONTROL WEIR
Head of Cook Slough

Scale in feet
100 50 0 100

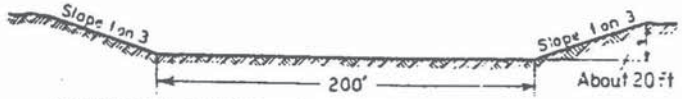




SECTION B-B
Scale in feet
5 0 5

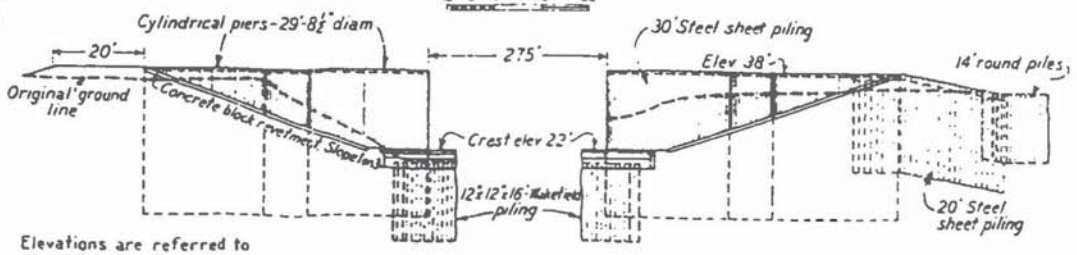


BRUSH MAT REVETMENT
Scale in feet
5 0 5 10

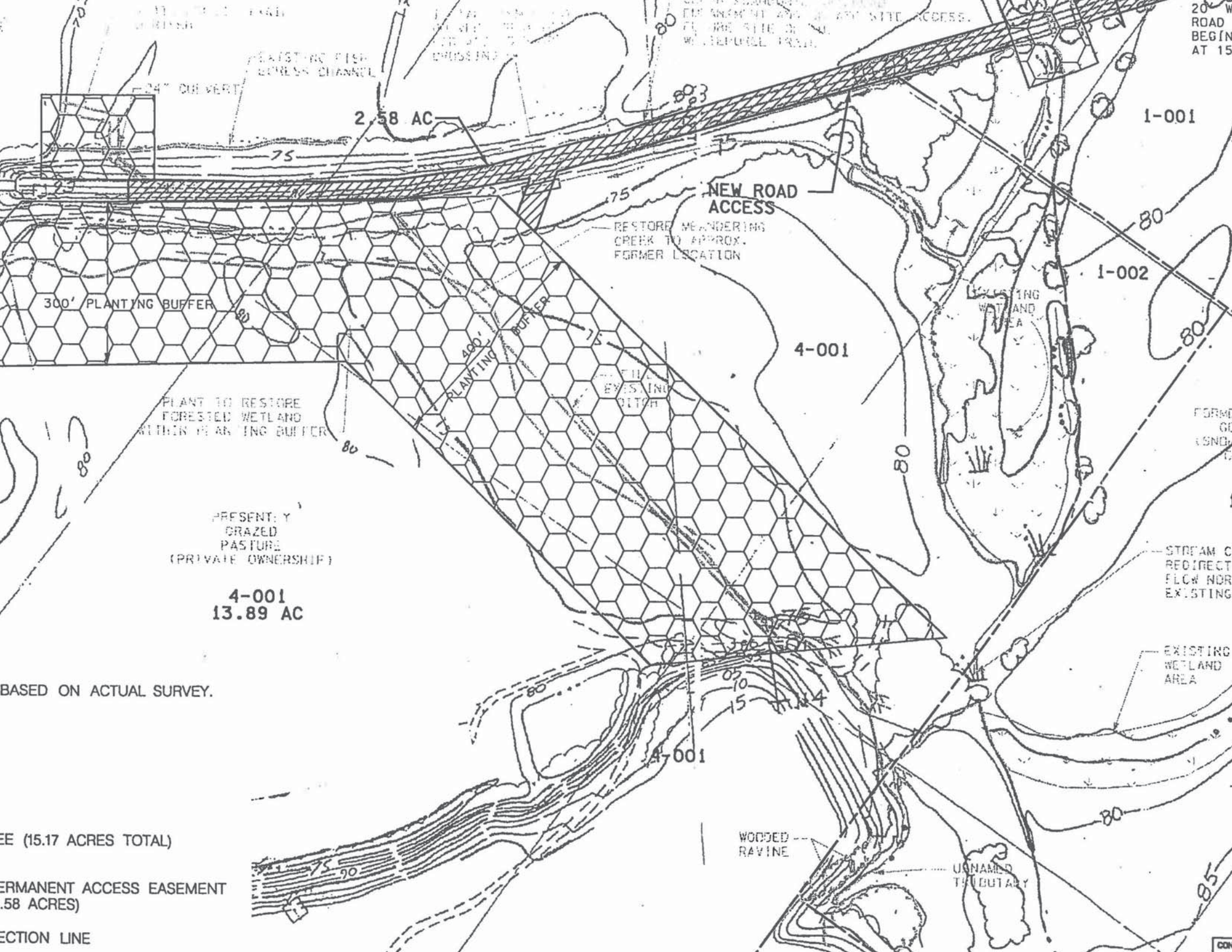


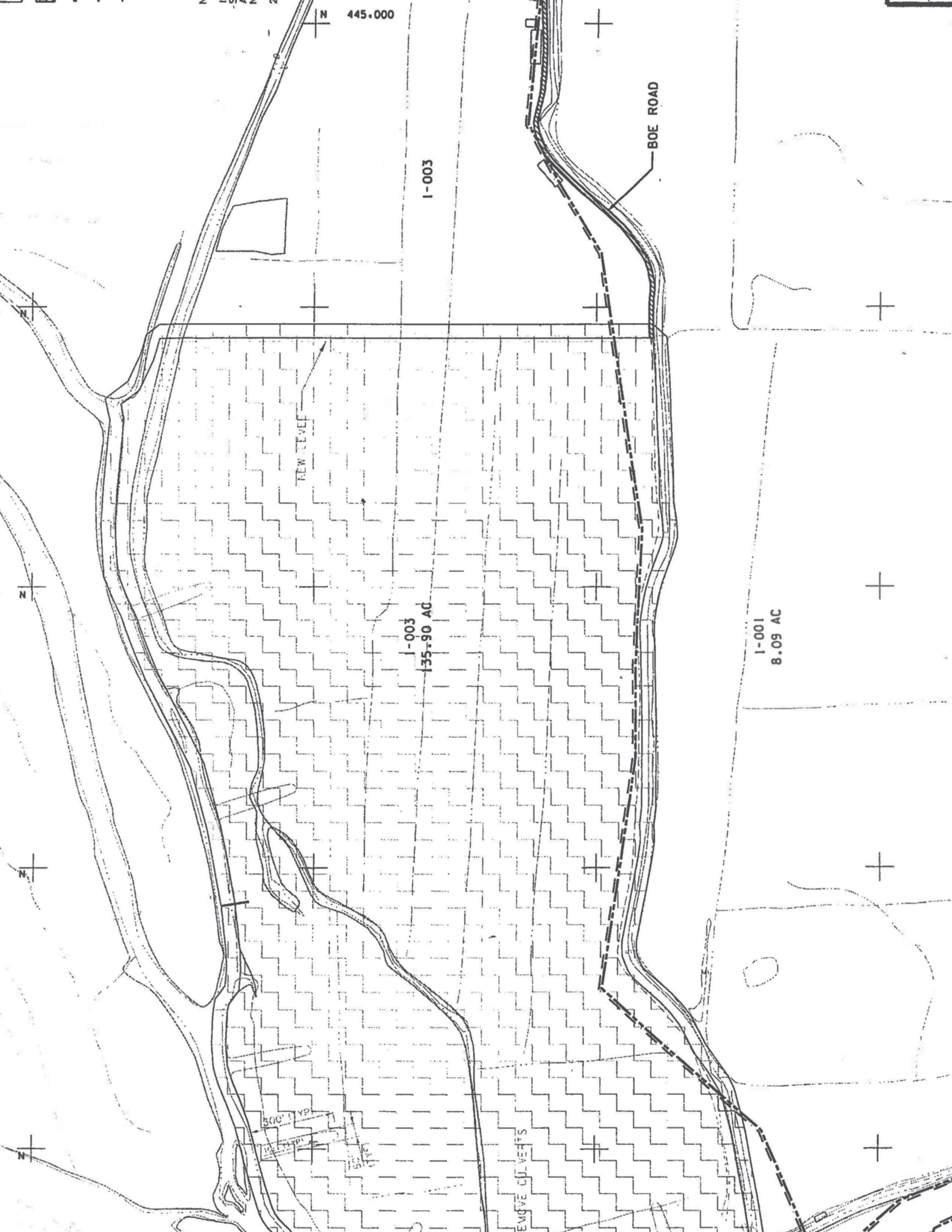
TYPICAL SECTION OF CUT-OFF CHANNEL
Scale in feet
50' 0 50'

SECTION A-A
Scale in feet
10 5 0 10 20

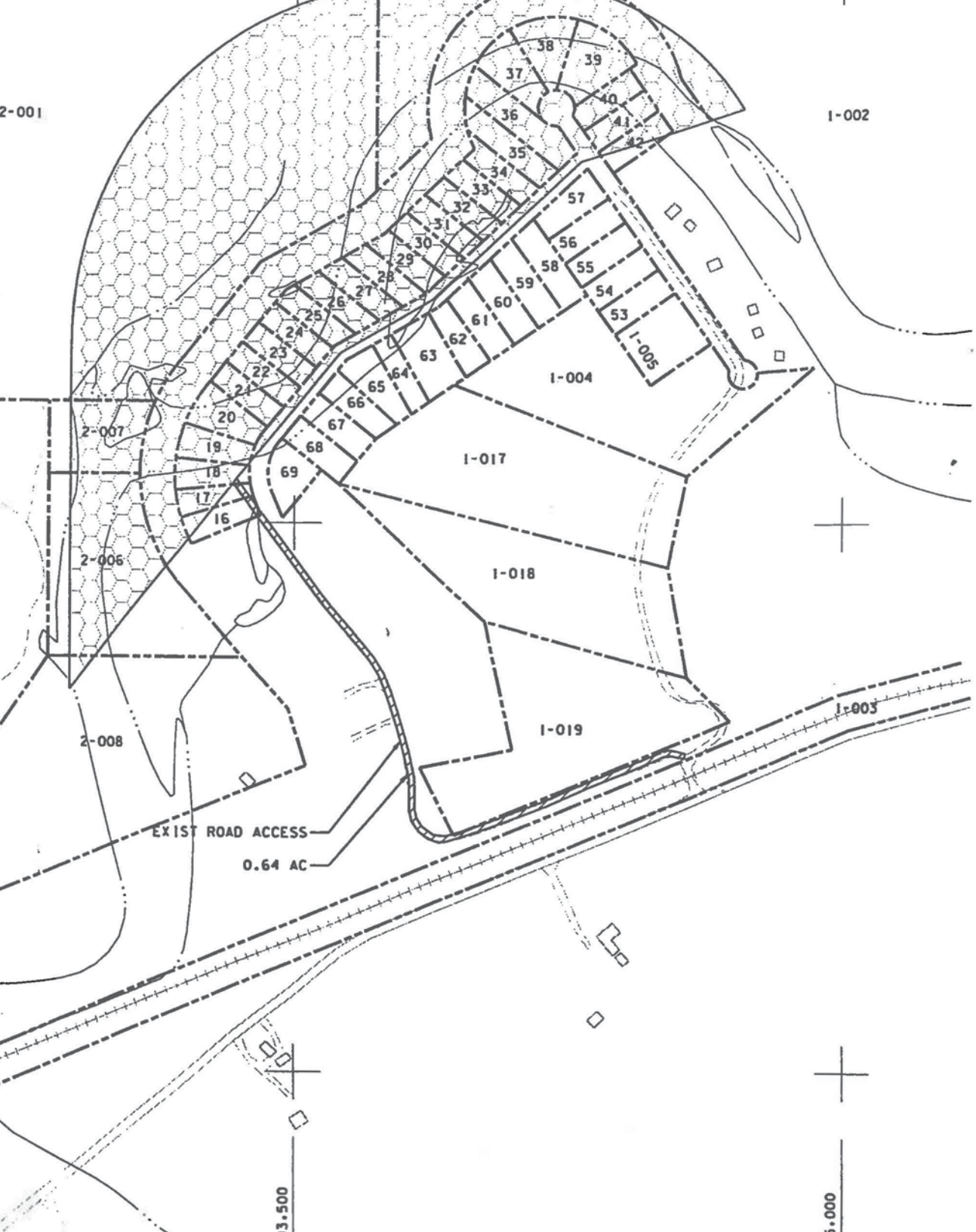


Elevations are referred to


2.58 AC
NEW ROAD ACCESS
1-001
1-002
4-001
300' PLANTING BUFFER
400' PLANTING BUFFER
RESTORE MEANDERING CREEK TO APPROX. FORMER LOCATION
PLANT TO RESTORE FORESTED WETLAND WITHIN PLANTING BUFFER
PRESENT: GRAZED PASTURE (PRIVATE OWNERSHIP)
4-001
13.89 AC
EXISTING WETLAND AREA
WOODED RAVINE
UNNAMED TRIBUTARY
24" CULVERT
EXISTING FISH BEARING CHANNEL
BASED ON ACTUAL SURVEY.
EE (15.17 ACRES TOTAL)
ERMANENT ACCESS EASEMENT
.58 ACRES)
ECTION LINE



N 445.000
BOE ROAD
I-003
NEW LEVEE
I-003
135.90 AC
I-001
8.09 AC
300' TYP

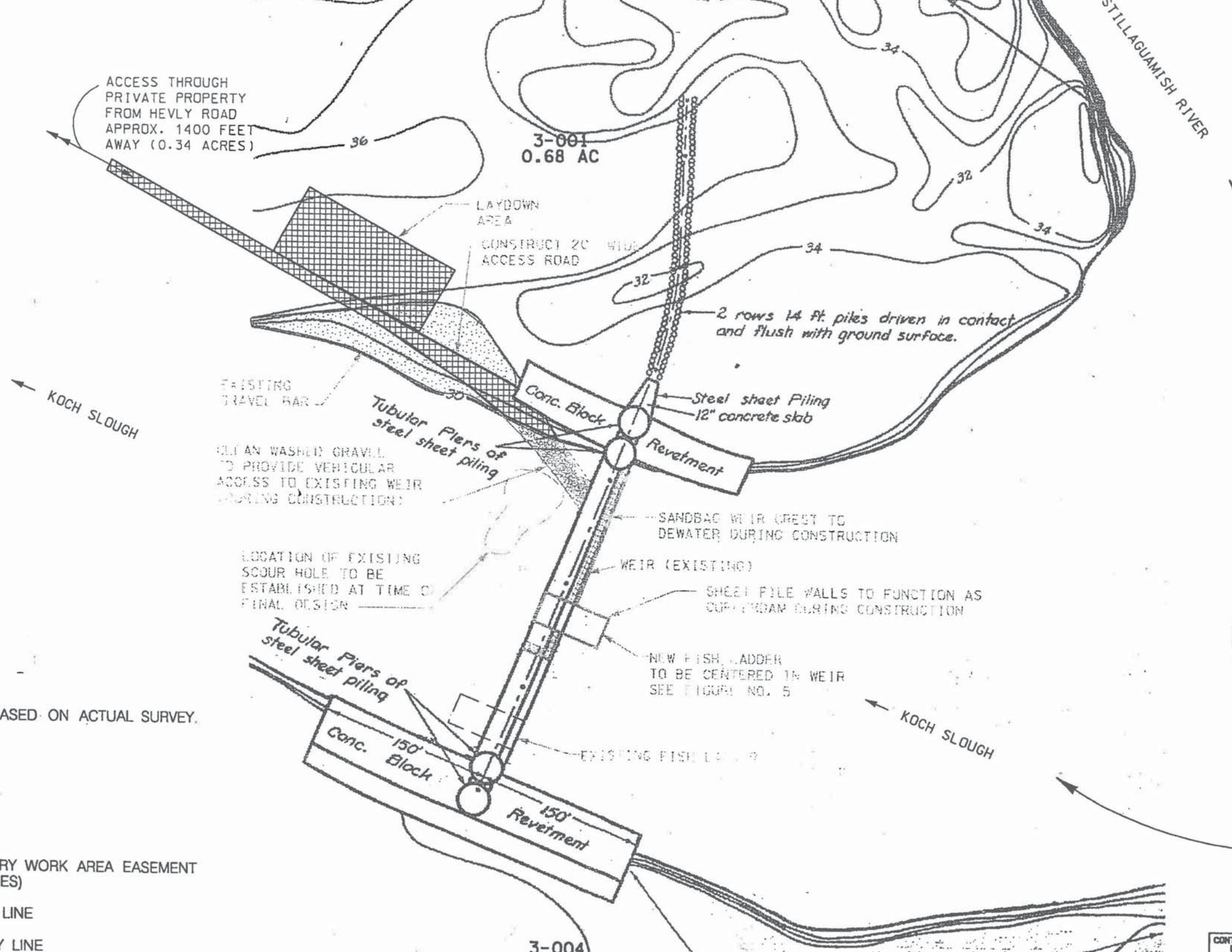


PARCEL NO.	ACRAGE
16	0.06
17	0.19
18	0.29
19	0.36
20	0.45
21	0.32
22	0.32
23	0.32
24	0.32
25	0.32
26	0.33
27	0.33
28	0.33
29	0.33
30	0.33
31	0.33
32	0.33
33	0.33
34	0.33
35	0.47
36	0.48
37	0.48
38	0.49
39	0.64
40	0.33
41	0.33
42	0.33
1-002	2.79
2-001	2.25
2-006	0.96
2-007	0.07
2-008	12.76

NOTES:

1. HORIZO
PLANE COO
DATUM. V

2. SITE NU



ASED ON ACTUAL SURVEY.

RY WORK AREA EASEMENT
ES)

LINE

Y LINE

NT ACCESS EASEMENT
E)
RY WORK AREA EASEMENT
E)
LINE
LINE
ENT MEANDER LINE

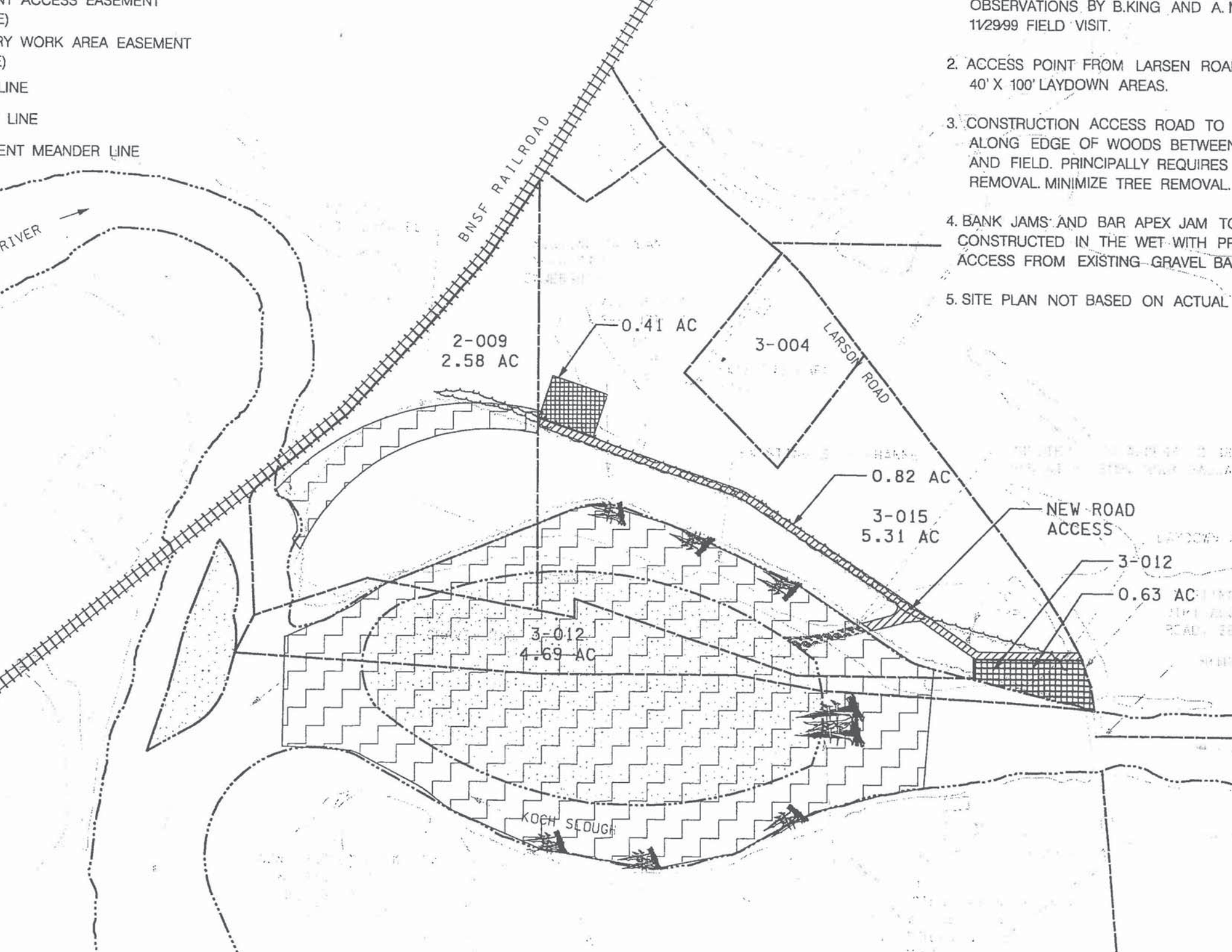
OBSERVATIONS BY B.KING AND A. M
11/29/99 FIELD VISIT.

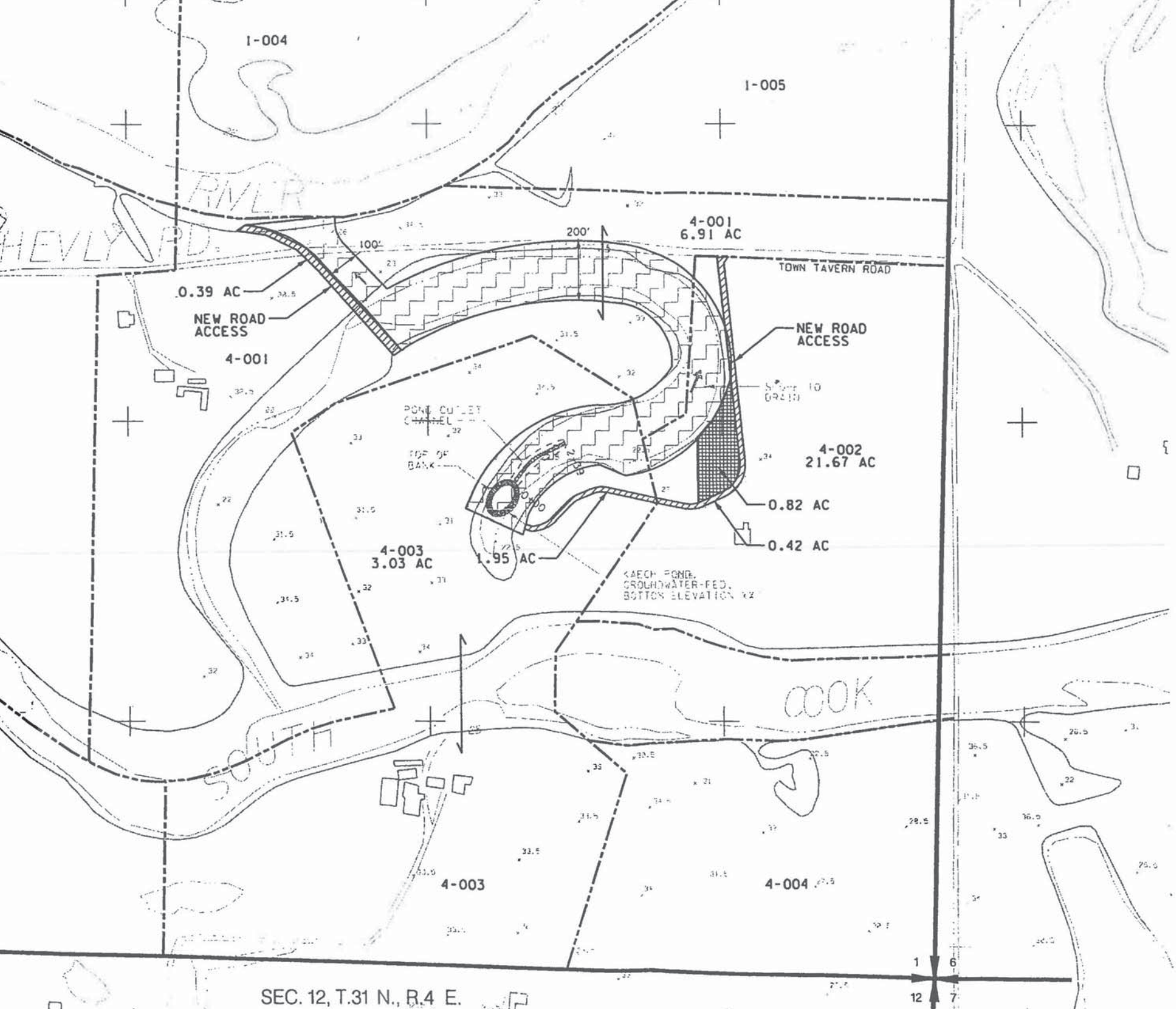
2. ACCESS POINT FROM LARSEN ROA
40' X 100' LAYDOWN AREAS.

3. CONSTRUCTION ACCESS ROAD TO
ALONG EDGE OF WOODS BETWEEN
AND FIELD. PRINCIPALLY REQUIRES
REMOVAL. MINIMIZE TREE REMOVAL.

4. BANK JAMS AND BAR APEX JAM TO
CONSTRUCTED IN THE WET WITH PR
ACCESS FROM EXISTING GRAVEL BA

5. SITE PLAN NOT BASED ON ACTUAL





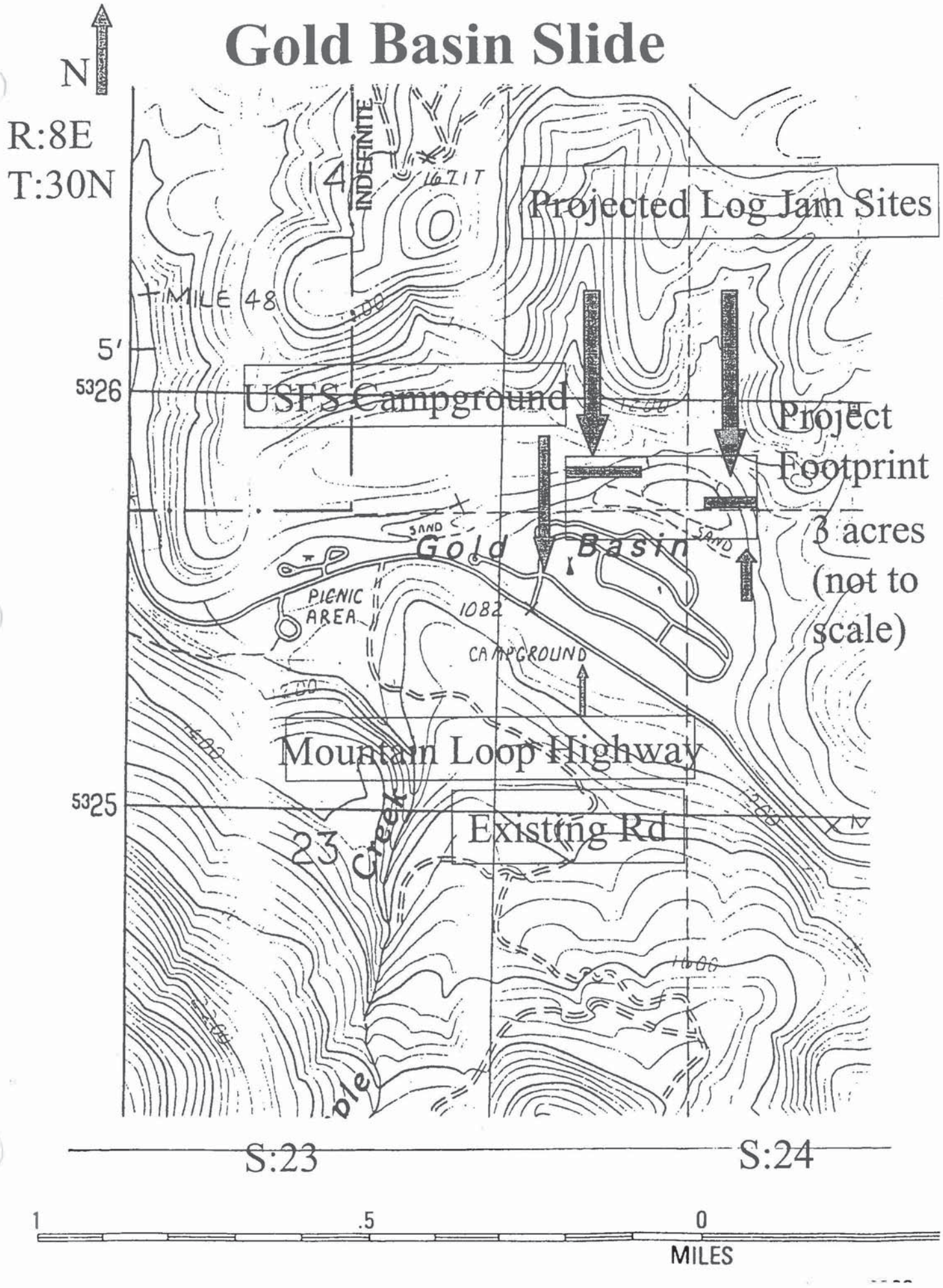
NOTES:

1. HORIZONT
PLANE COOR
DATUM. VE

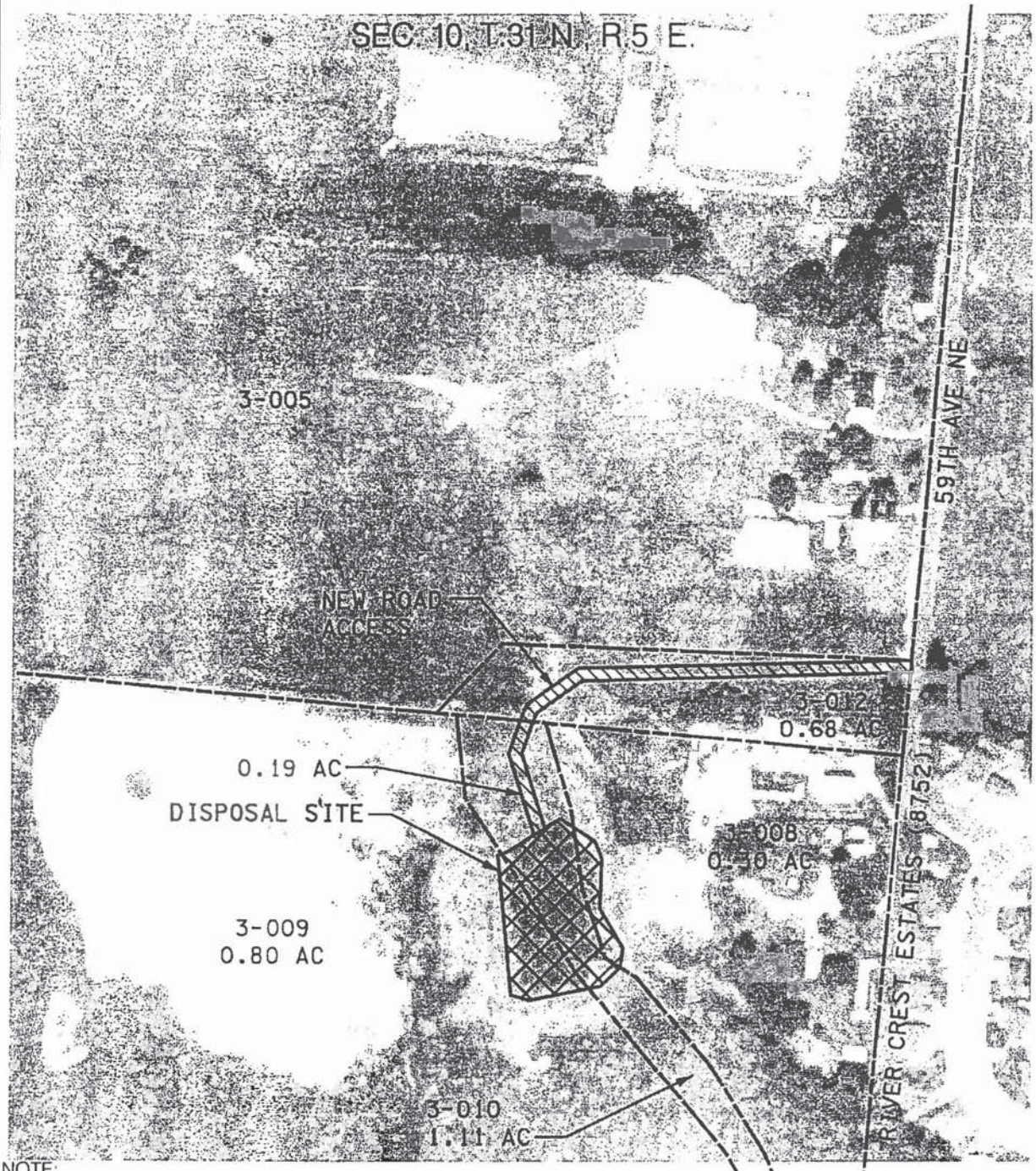
2. SITE PLA

LEGEND

Gold Basin Slide



SEC. 10, T.31 N., R.5 E.



NOTE:
SITE PLAN NOT BASED ON ACTUAL SURVEY.

LEGEND

- TEMPORARY DISPOSAL EASEMENT (2.24 ACRES)
- TEMPORARY ACCESS EASEMENT (0.87 ACRES)
- SECTION LINE
- PROPERTY LINE
- GOVERNMENT MEANDER LINE

CONTRACT NO. DACW67-98-D-1007
DELIVERY ORDER NO. 0022
HDR Engineering, Inc.

SITE PLAN
SCALE: 1" = 200'

Department of the Army
Seattle District, Corps of Engineers

KLINE FARM DISPOSAL SITE

STILLAGUAMISH RIVER ECOSYSTEM RESTORATION STUDY

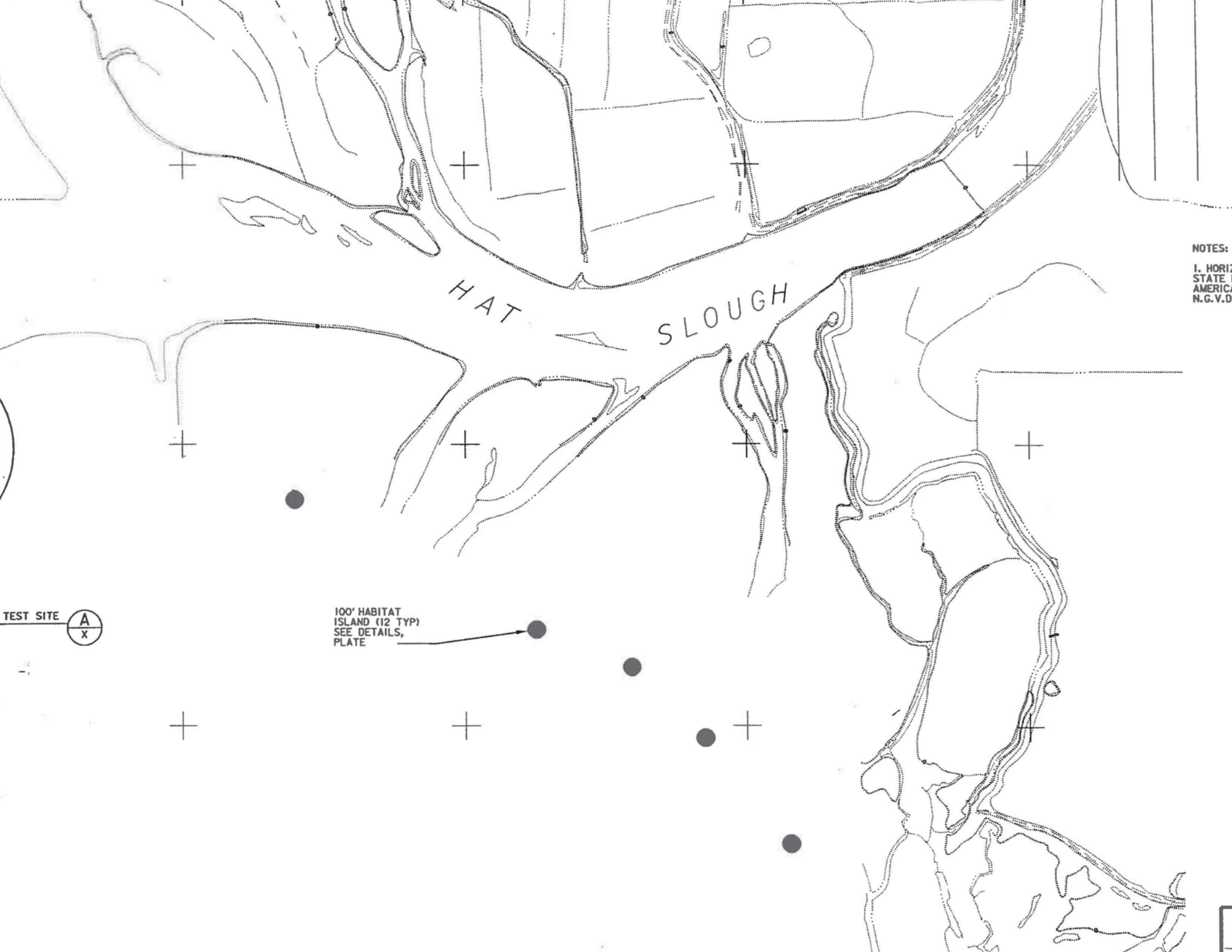
HDR Engineering, Inc.

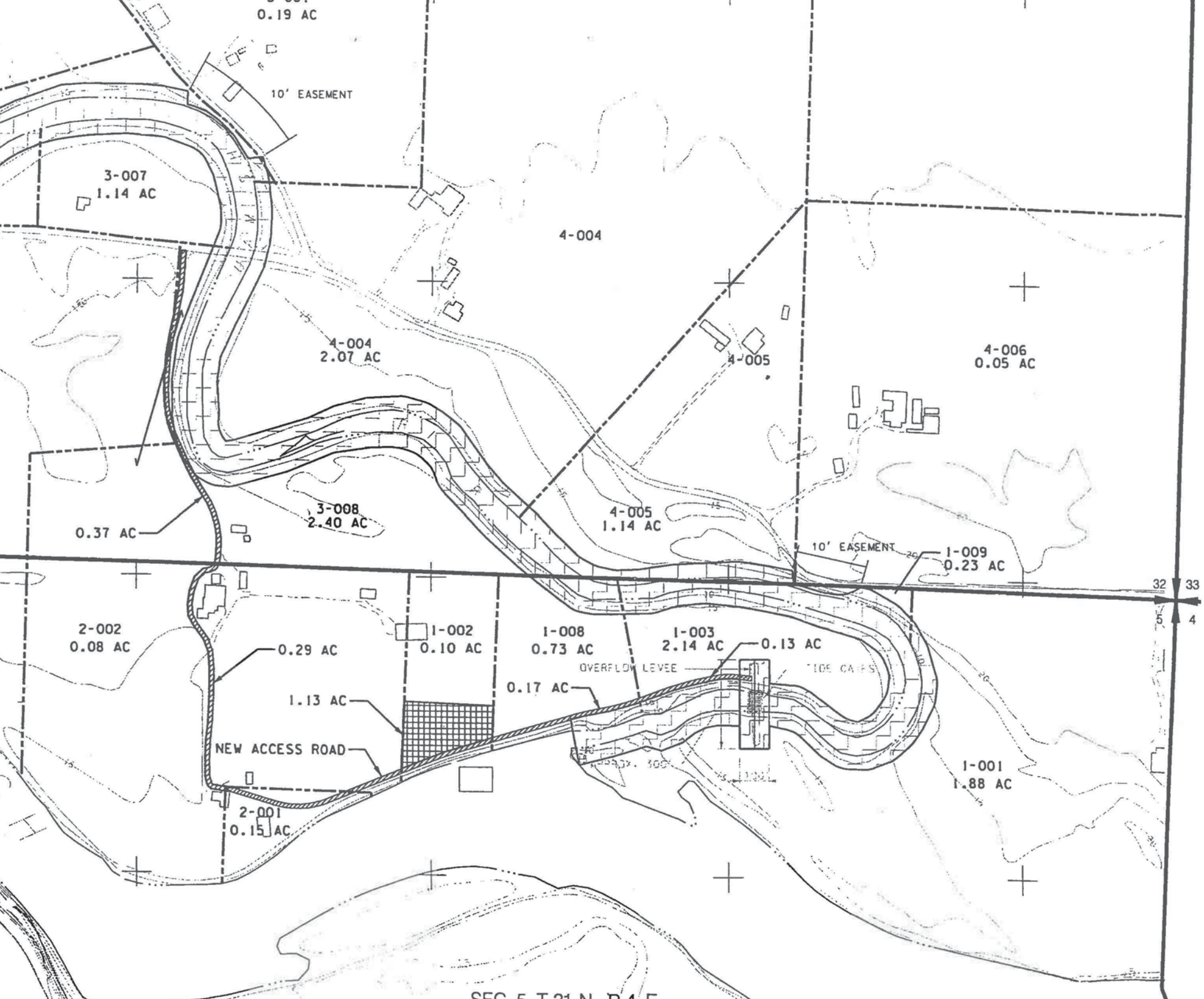
Delivery Order No. 22

Figure No. —

STILLBDR.DGN

PLOT DATE: 03-14-(

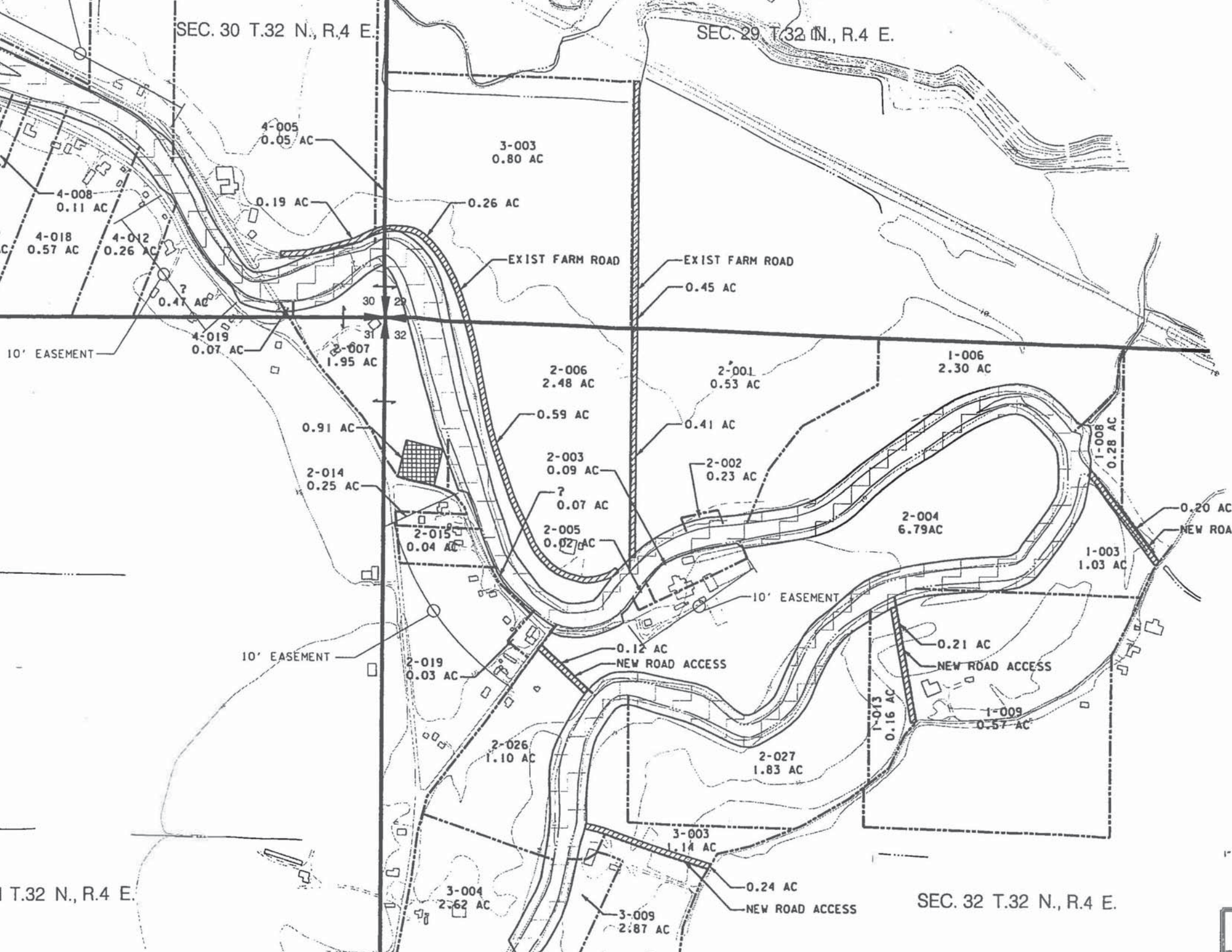

HAT SLOUGH
TEST SITE A/X
100' HABITAT ISLAND (12 TYP) SEE DETAILS, PLATE
NOTES:
1. HORIZ
STATE
AMERICA
N.G.V.D

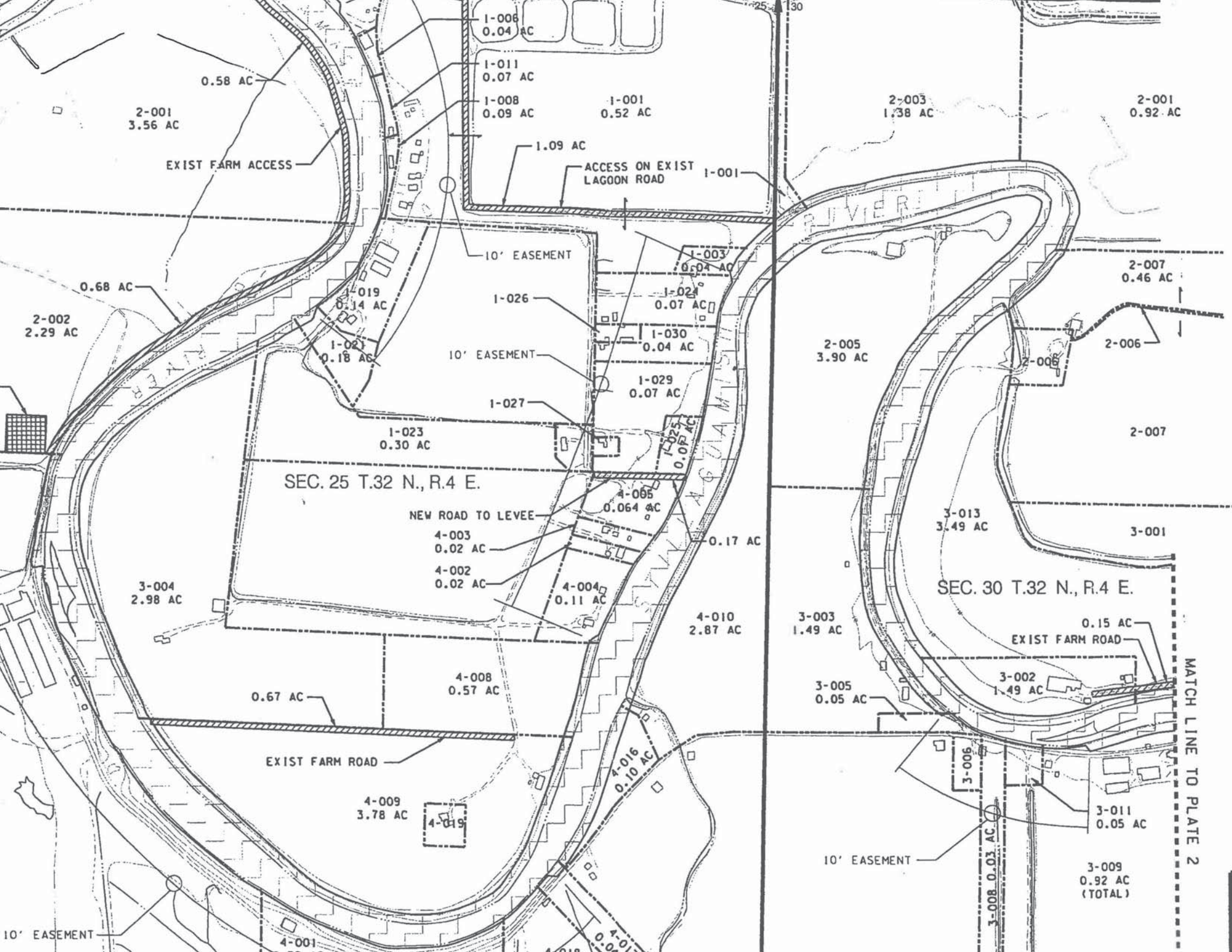


NOTE:
1. ENVIRONM
EACH CHANN

2. SITE PLA

LEGEND


SEC. 30 T.32 N., R.4 E.
SEC. 29 T.32 N., R.4 E.
SEC. 32 T.32 N., R.4 E.
T.32 N., R.4 E.
4-005
0.05 AC
3-003
0.80 AC
4-008
0.11 AC
0.19 AC
0.26 AC
4-018
0.57 AC
4-012
0.26 AC
EXIST FARM ROAD
EXIST FARM ROAD
0.45 AC
?
0.47 AC
30
29
31
32
10' EASEMENT
4-019
0.07 AC
2-007
1.95 AC
2-006
2.48 AC
2-001
0.53 AC
1-006
2.30 AC
0.59 AC
0.41 AC
0.91 AC
2-003
0.09 AC
2-002
0.23 AC
1-008
0.28 AC
2-014
0.25 AC
?
0.07 AC
2-004
6.79AC
0.20 AC
NEW ROA
2-015
0.04 AC
2-005
0.02 AC
1-003
1.03 AC
10' EASEMENT
10' EASEMENT
0.12 AC
NEW ROAD ACCESS
0.21 AC
NEW ROAD ACCESS
2-019
0.03 AC
1-013
0.16 AC
1-009
0.57 AC
2-026
1.10 AC
2-027
1.83 AC
3-003
1.14 AC
0.24 AC
NEW ROAD ACCESS
3-004
2.62 AC
3-009
2.87 AC


1-006
0.04 AC
1-011
0.07 AC
1-008
0.09 AC
1-001
0.52 AC
1.09 AC
ACCESS ON EXIST
LAGOON ROAD
1-001
2-003
1.38 AC
2-001
0.92 AC
0.58 AC
2-001
3.56 AC
EXIST FARM ACCESS
10' EASEMENT
1-003
0.04 AC
2-007
0.46 AC
0.68 AC
1-019
0.14 AC
1-026
1-024
0.07 AC
2-002
2.29 AC
1-021
0.18 AC
1-030
0.04 AC
2-005
3.90 AC
2-006
10' EASEMENT
1-029
0.07 AC
1-027
2-007
1-023
0.30 AC
1-025
0.05 AC
SEC. 25 T.32 N., R.4 E.
4-005
0.064 AC
3-013
3.49 AC
3-001
NEW ROAD TO LEVEE
4-003
0.02 AC
0.17 AC
4-002
0.02 AC
3-004
2.98 AC
4-004
0.11 AC
SEC. 30 T.32 N., R.4 E.
4-010
2.87 AC
3-003
1.49 AC
0.15 AC
EXIST FARM ROAD
3-002
1.49 AC
4-008
0.57 AC
3-005
0.05 AC
0.67 AC
EXIST FARM ROAD
3-006
4-016
0.10 AC
4-009
3.78 AC
4-019
3-011
0.05 AC
10' EASEMENT
3-009
0.92 AC
(TOTAL)
3-008 0.03 AC
MATCH LINE TO PLATE 2
10' EASEMENT
4-001

85

EXHIBIT B

NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISTION CAPABILITY ASSESSMENT

DRAFT

July 19, 2000

Exhibit B

STILLAGUAMSIH RIVER
ECOSYSTEM RESTORATION PROJECT
ASSESSMENT OF SNOHOMISH COUNTY,
NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY

I. **Legal Authority:**

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? **Yes.**

b. Does the sponsor have the power of eminent domain for this project? **Yes.**

c. Does the sponsor have "quick-take" authority for this project? **No, however, the County has other avenues available to them. For the County this is a willing seller only project and they do not have eminent domain authority, but could use a Possession and Use Agreement if it became necessary to have use of the property before settlement is made.**

d. Are any of the lands /interests in land required for the project located outside the sponsor's political boundary? **No.**

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? **Yes, State of Washington, Department of Natural Resources, State of Washington Department of Fish and Wildlife and State of Washington Depart of Game. The State of Washington Fish and Wildlife owns a majority of the lands for the South Pass (Smith Farms) site.**

State of Washington, DNR typically owns the submerged lands unless a court determines otherwise. Until further investigation of property ownership during the implementation phase, the premise for the purposes of this assessment is that the State DNR owns the submerged lands at the various project sites.

II. **Human Resource Requirements:**

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including PL 91-646, as amended? **No.**

b. If the answer to II.a. is "yes," has a reasonable plan been developed to provide such training? **N/A.**

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **Yes.**

d. Is the sponsor's projected in-house staff level sufficient considering its other work load, if any, and the project schedule? **Yes.**

e. Can the sponsor obtain contractor support, if required, in a timely fashion? **Yes**

f. Will the sponsor likely request USACE assistance in acquiring real estate? **No.** (If "yes," provide description).

III. **Other Project Variables:**

a. Will the sponsor's staff be located within reasonable proximity to the project site? **Yes.**

b. Has the sponsor approved the project/real estate schedule/milestones? **Yes, however, since there are 13 proposed project sites, the priority and proposed construction schedule could change during the Plans and Specification Phase.**

IV. **Overall Assessment:**

a. Has the sponsor performed satisfactorily on other USACE projects?

Snohomish County technical staff has performed and interfaced well with USACE staff, however, USACE staff has experienced difficulty with the County's legal staff related to potential liability of the County in real estate transactions. This has led to some difficulty in getting projects implemented when the County's legal staff must sign-off on Project Cooperation Agreements and real estate certifications. We will continue to work with the County's technical staff to address their legal staff's concerns when and where we can to obviate project delays.

b. With regard to this project, the sponsor is anticipated to be:

___ highly capable
__X__ fully capable
___ moderately capable
___ marginally capable
___ insufficiently capable. (If sponsor is believed to be "insufficiently capable:, provide explanation).

V. **Coordination:**

a. Has this assessment been coordinated with the sponsor? **Yes.**

b. Does the sponsor concur with this assessment? **Yes.**
(If "no," provide explanation).

Prepared by:

Wanda F. Gentry
Realty Specialist

Reviewed and approved by:

Joseph C. Duncan
Chief, Real Estate Division

EXHIBIT C

CERTIFICATION OF LANDS

AND

ATTORNEY'S CERTIFICATE

DRAFT

July 19, 2000

97 & 875

Exhibit C

DRAFT

DATE

Department of the Army
Seattle District, Corps of Engineers
ATTN: Real Estate Division
Post Office Box 3755
Seattle, Washington 98124-3755

RE Certification of Lands and Authorization for Entry for the Stillaguamish River Ecosystem Restoration System

Dear Sir:

By Project Cooperation Agreement dated the _____ day of _____ 2000__, Snohomish County, Washington, assumed full responsibility to fulfill the requirements of non-Federal cooperation as specified therein and in accordance with the Water Resources Development Act of 1986, as amended.

This is to certify that Snohomish County has sufficient title and interest in the lands hereinafter shown on Exhibit A, attached, in order to enable Snohomish County to comply with the aforesaid requirements of non-Federal cooperation.

Said lands and/or interest therein are owned or have been acquired by Snohomish County, and are to be used for the construction, maintenance and operation of the above referenced project and include but are not limited to the following specifically enumerated rights and uses, except as hereinafter noted:

1. Fee: The fee simple title to the land shown on Exhibit "A" attached.

2. Environmental Easement. A perpetual and assignable right and easement in, on, and across the lands of the Grantor delineated in Exhibit A attached hereto to construct, operate, maintain, repair, alter, rehabilitate, remove, replace and monitor project features; plantings; and any other improvements within and adjacent to the stream or shore for grade control, channel, bank, and /or shore, and bank stabilization, fish and wildlife habitat improvements, and other environmental improvements, including the removal of structures or obstructions including levees; the placement of materials or structures in the bed, banks, or shorelines that influence stream velocity or channel form, the removal or placement of gravels, cobbles, and boulders, and other structures, or

conveyances to recharge or maintain flow to existing wetlands; reserving, however, to the owners, their heirs and assigns, all other rights and privileges that may be used without interfering with or abridging the enumerated rights and easement hereby conveyed and acquired.

3. Permanent Access Easement. A perpetual and assignable easement and right-of-way in, on, over, and across the lands of the Grantor delineated in Exhibit A for the location, construction, operation, maintenance, alteration, and replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell, and remove therefrom all trees, underbrush, obstructions, and other vegetation, structures, or obstacles within the limits of the right-of-way.

4. Temporary Work Area Easement. A temporary easement and right-of-way in, on, over, and across the lands of the Grantor delineated in Exhibit A, for a period not to exceed one year, beginning with date possession of the land is granted to Snohomish County, Washington for use by the United States, its representatives, agents, and contractors as a work area, including the right to deposit fill, and waste material thereon, move, store, and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Stillaguamish River Ecosystem Restoration Project, together with the right to trim, cut, fell, and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired.

5. Temporary Disposal Easement. A temporary easement and right-of-way in, on, over, and across the land of the Grantor delineated in Exhibit A, for a period not to exceed one year beginning with date possession of the land is granted to the Snohomish County, Washington, for use by the United States, its representatives, agents, and contractors as a work area, including the right to borrow and/or deposit fill, and waste material thereon, move, store, and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Stillaguamish River Ecosystem Restoration Project, together with the right to trim, cut, fell, and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired.

6. Temporary Access Easement. A temporary and assignable easement and right-of-way in, on, over, and across the land described in Exhibit A for a period not to exceed twelve years, beginning with the date possession of the land is granted to the Snohomish County, for use by the United States, its representatives, agents, and contractors for the location, construction, operation, maintenance, alteration and replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell, and remove therefrom all trees, underbrush, obstructions and other vegetation,

structures, or obstacles within the limits of the right-of-way; reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Snohomish County does hereby grant to the United States of America, its representatives, agents and contractors, an irrevocable right, privilege and permission to enter upon the lands hereinbefore mentioned for the purpose of prosecuting the project.

Snohomish County certifies to the United States of America that any lands acquired subsequent to the execution of the Project Cooperation Agreement that are necessary for this project have been accomplished in compliance with the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (Public Law 91-646) as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR, Part 24.

SNOHOMISH COUNTY, WASHINGTON

BY _____
NAME:
TITLE:

DATE: _____

*****

ATTORNEY'S CERTIFICATE

I, _____, an attorney admitted to practice law in the State of Washington, certify that:

I am the attorney for Snohomish County, Washington.

I have examined the title to _____ [Parcel #'s] of land identified by the U.S. Army Corps of Engineers as needed for the Stillaguamish River Ecosystem Restoration Project and included in the Certification of Lands and Authorization For Entry document to which this Certificate is a part of.

Snohomish County, Washington is vested with sufficient title and interest in the described lands required by the United States of America to support the construction, operation, and maintenance of the Stillaguamish River Ecosystem Restoration Project.

There are no outstanding third party interests of record that could defeat or impair the title and interests of Snohomish County, Washington, in and to the lands described, or interfere with construction, operation, and maintenance of the Project. Such interests include, but are not limited to, public roads and highways, public utilities, railroads, pipelines, other public and private rights of way, liens and judgments. To the extent such interests existed prior to acquisition of the described lands by Snohomish County, Washington, such interests have either been cleared or subordinated to the title and interests so acquired.

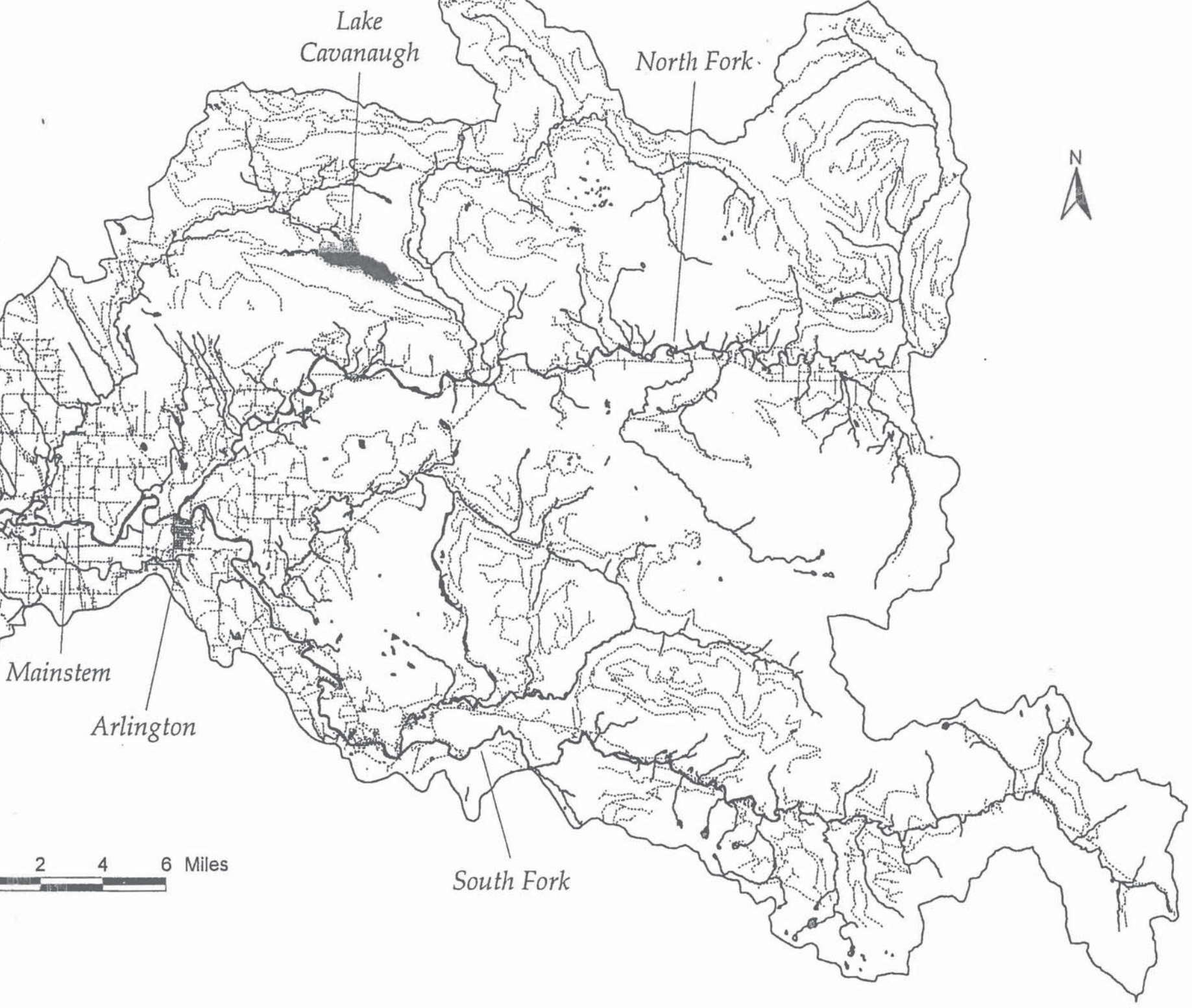
Snohomish County has authority to grant the Certification of Lands and Authorization For Entry to which this Certificate is appended; that said Certification of Lands and authorization for entry is executed by the proper duly authorized authority; and that the authorization for entry is in sufficient form to grant the authorization therein stated.

DATED AND SIGNED at _____, this ____ day of _____ 2000__.

BY _____
NAME:
TITLE:

APPENDIX D

DESIGN APPENDIX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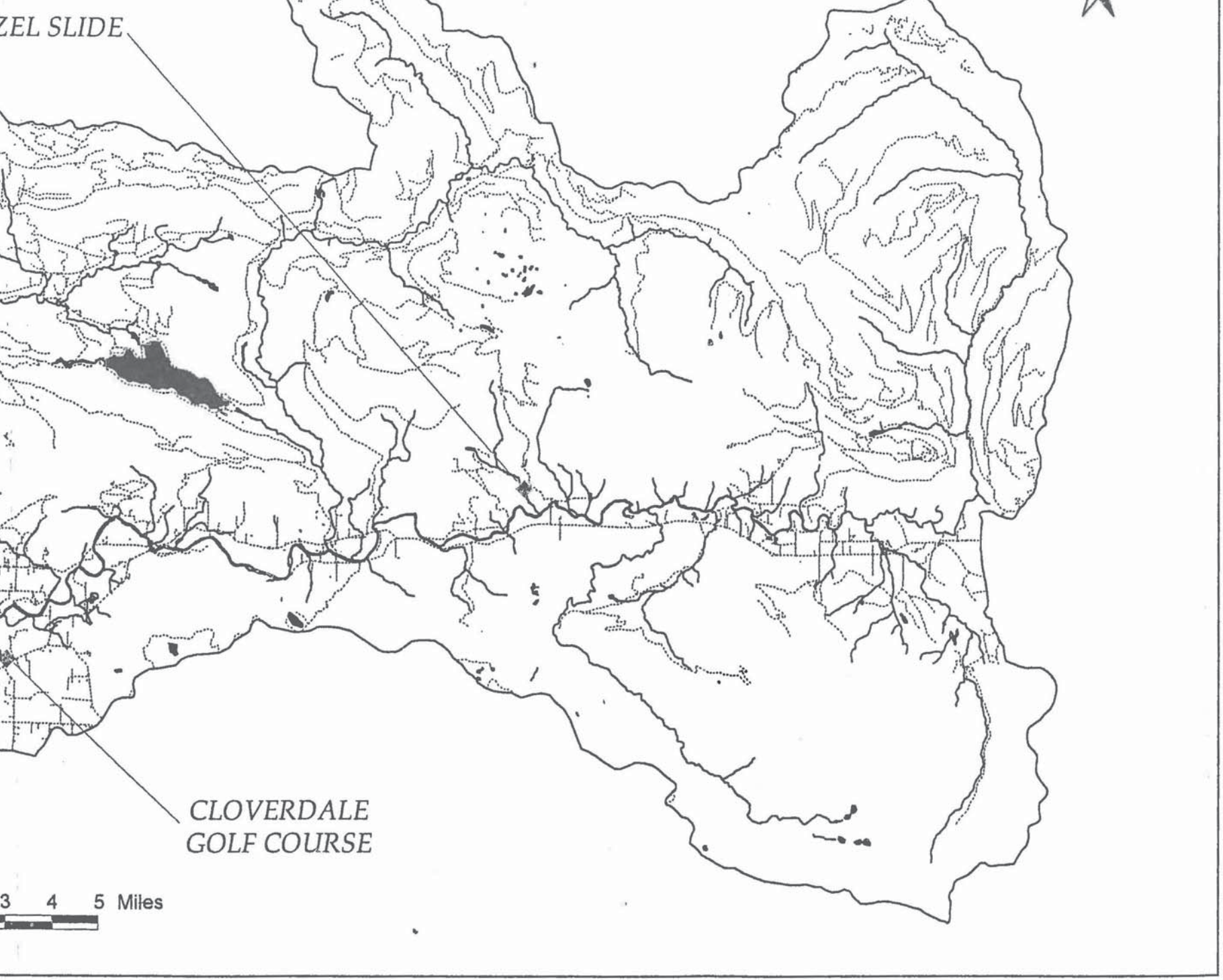

Sources

River information obtained from Snohomish County.
City Boundaries, Roads and additional data provided by TIGER Census

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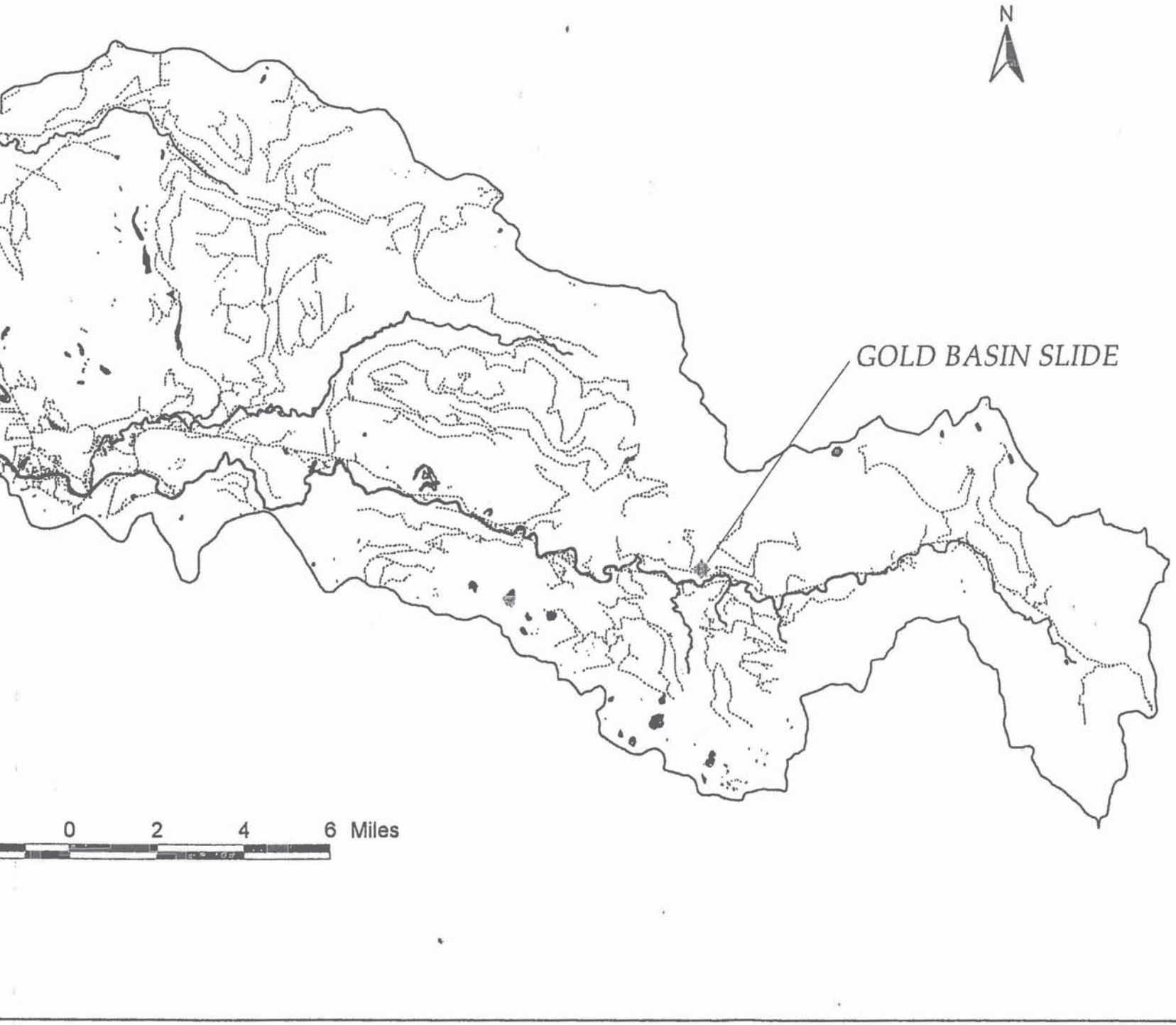

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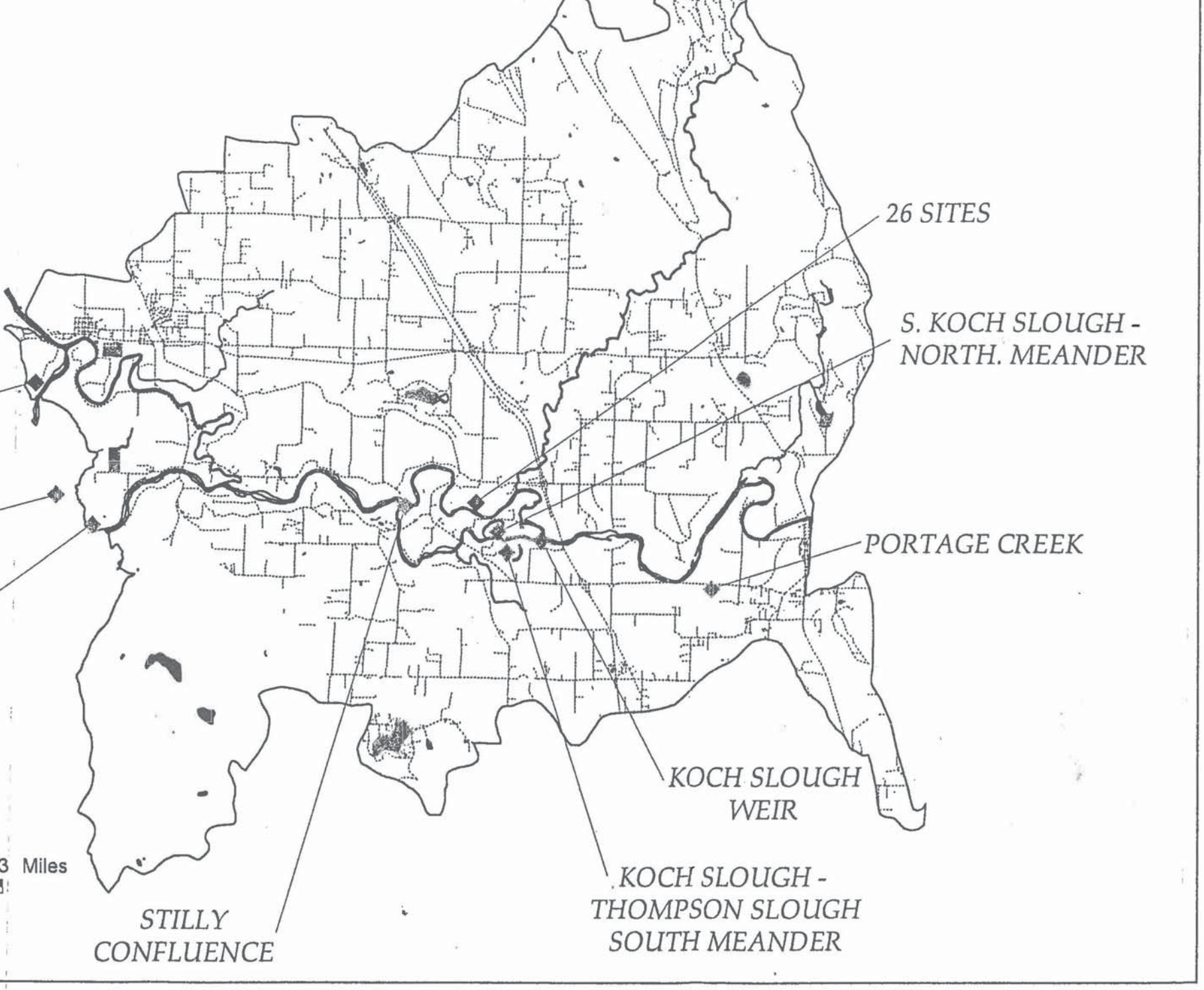
It is understood that, while the Corps of Engineers and information suppliers have no indication or reason to believe that there are inaccuracies in information incorporated in the basemap, THE CORPS AND ITS

Sources

River information obtained from Snohomish County



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STILLAGUAMISH RIVER ECOSYSTEM RESTORATION FEASIBILITY STUDY

PROJECT DESCRIPTION AND WRITE UP

1.0 SITE DESIGNATION: PORT SUSAN HABITAT ISLANDS

Site Description

Township 31N, Section 1,Range 3E. The project sites are located in the estuarine portion of Port Susan Bay near the mouth of Hat Slough. There are twelve proposed sites scatted throughout the tideflats area in the southeastern portion of the Bay (see attached site map.)

Project Objectives and Criteria

The purpose of the project is to provide additional habitat complexity in the estuary. Historically, Port Susan Bay had a large and diverse array of estuarine habitats. Vegetated shallows (such as eelgrass), extensive mudflats and fringing marshlands comprised the estuarine portion of the Bay. These habitats were very productive and a wide variety of fish and wildlife were dependent upon them. As early as the 1870's sea dikes were constructed at the land water interface in an effort to convert marshland to agricultural purposes. This conversion, while eliminating much of the wetlands and sloughs, left the remaining tideflats on the exterior of the sea dikes. Presently, there are wide expanses of uncharacteristic flats interspersed with just a few marsh islands in the southeastern portion of the bay. While mudflats provide many benefits to fish and wildlife (benthic and epi-benthic production to name a few) this area could benefit from additional marshland. Nutrient export to the mudflats could make them more productive. Plus, from a habitat complexity standpoint, more marsh would add to the species diversity in the area. This project proposes to provide that habitat complexity. This is a pilot project and we are trying to test two separate hypotheses. The first is, can we use interlocked large woody debris to trap sediment coming out of Hat slough to raise the bed elevation to intertidal marsh. The second is, will scour channels form on the bayward side of the structures to allow juvenile salmon to access the area at low tide. Since this project is experimental in nature we intend to develop a monitoring plan to test our assumptions. Structure stability would be a key component for this project.

Alternatives

We considered three alternatives for this project:

- Alternative 1: No action. This will not meet the objective for this project.

- Alternative 2: This alternative would dredge a channel through the mudflats and side cast the material next to the newly excavated channel. This side cast material would have come up to approximately +9 (MllW =0) and we expect this would have colonized with estuarine emergent vegetation. The work would be accomplished by a clam shell dredge and barge. We rejected this alternative for a couple of reasons.

The first is the extent of long and continuous dredging necessary to reach deeper portions of the Bay. This would generate a lot of loosely formed material (unconsolidated) that would have long term turbidity associated with it (until it was vegetated or the tides re-worked the material). This long channel would also need a gentle downward slope so that it properly drained and did not form pools at low tide where fish could strand. The third reason is Hat slough yields a large amount of sediment and the channel would need continual maintenance to keep it open.

- Alternative 3: The recommended alternative would construct twelve large wooden cribs, in specific locations in the southwestern portion of the Bay.

Recommendations/Conclusions

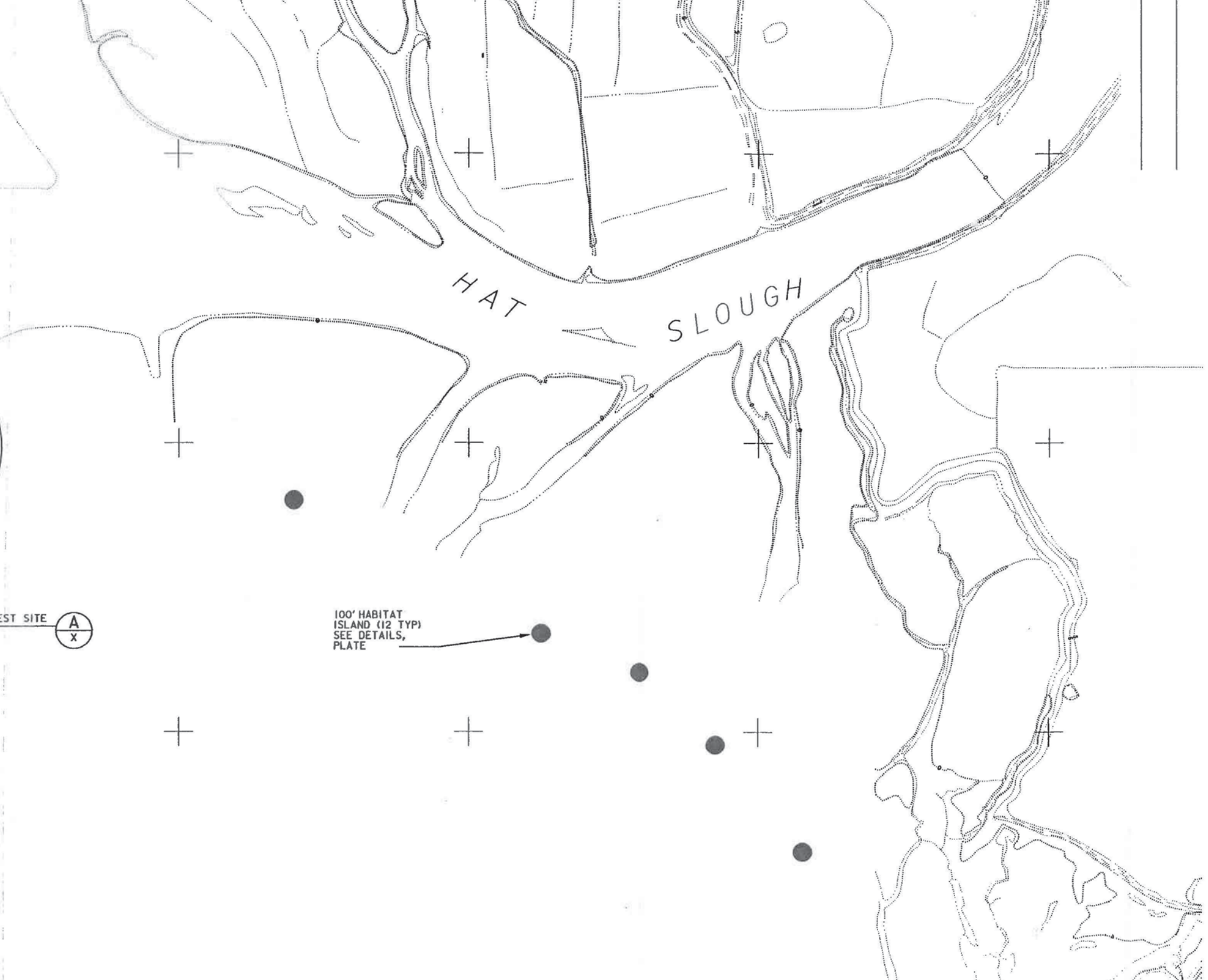
Alternative 3, is our recommended alternative. We came to this alternative by observing how large pieces of wood act in the Bay. They seem to hold sediment and stabilize the local area allowing for establishment of vegetation. Construction of this alternative would be as follows:

Using a Clam bucket and barge, we would occupy a site at high tide. The equipment would be held in place and work would commence at low tide. The clamshell would excavate a large hole. Very large pieces of wood ([30'DBH with root wads) would be placed in the excavated hole. The wood would be interwoven so that the key members meshed forming a "V" shape with the root wads pointing out. The material that was excavated would be placed back in the hole and also on top of the wood to hold it place. Much of the structure would be buried but several key members would be exposed above the mud line. The top of the structure would be at about elevation +9 (MllW =0). Several stack members, about 20" diameter at breast height(DBHμ20'), would be placed on top of the structure to capture sediment. We would plant estuarine emergent vegetation such as sedges and rushes if the final elevation is suitable. As previously mentioned, a monitoring plan would be developed to determine if project objectives have been met or if the structure needs to be adjusted. We would also monitor the vegetation to insure noxious plants were kept out of the sites. We assume that channels would form along the outside edge of these islands and help provide both adult and juvenile habitat. We would test this system early in the construction phase by building 3 test islands and waiting several seasons to see how they react to the local wave and sediment environment. We would also monitor the fish use of these sites to insure their benefit prior to construction of other sites.

We would have to investigate the potential effects of the proposed structures on navigation and if necessary mark them as hazards in accordance with Cost Guard Regulations. Because the sites are well out in Port Susan we do not believe they will have any effect on flood levels in Hat Slough. Another issue that will have to be addressed prior to construction is the effect of barge grounding during construction.

Quantity and Cost Estimates

Quantity and cost estimates for this project are shown in the MCACES section of this attached engineering appendix.



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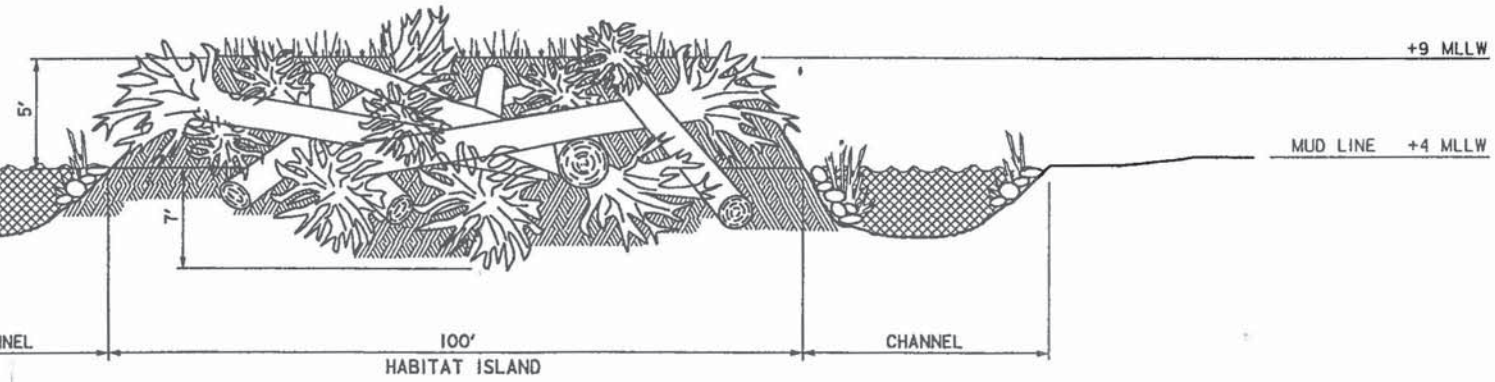

HABITAT ISLAND CROSS-SECTION

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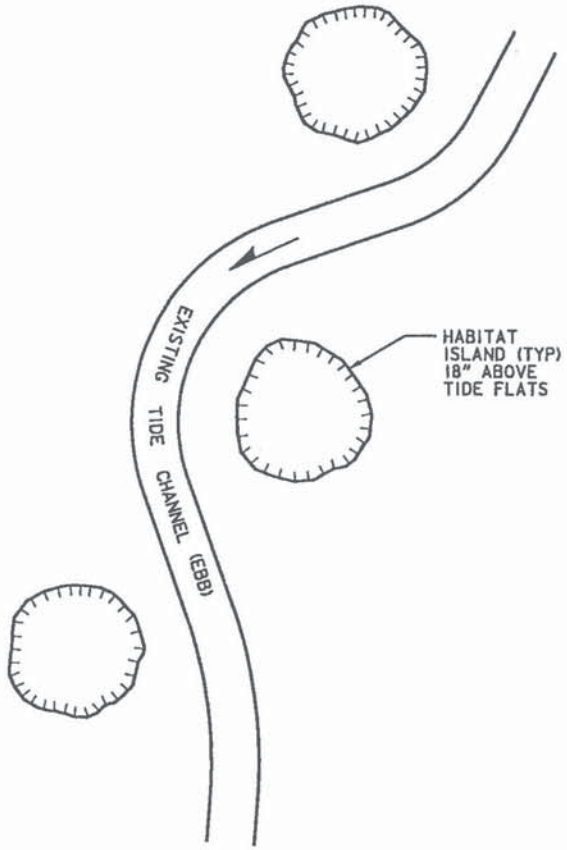

TEST SITE PLAN VIEW

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STILLAGUAMISH RIVER ECOSYSTEM RESTORATION
FEASIBILITY STUDY

PROJECT DESCRIPTION AND WRITE UP

2.0 SITE DESIGNATION: SMITH FARMS SOUTH PASS (Leque Island)

Site Description

Township 32N, Section 26 Range 3E. The project is located near South Pass, near where the Old Stilli channel empties into Port Susan Bay. State Highway 532 bisects the property as you leave Stanwood and go west towards Camano Island. The site is currently owned by State Department of Fish and Wildlife and was formerly in agricultural production. A few farm buildings can be found on the property.

Project Objectives and Criteria

The purpose of the project is to restore tidal hydrology to a portion of the property. Project action includes excavation of a tidal channel and removal of sea dikes. Historically, this portion of the Bay was at the land water interface. At one time Port Susan Bay had extensive estuarine marshes and sloughs. Starting in the 1870's sea dikes were constructed at the marsh edges and these areas were converted to agricultural production. Sloughs in the area were also filled to make more farmable land. Over 40% of the estuary and numerous tributary channels were loss during this conversion. From a fish and wildlife standpoint, this conversion had harsh consequences. The sea dikes, constructed along the margins of the estuary, interrupted the tidal flow causing nutrient export from the marshes to the adjoining habitats -including mudflats –to diminish. Intertidal sloughs that were once refuge areas for juvenile fish (salmon, sculpins, flounder and sole) shorebirds (dunlin, sandpiper and yellowlegs) and waterfowl (pintail, and baldpate) were lost. The continuity of the large interspersed habitats of the estuary became fragmented. This project offers an opportunity to restore on large scale, some of the former estuary. There are a few criteria besides restoring tidal inundation that need to be considered. These include, removal of dikes should not effect any flooding to adjacent properties, and this site is also a significant haven for snow geese during the winter.

Alternatives

Several alternatives were considered for this project. They include:

- Alternative 1: No Action. This would not achieve the goal of restoring historic hydrologic conditions.

- Alternative 2: Remove all of the Sea dikes and excavate out the mouths of a remnant tidal slough. Material from the sea dikes would be placed in adjacent borrow pits so as not to impede the hydrologic process. On the North portion of the property, the existing dike would be removed and then rebuilt adjacent to Highway 530 to protect the highway from flooding. Certainly from a restoration standpoint this is a viable

option but it does not consider all of the resource and social needs that may need to occur on this property.

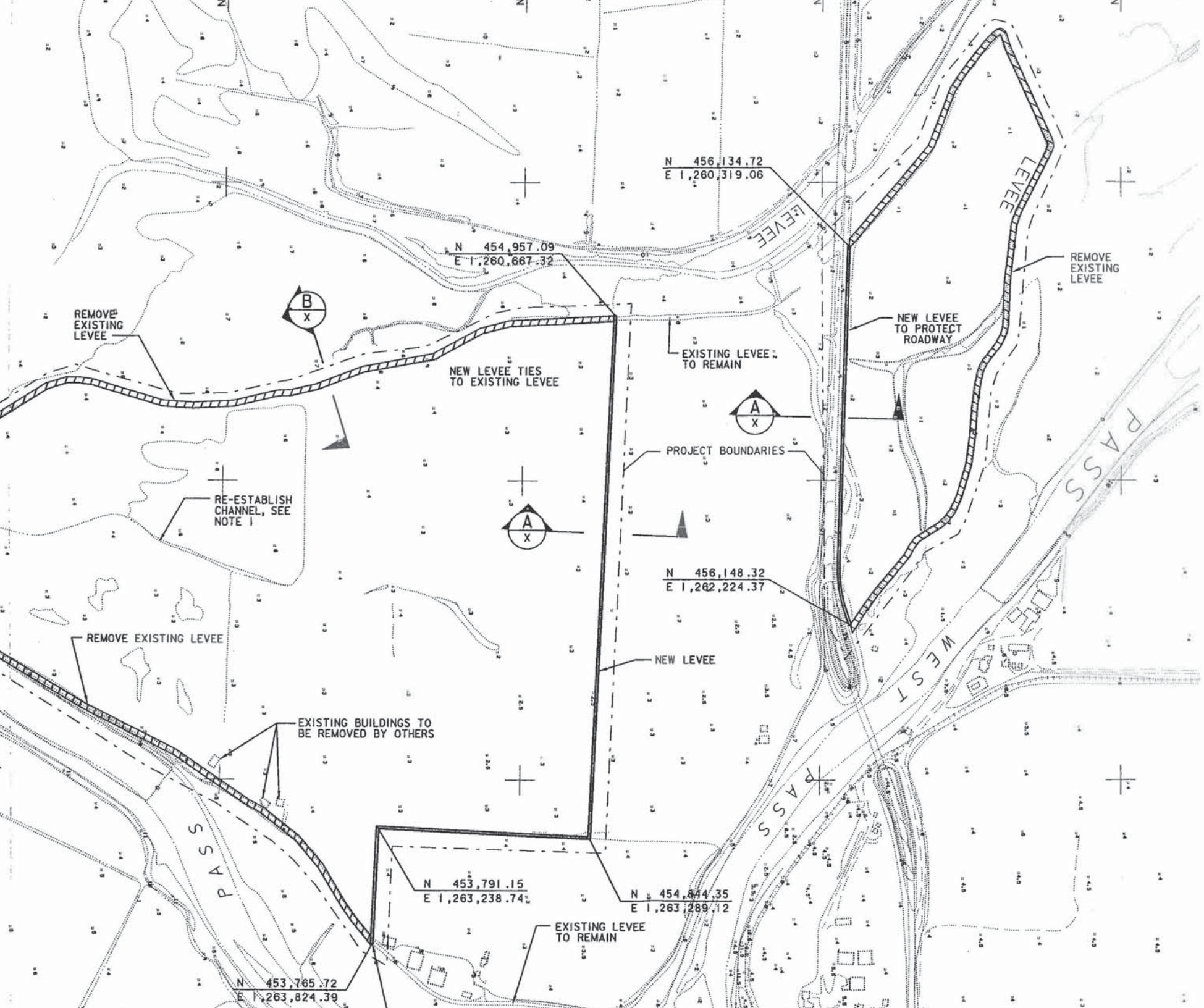
- Alternative 3: The preferred alternative. Restore a portion of the property to tidal influence.

Recommendations and Conclusions

In Alternative 3, the sea dikes within the project area would be completely removed and the majority of the material placed in the existing borrow ditch. An existing slough would be used to help drain this area at low tide. This existing, remnant slough is cut off from Port Susan by the sea dike. The mouth of the slough would be excavated down to the elevation currently on the outside of the dike. Estuarine emergent vegetation would be planted in the area around the newly excavated mouth if the elevations were appropriate. The excavated material from the sea dike would be placed in surrounding borrow ditches that were used to construct the original dikes. A new cross levee would be constructed from imported material. This cross levee could be placed just about anywhere on the property to divide the tidally influenced area from the uplands. For discussion purposes only, the enclosed figure shows a cross levee dividing the property on a two-thirds tidal and one third uplands share. If this alternative is selected the location of the cross levee will be negotiated. On the North portion of the property, the existing dike would be removed and then rebuilt adjacent to Highway 530 to protect the highway from flooding.

Quantity and Cost Estimates

Quantity and cost estimates for this project are shown in the MCACES section of this attached engineering appendix.



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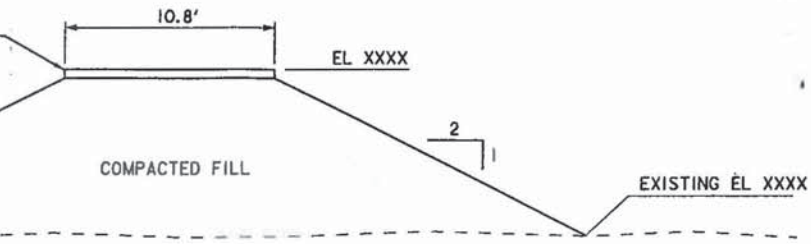

PICAL NEW LEVEE SECTION (A/X)

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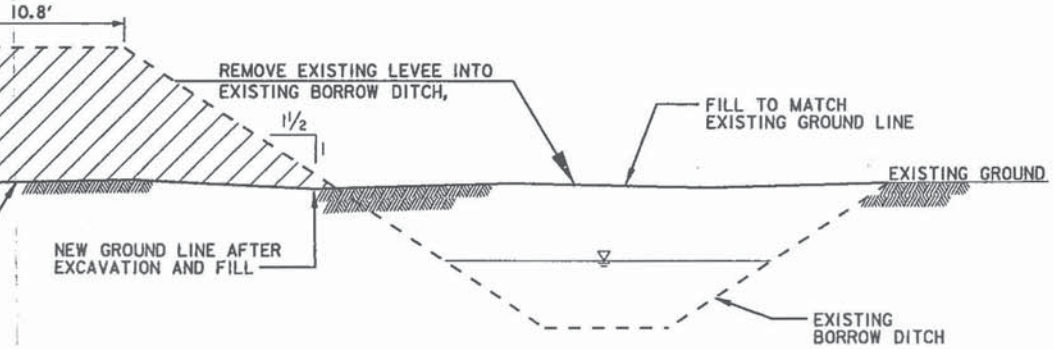
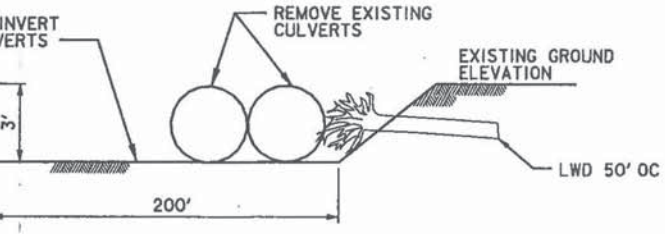
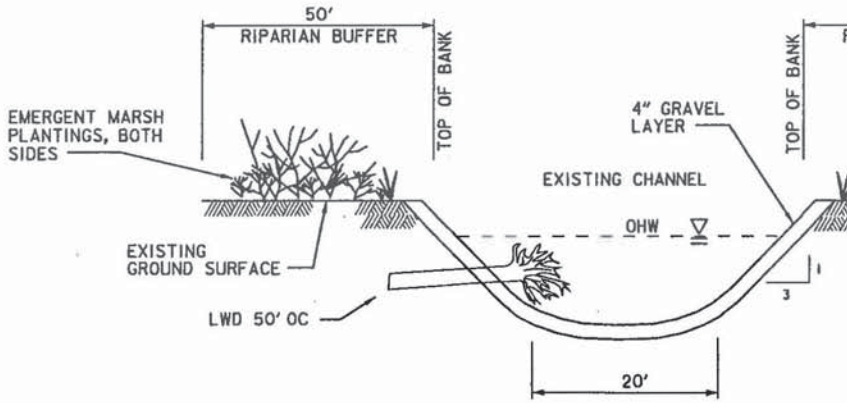


EVEE – FILL BORROW DITCH (B/X)



CHANNEL RE-ESTABLISHMENT (C/X)



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STILLAGUAMISH RIVER ECOSYSTEM RESTORATION
FEASIBILITY STUDY

PROJECT DESCRIPTION AND WRITE UP

3.0 SITE DESIGNATION: HAT SLOUGH ENTRANCE

Site Description
Township 31N, Section 1 Range 3E. The projected is located at the juncture of Port Susan Bay and Hat slough on the Right Bank. The site is currently in agricultural production and comprises of over 300 acres. A few farm buildings can be found on the property.

Project Objectives and Criteria
The purpose of the project is to restore tidal hydrology to a portion of the property. Project features include excavation of tidal channels and removal of sea dikes. Historically, this portion of the Bay was at the land water interface. At one time Port Susan Bay had extensive estuarine marshes and sloughs. Starting in the 1870's sea dikes were constructed at the marsh edges and these areas were converted to agricultural production. Sloughs in the area were also filled to make more farmable land. Over 40% of the estuary was loss during this conversion. From a fish and wildlife standpoint, this conversion had harsh consequences. The sea dikes that were constructed along the margins of the estuary interrupted the tidal flow and as a result, nutrient export from the marshes to the adjoining habitats such as mudflats was diminished. Intertidal sloughs that were once refuge areas for juvenile fish (salmon, sculpins, flounder and sole) shorebirds (dunlin, sandpiper and yellowlegs) and waterfowl (pintail, and baldpate) was lost. The continuity of the large interspersed habitats of the estuary became fragmented. This project offers an opportunity to restore on large scale, some of the former estuary. There are a few criteria besides restoring tidal inundation that need to be considered. Removal of dikes should not effect any flooding to adjacent properties. This site is also a significant haven for snow geese during the winter. The project should be developed in such a manner as to not impinge upon snow geese needs. It should be pointed out though, that snow geese are frequently found in the intertidal habitats in Port Susan and Skagit Bay. In addition, the Nature Conservancy and US Fish and Wildlife are attempting to purchase the property. This has currently not occurred. This proposal should be sympathetic to the current property negotiations.

Alternatives
Several alternatives were considered for this project. They include:

- Alternative 1: No Action. This would not achieve the goal of restoring historic hydrologic conditions.

- Alternative 2: Remove all of the Sea dikes and excavate out the mouths of remnant tidal sloughs. Material from the sea dikes would be placed in adjacent borrow pits so

as not to impede the hydrologic process. Certainly from a restoration standpoint this is a viable option but it does not consider all of the resource and social needs that may need to occur on this property. Since the property has not changed hands his option would negate the opportunity to farm the parcel. It also does not consider leaving some of the area in upland so it could be planted for snow geese and other waterfowl.

- Alternative 3: The preferred alternative. This alternative would restore a portion of the property to tidal influence by breaching sea dikes.

Recommendations and Conclusions

In Alternative 3, the sea dikes would be breached in up to seven locations on the southern and western portion of the property (Hat slough and Port Susan side). The breaches would occur where remnant or existing channels were located. The breaches would be approximately 50 ft. Wide and new channels would be excavated about 400 feet to allow for new channel formation The excavated material would be placed in surrounding borrow ditches that were used to construct the original dikes. The new channels would have an adjacent bench constructed next to them and planted with emergent vegetation. A new cross levee would be constructed from imported material. This cross levee could be to divide the tidally influenced area from the uplands. The enclosed figure shows a cross levee dividing the property on a two-thirds tidal and one third uplands share but this is for discussion purposes only. If this alternative is selected the location of the cross levee will be negotiated. Prior to construction an analysis on the potential scour and deposition effects need to be done on the entrance sites to insure they will perform with a minimum of maintenance.

Quantity and Cost Estimates

Quantity and cost estimates for this project are shown in the MCACES section of this attached engineering appendix.


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NEW LEVEE CONNECTS
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TO EXISTING LEVEE
N 443,884.00
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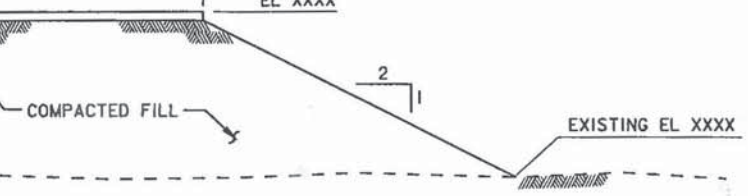
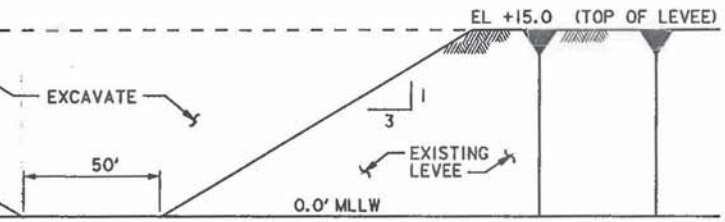


W LEVEE SECTION (A / X)



ACH LEVEE (B / X)
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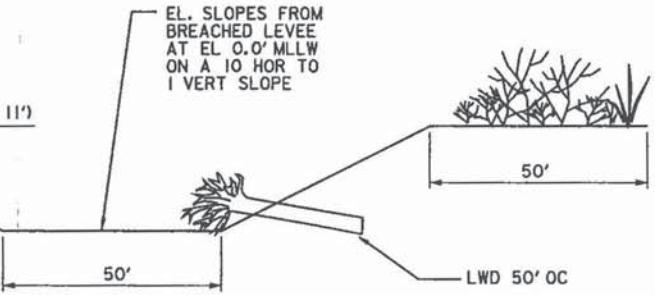

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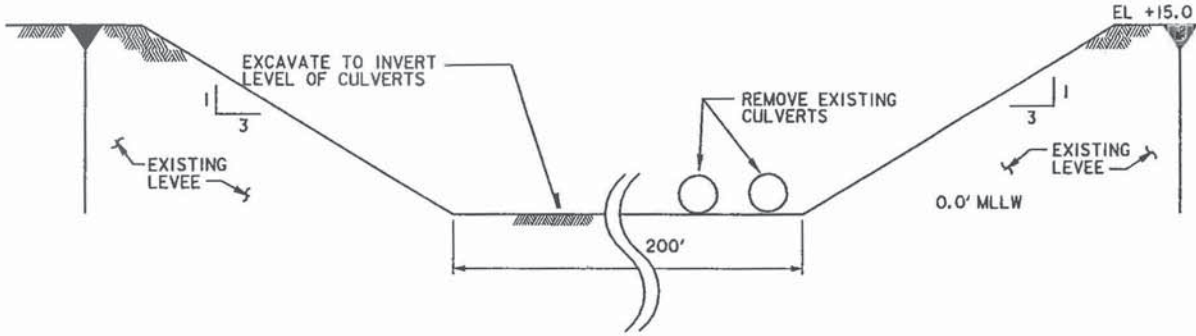

CULVERT REMOVAL (D / X)
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PROJECT DESCRIPTION AND WRITE UP

5.0 SITE DESIGNATION: CONFLUENCE SITE

Site Description

The confluence site, shown in Figures 2 and 3, is located on Koch Slough downstream of the Larson Road crossing (Bridge 101) and upstream of the Burlington Northern Railroad and the Stillaguamish River/Koch Slough confluence. A large gravel bar, approximately 200 feet wide and 800 feet long, is located in the right half of the channel. The absence of side channels at the project site is characteristic of the entire lower Stillaguamish River. During summer and fall, a side channel is exposed along the right side of the gravel bar. However, flow in this side channel is insufficient for fish passage and rearing during dry periods. Fish species of interest include coho and chinook salmon. A steady volume of cool, oxygenated flow is lacking during summer months. Good riparian vegetation, including a stand of mature cottonwoods, is found in the right overbank area, a historic highwater bypass. Adjacent to this wooded area is a contiguous strip of blackberry and scrub approximately 15 feet wide and 1,100 feet long. Beyond the scrub to the east is agricultural farmland, under private ownership. Access to the site is from a dirt road leading north onto the farmland property from Larson Road to the scrub area, located immediately east of the bridge crossing over Koch Slough. The land along the west overbank is also under private ownership and is an active gravel mining operation. There are no existing federal projects in the immediate vicinity of the site.

Project Objectives and Criteria

The project objectives for this site include adding complexity to the reach and providing approximately 1,100 feet of off-channel fish access and seasonal rearing habitat in Koch Slough just upstream of its confluence with the Stillaguamish River. Cool, oxygenated flow is sought in the proposed side channel. The fish species of interest include coho and chinook. The project design must also minimize fish stranding. No spawning is directly sought at the project site.

In addition to these ecological considerations, the recommended measures should not cause the Koch Slough channel to shift from its current location. Flooding risks to adjacent properties should not be increased from those posed under existing conditions. Project designs should largely maintain existing channel hydraulics and mitigate potential undercutting of the right bank within the project reach.

Alternatives

Three alternatives were proposed by the Corps and Stillaguamish Tribe representatives during the initial field visit with HDR on September 1, 1999. These alternatives include:

- Alternative 1: Construct an engineered bar apex log jam
- Alternative 2: Excavate a side channel in the wooded right overbank area and connect to the main channel both upstream and downstream of the existing gravel bar;
- Alternative 3: Excavate a side channel in the wooded right overbank area and establish a downstream connection with the main channel. Subsequent to the field visit, the construction of a rock groin at the head of the gravel bar was proposed as a fourth alternative by HDR.
- Alternative 4: The preferred alternative combines two of the proposed alternatives and includes construction of a Bar Apex Jam (BAJ), combined with a system of six bank jams, and the excavation of a side channel within the wooded overbank area that makes a downstream connection with the Stillaguamish River (see Conclusions and Recommendations).

Bar Apex Jam and Bank Jam Construction

Engineered log jams (ELJs) are constructed to imitate naturally occurring jams and to promote establishment of the desirable physical and ecological conditions that they commonly induce. However, in contrast to naturally occurring jams, the placement and structure of ELJs is based on a rigorous engineering analysis of jam stability, channel hydraulics and flooding potential.

Abbe et al. (1996) in studies of the Queets River in Washington classify naturally occurring jams into three groups: Bar Apex Jams (BAJs), Bar Meander Jams (MJs) and Bar Top Jams. Bar apex jams initiate the development of an arcuate bar directly and a crescentic pool upstream of the jam. BAJs create a flow separation around the structure, initiating the development of side channels. ELJs are also relatively flexible structures in comparison to other structural flow diversion measures. ELJs have the ability to settle into areas of scour and undercutting while maintaining their structural integrity (Abbe 1997). A total of 8 ELJs, including 1 BAJ, have been constructed on the North Fork of the Stillaguamish River upstream of Oso.

This alternative calls for the construction of a BAJ at the head of the existing gravel bar shown in Figures 2 and 3. The proposed BAJ would be placed to promote increased flow into the existing low velocity channel along the right bank. This 1,100 to 1,200-foot side channel would provide summer rearing habitat. Both the side channel and gravel bar would be submerged during winter and spring. Bank jams would also be constructed at six locations along the side channel and main channel to protect the existing bank and to provide additional cover and complexity. Holding pools would naturally be created underneath the exposed rootwads at the head and along the sides of the BAJ and bank jams.

Risk management issues must be addressed in the design of this alternative including: the stability of the apex jam in high flows, its potential impacts on channel migration, and the potential for backwater effects and increased flooding upstream. It was noted that a significant fluctuation in flows is experienced within the project reach during the year (HDR, 1999).

Excavated Side Channel with Upstream and Downstream Connections
The second proposed alternative excavates a side-channel parallel to Koch Slough in the vicinity of the historic high-water bypass. The upstream connection of the side channel would occur just downstream of the Larson Road (Bridge 101) crossing. The channel, approximately 8 feet deep and 32 feet wide, would continue for approximately 1,200 feet along a downward slope, reconnecting with the slough just upstream of its confluence with the Stillaguamish River. Flows of 15-20 cfs are sought. The side channel would function primarily as a winter and spring refuge and rearing habitat for coho and chinook. There is an established canopy of mature cottonwoods along this proposed route. However, supplemental plantings would be needed along the slopes of the excavated channel. LWD could also be placed at 50-foot intervals to supplement natural wood recruitment to the side channel.

Excavated Side Channel with Downstream Connection
The excavated channel proposed under this alternative would run parallel to Koch Slough through the wooded right overbank area from approximately the middle of the existing gravel bar to just upstream of the confluence. The channel would be approximately 500 feet long and 70 feet wide. It would be excavated to a depth of approximately 10 feet until a connection with groundwater is made to provide adequate flows of 3-5 cfs.

This excavated side channel would provide winter and spring refuge and rearing habitat. It will be inundated during portions of the winter or spring where flows overtop the main channel. These intermittent overbank flows will cause channel sedimentation over time. Since there is an established canopy of mature cottonwoods along this proposed route, supplemental plantings would be needed only along the slopes of the excavated channel. LWD could also be placed at 50-foot intervals to supplement natural wood recruitment to the side channel.

Buried Rock Groin
This alternative entails construction of a buried rock groin with a diversion weir at the head of the gravel bar. The groin will be designed to create sufficient flows (3-6 cfs) for summer rearing in the side channel. The groin would be buried beneath the channel bed, spanning from the head of the gravel bar into the right bank, and provide a grade control to resist scour during high flow events. It would be constructed to also prevent attack and retreat of the right bank.

Discussion of Alternatives
A preference for selecting a low maintenance, low risk alternative was articulated by Corps field representatives. Summer rearing habitat was noted to be preferred over winter rearing and refuge by the project team.

Although there are potential risks associated with Bar Apex Jam construction, this course of action has the potential advantages of significantly enhancing channel diversity and complexity while providing the preferred summer habitat. The rock groin alternative, while expected to increase side channel flows to a level adequate for summer rearing, provides no other habitat enhancement.

The two alternatives which call for side channel excavation in the right overbank area, provide winter and spring habitat, which is of lower preference than summer habitat at this site. Disadvantages associated with side channel excavation include the required removal of existing mature cottonwoods, causing ground disturbance and exposure, and disposal of large volumes of earth.

The feasibility of making an upstream side channel connection with the Stillaguamish and controlling the diversion within the desired range of flows is uncertain. A structural control at the point of diversion may be needed to maintain the desired range of flows. Concerns were raised that a side channel with both upstream and downstream connections might pose an additional risk of flooding to adjacent croplands, and potentially promote migration or avulsion of the main channel.

Recommendations and Conclusions

The recommended restoration plan combines two of the proposed alternatives and includes construction of a Bar Apex Jam (BAJ), combined with a system of six bank jams, and the excavation of a side channel within the wooded overbank area that makes a downstream connection with the Stillaguamish River. The excavated side channel, combined with plantings on its slopes and LWD placement along the channel bottom, will provide winter and spring habitat for anadromous fish. The ELJ system will create summer habitat. Plan and sectional views of this alternative are provided in the attached figures.

The ELJ system will be designed to increase summer flows in the existing stagnant side channel to levels adequate for summer anadromous fish habitat. The system will provide a complex summer habitat with pools and cover, without stranding fish. Detailed hydrologic, hydraulic and structural analysis during final design will be required to allow the development of designs that address the potential risks of bank deterioration, channel avulsion and increased flooding in the vicinity of the project site. Abbe (1997) notes that existing ELJ's installed on the North Fork of the Stillaguamish River have enhanced physical habitat, remained stable in high flows, and effectively redirected channel flows without adversely impacting local flooding potential.

The exact placement and dimensions of the BAJ and bank jams for this project cannot be specified until the detailed hydraulic, hydrologic and structural analysis is completed. The performance and associated impacts of the ELJ system should be assessed under a wide range of flows. Analyses should be conducted assuming the growth of the jams over time as LWD is recruited and becomes a part of the jams during future flood flows. Prior to project construction a complete geomorphic analysis of the site will be done to

determine the historical movement of material and channels in the confluence area and to determine the probable effect of the proposed construction.

Based on existing ELJ construction, the proposed BAJ configuration would include 6 key members with stem lengths greater than 40 feet and a basal diameter of at least 48 inches, and over 60 stacked and racked members with a minimum diameter of 22 inches. All members should be constructed with spruce, western red cedar, hemlock, or fir. If 48 inch basal diameter wood cannot be found, then pieces as close to this dimension as possible should be used and the design may require more key members of a smaller diameter. The ELJ side jams would consist of 3 key members and up to 30 stacked pieces and racked members per jam. The top of the jams should be filled with soil and planted with cottonwood and willow to further enhance structural stability and enhance riparian habitat.

A complete h&h and geomorphological analysis will be complete prior to project construction. One of the aspects that needs to be investigated is the effect on the new channel of dewatering the existing channel during low flow. Also we need to investigate the effects of flows on the side channel to see if there will be any erosion effects on its entrance and if it will require any undue maintenance after construction.

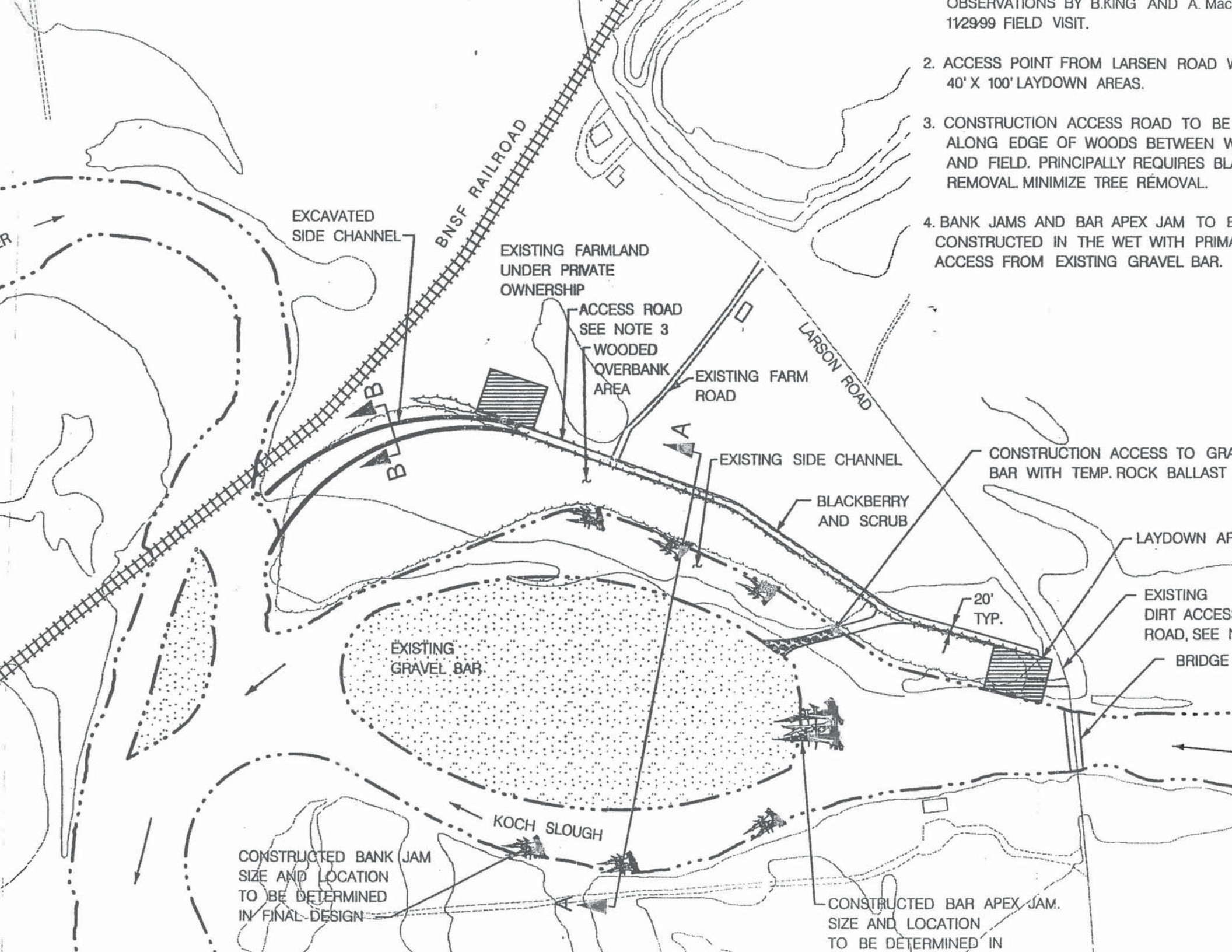
Site Access and Construction Approach

Temporary and permanent access to the site can be obtained via the dirt road turnout off of Larson Road at the upstream end of the site. A temporary access road to the side channel excavation area can be created by removing the layer of blackberries that runs along the wooded right overbank and extending the existing turnout. It is recommended that two 4,000 square foot construction laydown areas be established. An additional access route will branch from the Larson Road access, down the bank and across the stagnant side channel to the gravel bar. The gravel bar will provide an additional laydown area.

Construction should occur during summer low flow months during non-migration periods for fish. ELJ construction will occur in the wet, with primary access being from the gravel bar. Construction activities will need to be coordinated with fisheries agencies and tribal representatives to determine the most desirable timing. Excavated material will be placed over key and stacked members of the BAJ to enhance its structural stability. Any excess excavated material will be disposed offsite and sent to an approved landfill.

Quantity and Cost Estimates

Quantity and cost estimates for this project are shown in the MCACES section of this attached engineering appendix.


OBSERVATIONS BY B.KING AND A. Mac
11/29/99 FIELD VISIT.
2. ACCESS POINT FROM LARSEN ROAD W
40' X 100' LAYDOWN AREAS.
3. CONSTRUCTION ACCESS ROAD TO BE
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4. BANK JAMS AND BAR APEX JAM TO B
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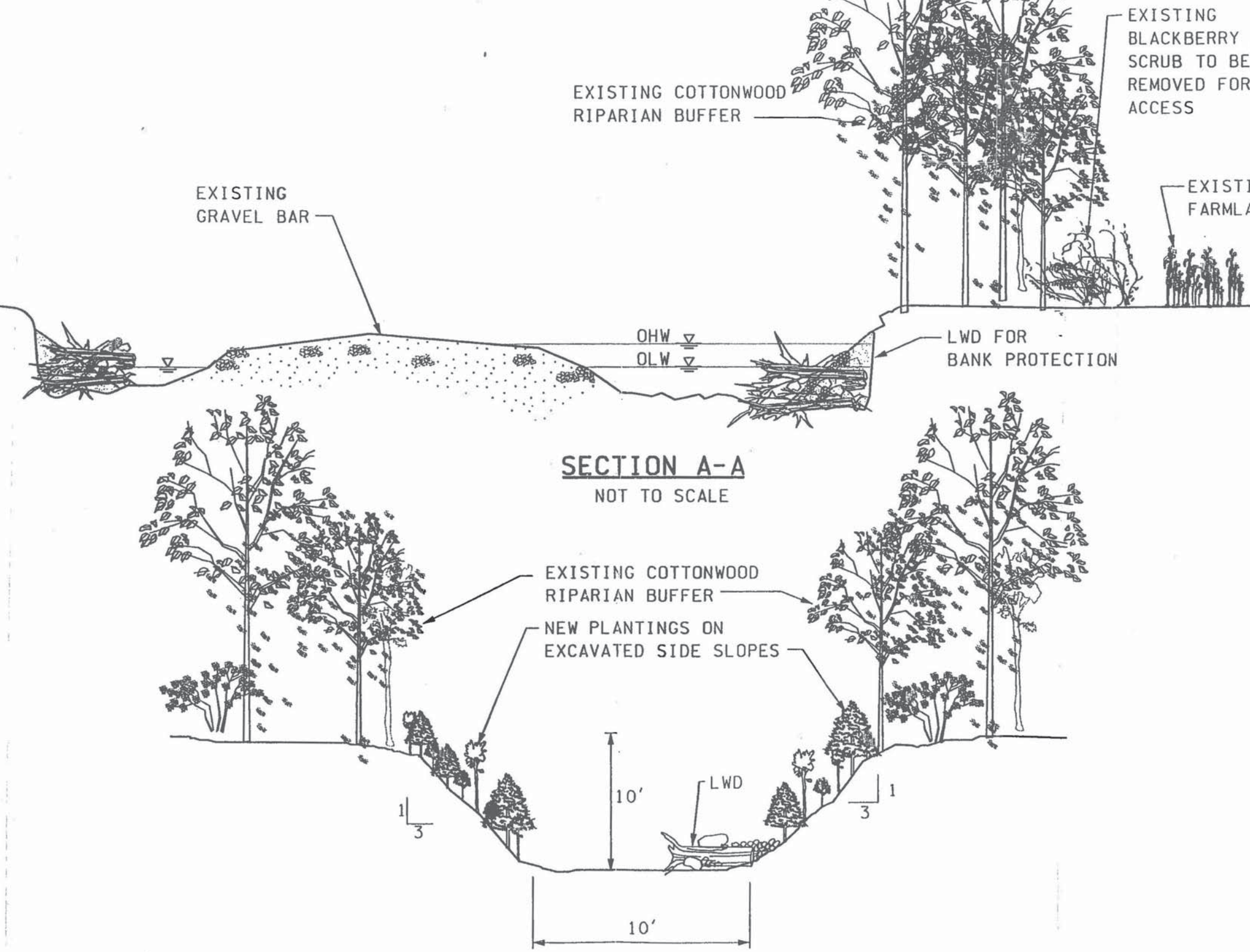
SIZE AND LOCATION
TO BE DETERMINED IN



SECTION A-A

NOT TO SCALE

STILLAGUAMISH RIVER ECOSYSTEM RESTORATION
FEASIBILITY STUDY

PROJECT DESCRIPTION AND WRITE UP

6.0 SITE DESIGNATION: NORTH MEANDER SITE

Site Description

The project site is located on an old meander channel north of Koch Slough. The total length of the old meander channel is approximately 4000 feet. The entire length of this meander channel was cut off in 1936 - 1937 as part of a Work Project Administration, flood control project whose purpose was to increase flood flows down the Koch Slough, see the attached figure. The major components of this project included the Stillaguamish Weir, straightening out of the channel, and elimination of the flow through the north and south meanders

The North Meander is completely cut off from the river and provides some wildlife benefits but no fish benefits. The old channel has water in it during the high river flow period of the year and is probably connected by groundwater to the river. On the down stream end of the old meander, there are indications that the slough has downcut 8 to 10 feet below the bed of the old meander channel. This downcutting is a result of the increased velocity and reduced length of the new channel on Koch Slough.

Project Objectives and Criteria

The primary project objective at this site is to provide significant off main river refuge from high winter flows and year-round off river fish habitat.

Alternatives

Three Alternatives were proposed:

- Alternative 1: No Action.

- Alternative 2: Connection to Old Stillaguamish River Channel
  This alternative would require the construction of a channel from the existing meander channel to the Old Stillaguamish River Channel. The channel bottom and a ground water intercept pond would be based on piezometric studies conducted during PED studies. Current designs are based on water surface calculations - surveys conducted by Snohomish County.

- Alternative 3: Connection to Koch Slough Channel
  This alternative would connect the existing meander channel back to the Koch Slough Channel and provide the maximum amount of fish habitat. However, based on current surveys, it would require the excavation of a significant amount of material and the destruction of some riparian growth along the old meander scar. It was assumed that because of the downcutting of Koch Slough we could use the difference

in river elevations between the Stillaguamish River channel and the Koch Slough Channel to get a flow of water through the old modified river channel all year. Surveys of river elevations by Snohomish County showed very little elevation difference between the Stillaguamish River and Koch Slough. During PED studies additional survey and groundwater studies would be conducted to determine the feasibility of this alternative.

Under both alternatives one and two, a ground water source of water would have to feed into the pond shown on the drawings and then into a channel that fed into either the Stillaguamish Channel of Koch Slough. If a ground water source cannot be found other alternatives including providing a piped source of water from upstream of the existing Koch slough weir should be investigated.

Based on current surveys, connecting the North Meander channel to the Stillaguamish will require far less excavation and expense than connecting the existing channel to Koch Slough. However, the Koch slough alternative has significantly more off stream habitat than the Old Stillaguamish Channel alternative.

Recommendations and Conclusions

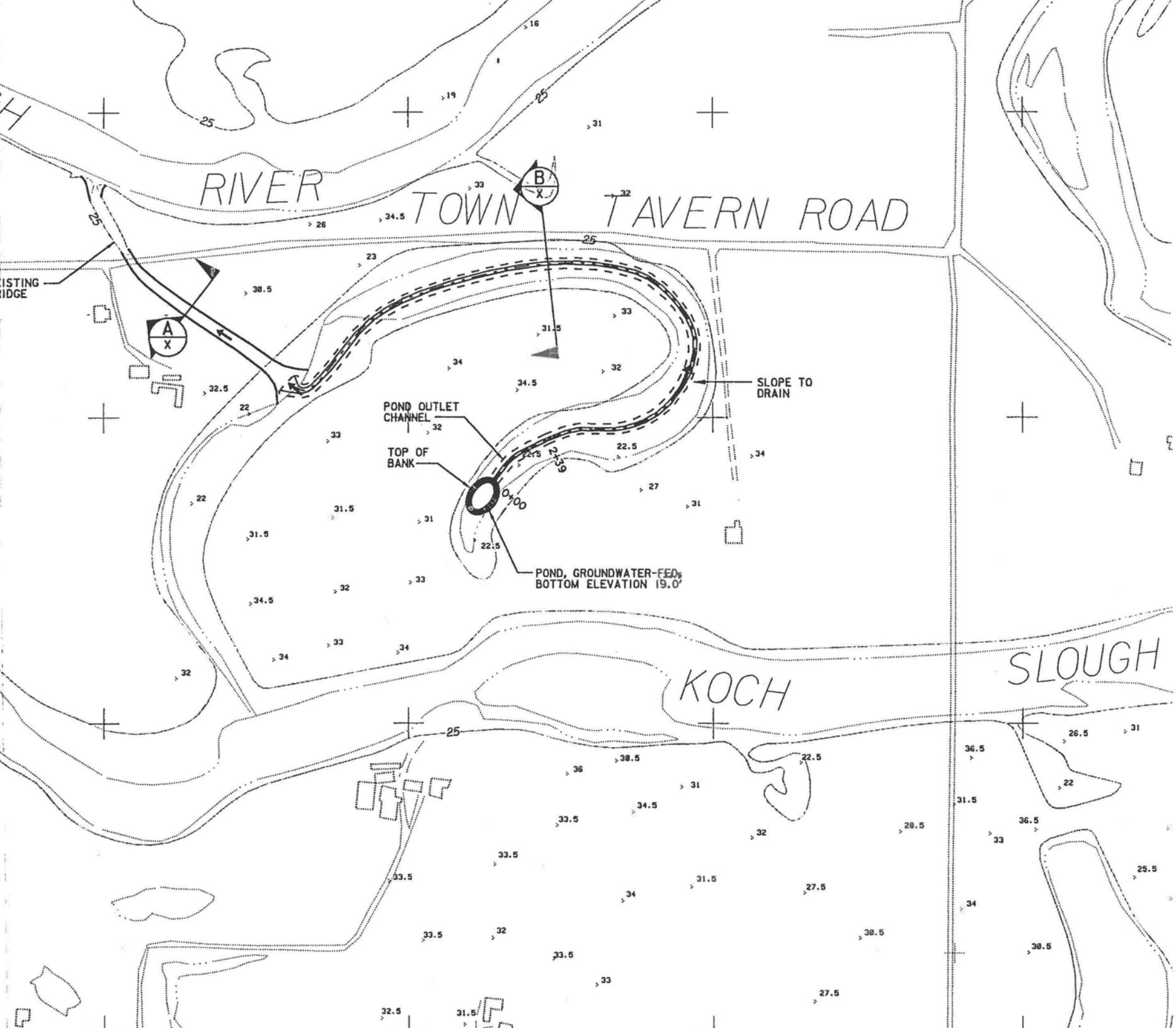
We recommend alternative 3, connecting the old North Meander channel to Koch Slough. Additional piezometric and survey studies should be conducted during pre-construction to confirm this recommendation. An h&h analysis of the flow characteristics of the proposed channel especially under flood conditions and a geotec analysis must be completed prior to construction. There is an existing piezometer at this site; this data as well as possible additional data will be used to size and locate the pond and other project features.

The site would be accessed by existing county roads and an additional permanent access would be required. Also, a 1 acre staging area would be required for construction. Access should be planned to minimize impact. Based on visual observation, no utility or facility relocations will be needed to implement these recommendations. Any impact to riparian areas caused by project construction and access would be mitigated.

In River work would be scheduled for the summer months during a non-migration period. Excavated and scrap material should be disposed offsite at a location determined by the county.

Quantity and Cost Estimates

Quantity and cost estimates for this project are shown in the MCACES section of this attached engineering appendix.



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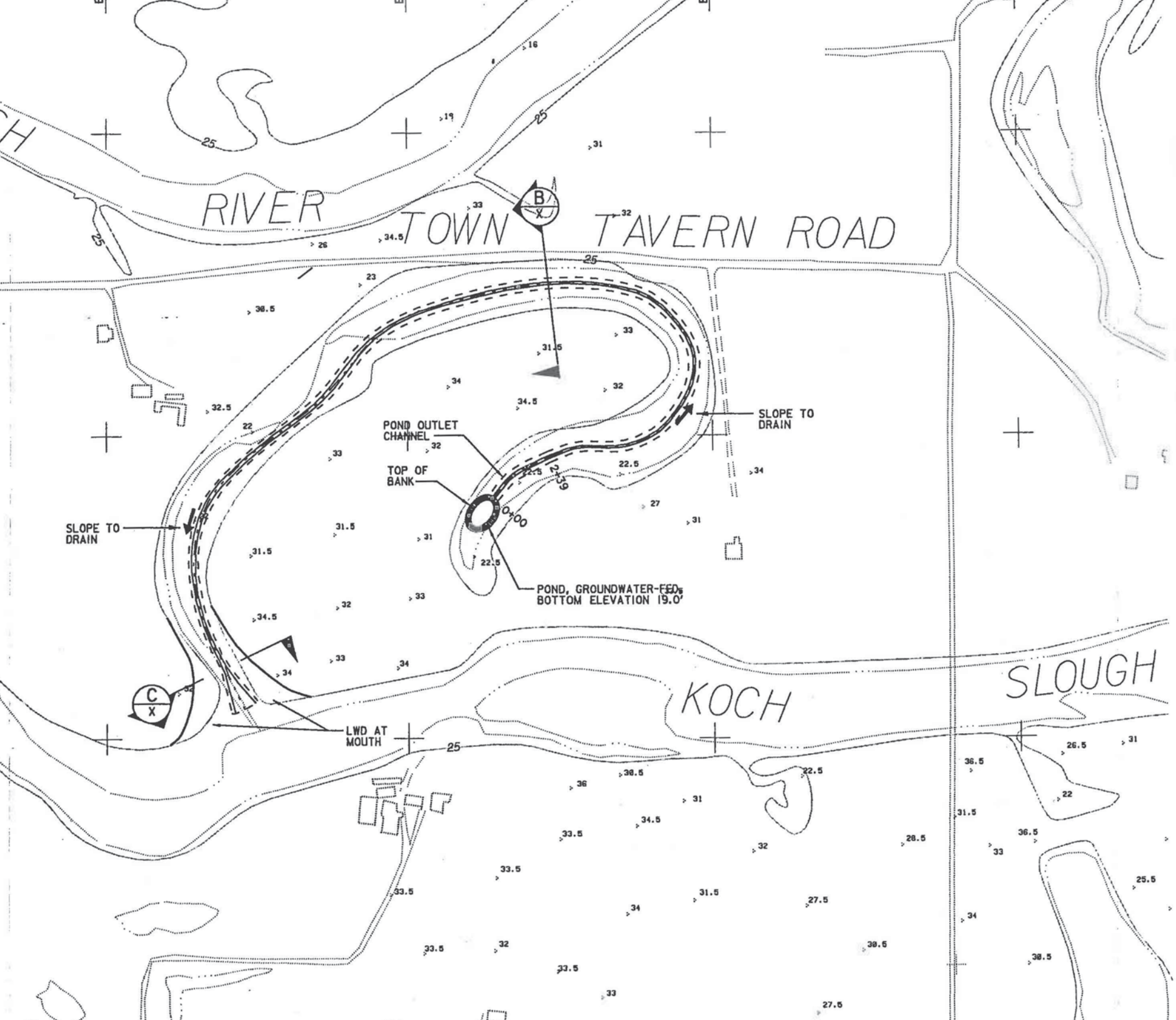

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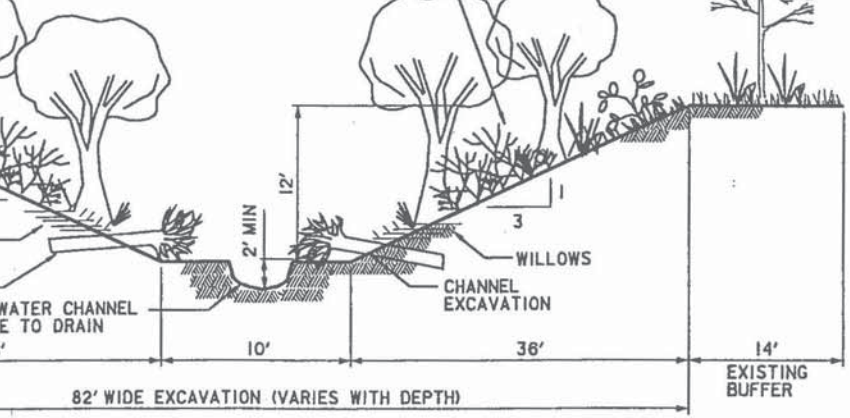

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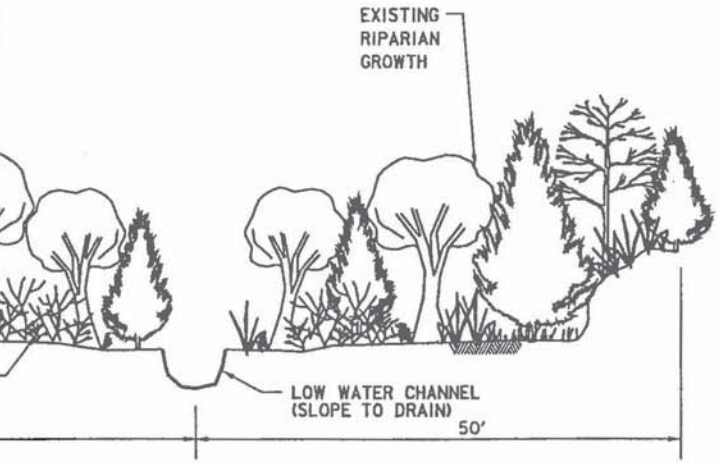

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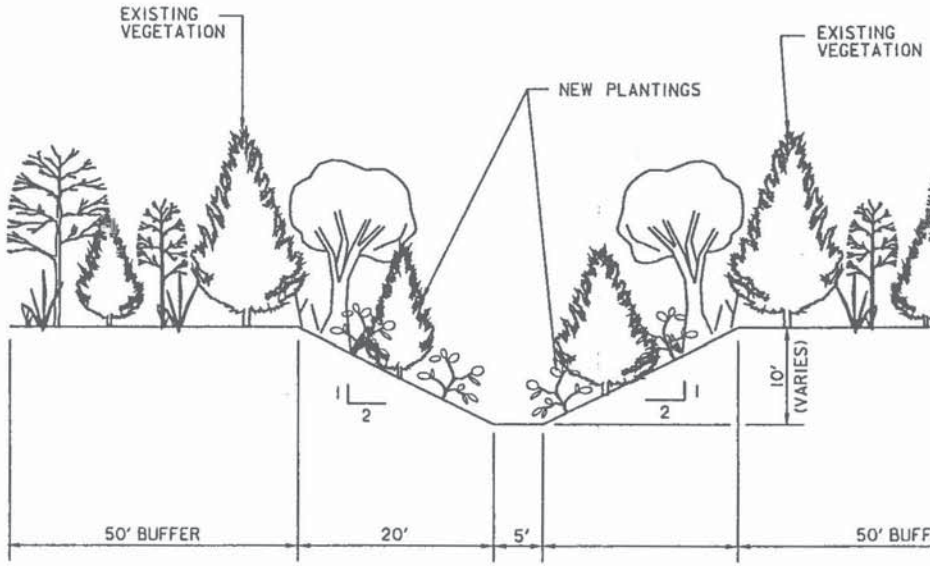

NEW EXIT CHANNEL FOR ALTERNATIVE 2

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7.0 SITE DESIGNATION: SOUTH MEANDER CHANNEL (THOMPSON SLOUGH)

Site Description
The project site is located on an old meander channel of Koch Slough on its south side. The total length of the channel is approximately 4000 feet. The entire length was cut off in 1936 - 1937 as part of a Work Project Administration, flood control project to increase flood flows down the Koch Slough (see figure). The major components of this project included the Stillaguamish Weir, straightening out the channel, and eliminating flow through the north and south meanders

The South Meander is completely cut off from the river, providing some wildlife benefits but no fish benefits. The old channel has water in it during the high river flow period of the year and is probably connected by groundwater to the river. On the upstream end of the channel there is an all season pond connected by ground water to Koch Slough. On the Koch Slough end of the channel there are indications that the slough has downcut 8 to 10 feet from its historic bed elevation; this downcutting resulted from increased velocity and reduced length of the new channel due to channel modification in the 1930s.

Project Objectives and Criteria:
The primary project objective is to provide both summer and winter rearing and refuge fish habitat. A secondary benefit is improved wildlife habitat.

Alternatives
- Alternative 1: No Action

- Alternative 2: Connection to Koch Slough
  This alternative would require the construction of a deep channel from the existing meander channel to the Koch Slough at both its upstream and downstream ends. The channel bottom would be based on piezometric and survey studies conducted during PED. Current designs are based on water surface calculations conducted by Snohomish County. This alternative would require significant excavation, which would destroy some of the existing riparian buffer.

- Alternative 3: Connection to Portage Creek
  A second alternative is to connect the existing meander channel to Thompson Slough and Portage Creek. This alternative would require much less excavation than the first and would connect the all season pond through Thompson Slough to Portage Creek. Several high spots would be excavated and replanted. Also, areas lacking riparian cover would be planted to enhance the project. Existing surveys indicate this project

would be feasible and water would be available for this channel -even during the low flow periods -from the all season pond. The total length of this project is about 4500 feet.

Recommendations and Conclusions

We recommend alternative 3 for implementation. Based on current surveys, connecting the South Meander Channel to Portage Creek seems most feasible; the Portage Creek connection will require far less excavation and expense and has a much better chance of success than does connection to Koch Slough.

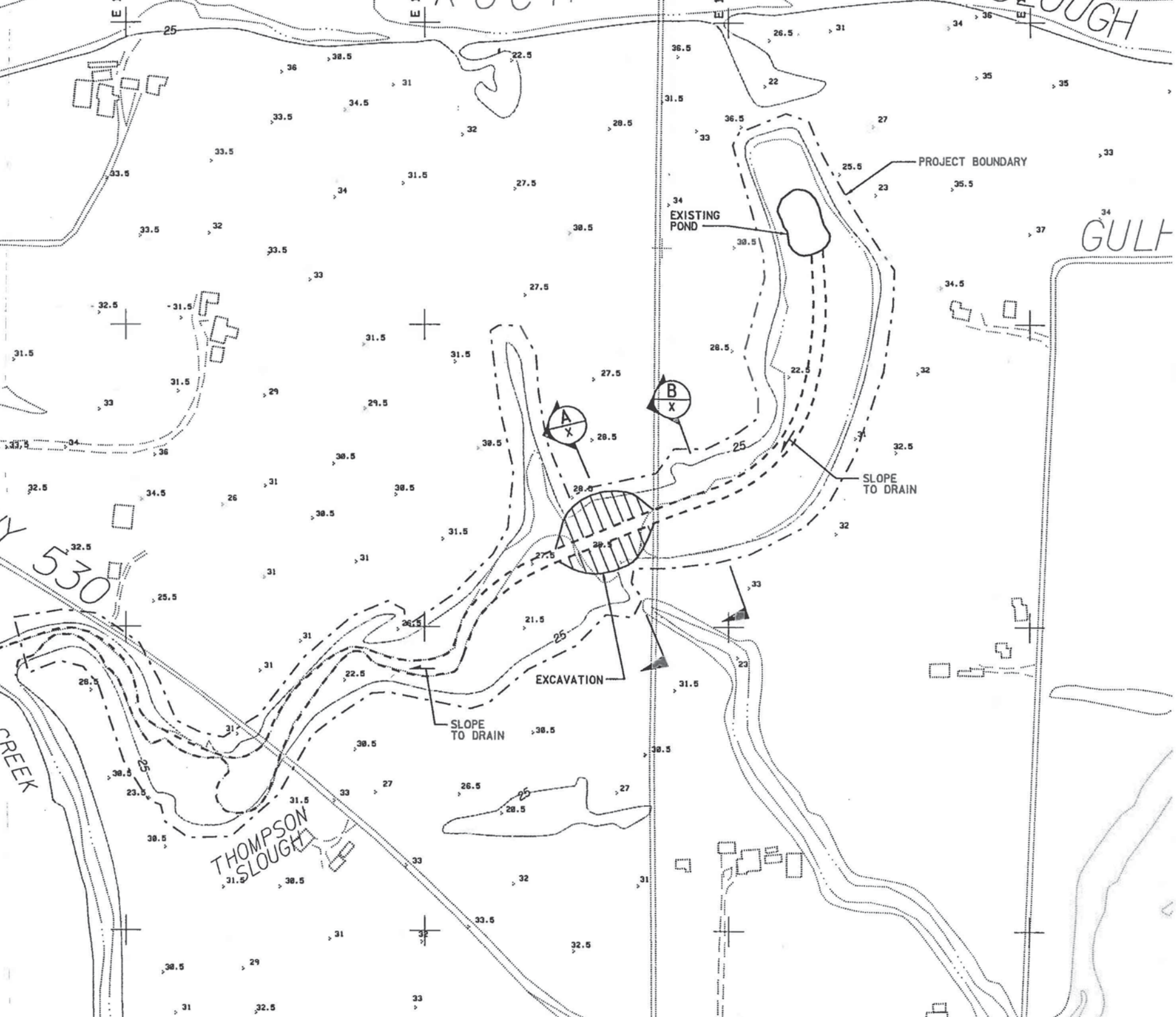
We recommend that piezometer and survey studies be conducted during pre-construction studies to confirm this recommendation. An existing piezometer has been installed at the site and this data will be used to size project features.

The site would be accessed by existing county roads and additional permanent access would be required. A 1 acre staging area would also be required for construction. Access should be planned to minimize impact. Based on visual observation, no utility or facility relocations will be needed to implement these recommendations. Any impact to riparian areas caused by project construction and access would be mitigated.

In stream work would be scheduled for the summer months during a non-migration period. Excavated and scrap material should be disposed offsite at a location determined by the county. An h&h analysis of the flow characteristics of the proposed channel especially under flood conditions, and a site specific geotec analysis, need to be done prior to construction.

Quantity and Cost Estimates

Quantity and cost estimates for this project are shown in the MCACES section of this attached engineering appendix.



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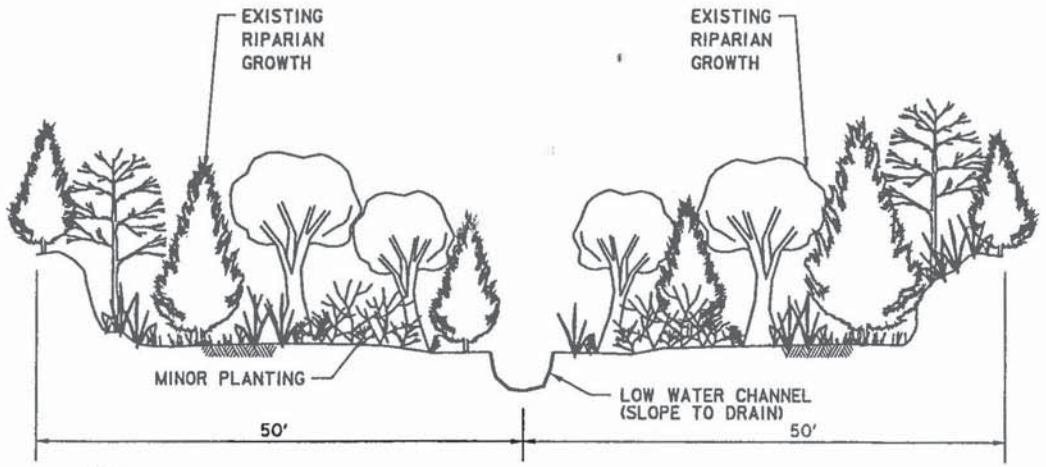

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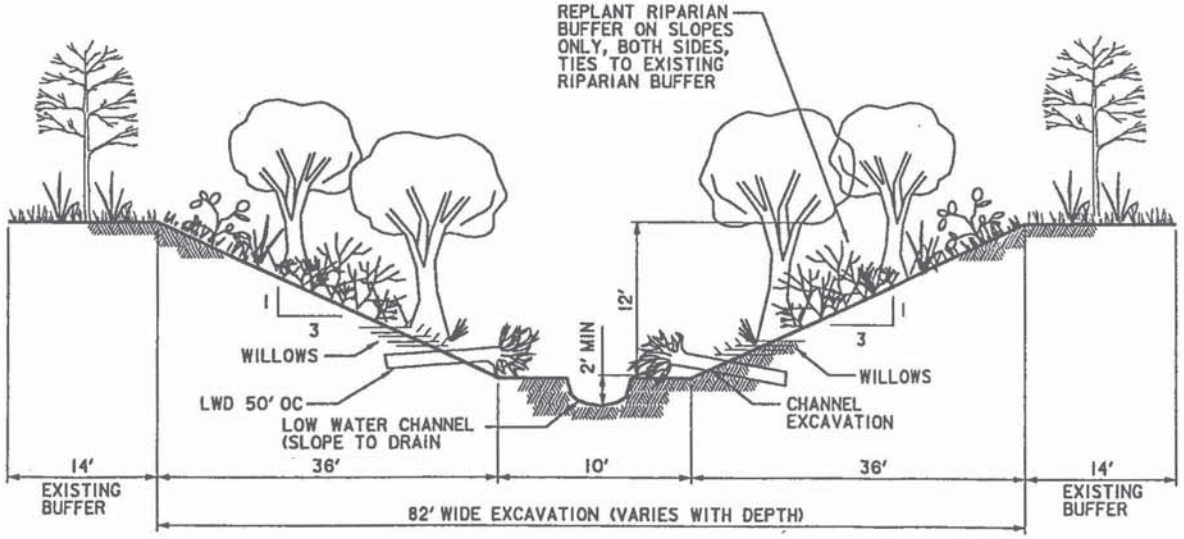

TYPICAL CHANNEL

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8.0 SITE DESIGNATION: KOCH SLOUGH WEIR SITE

Site Description

The project site is located on Koch Slough approximately 1,800 feet downstream of the Interstate 5 crossing over the Stillaguamish River. The weir is located immediately downstream from where the main stem Stillaguamish River flow forks to form Koch Slough (Figure 1)

The weir was built in 1936-1937 by the Work Project Administration. It was constructed to provide a grade control to keep adequate flows in both the Stillaguamish mainstem and Koch Slough and to reduce backwater during flood events.

The weir has been repaired and modified several times during the 1980's and 1990's in efforts to improve fish passage and maintain its structural integrity. Fish species that migrate through the project site include pink, coho, chum, sockeye and chinook salmon, steelhead, cutthroat trout, bull trout, and Dolly Varden. In 1988, the Corps created a low-flow notch in the center of the weir and constructed a fishway at the left bank side of the structure. In 1989, a low flow year, pink salmon were observed to have difficulty navigating the fishway. Modifications to enhance the performance of the existing fish ladder were made in the mid-1990's. Baffles were added and a plunge pool was created. The weir was also refurbished during this period to mitigate the impacts of scour on the structure. An existing scour hole spans approximately three quarters of the channel, extending from the right overbank (Bates, 1999).

A gravel bar is located along the right bank immediately downstream of the weir. An additional gravel bar is exposed upstream of the weir along the left bank during low flow periods. The land on both the right and left overbanks are privately owned and used for grazing and agricultural production.

Project Objectives and Criteria:

The primary project objective at this site is to provide dependable upstream fish passage for pink salmon and all upstream migrants that continue to have difficulty passing through the existing ladder during low flows. Pink salmon are currently the primary species of concern, as other species are better able to navigate the existing fish ladder in their migration upstream. No habitat modifications are sought for this site. However, fish passage velocity criteria must be met. The recommended alternative should not increase flooding.

Alternatives

- Alternative 1: No Action

- Alternative 2: Weir Removal
  This action would remove the weir completely to facilitate fish passage.

- Alternative 3: New Fishway Construction
  A new fish ladder could be constructed to improve fish passage through the weir as shown in Figure 4. We recommend the pool and chute fish ladder design developed for the project site by Ken Bates of Washington State Department of Fish and Wildlife Tribes.

Removal of the existing weir may potentially dewater the Old Stillaguamish channel and increase flooding in Koch Slough downstream. It has significant regulatory hurdles and would also be more costly than construction of a new fishway. The no action alternative does not comply with the ecological criteria established for fish passage at the project site.

Recommendations and Conclusions

Alternative 3, construction of a new fishway is recommended. This alternative utilizes Washington Department of Fish and Wildlife's pool and chute fishway design (US Army Corps of Engineers 1997). The pool and chute fishway (Bates, 1992) acts as a pool and weir fishway at low flow, when flow plunges and dissipates in each pool (Figure 5). At high flow, the fishway performs as a hybrid between a pool and weir and a roughened chute structure, creating a streaming flow condition down the center of the fishway. The fishway is designed to create a significant amount of attraction flow, and to function over a wide range of flows.

The new fishway should be keyed into the weir crest. It should be positioned near the center of the weir in the vicinity of the channel thalweg to minimize potential poaching of upstream migrating fish. Smaller steps than those shown in the drawing should be considered. Several biologists have recommended 6 inch steps. An analysis of the new fishway under high flow conditions should be done prior to construction.

Prior to construction, a hydrologic and hydraulic analysis of the fishway should be performed to insure that species-specific fish velocity criteria and flooding constraints are met. The flow split between Koch Slough and the mainstem Stillaguamish River needs to also be determined. Current estimates by the Corps are that approximately 70% of downstream flow splits off to form to Koch Slough and 30% remains in the mainstem Stillaguamish channel.

Corps representatives have indicated that there is an existing easement along the left bank of Koch Slough in the vicinity of the weir. The exact location and width of the easement needs to be verified. However, temporary access via the right overbank is preferred. The construction access and river diversion approach employed by the Corps in the mid-1990's is recommended. Access should be planned to minimize impact. The site can be accessed from the right overbank via Hevly road, across the adjacent farm property, and

from the existing gravel bar on the right overbank. Portions of the weir top would be sandbagged to provide access to the construction area. This is the same dewater method that has been used in the past. Permanent access to the site will be from the existing easement which runs along the left overbank. Based on visual observation, no utility or facility relocations will be needed to implement these recommendations. Any impact to riparian areas caused by project construction and access should be mitigated.

Construction should be scheduled for the summer months during a non-migration period. Cofferdams will need to be constructed both upstream and downstream of the weir so that construction can occur in the dry. Excavated and scrap material should be disposed offsite and sent to an approved landfill.

Quantity and Cost Estimates

Quantity and cost estimates for this project are shown in the MCACES section of this attached engineering appendix.

References

Abbe, T. B., Montgomery, D. R. and C.Petroff. "Design of Stable In-channel Wood Debris Structures for Bank protection and Habitat Restoration. An example from the Cowlitz River, WA, Proceedings of the Conference on Management Landscapes Disturbed by Channel Incision, Center for Computational Hydroscience and Engineering, University of Mississippi, May, 1997.

Abbe, T.B., Montgomery, D. R., Petroff, C. and G. Pess, Technical Summary North Fork Stillaguamish River Habitat Enhancement and Bank Protection Project, River Miles 21 to 23, Snohomish County, Washington, April 28,1997.

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Abbe, T. B., and D. R. Montgomery, "Large Woody Debris Jams, Channel Hydraulics, and Habitat Formation in Large Rivers", Regulated Rivers Research and Management, Volume 12, pp. 201–221, 1996.

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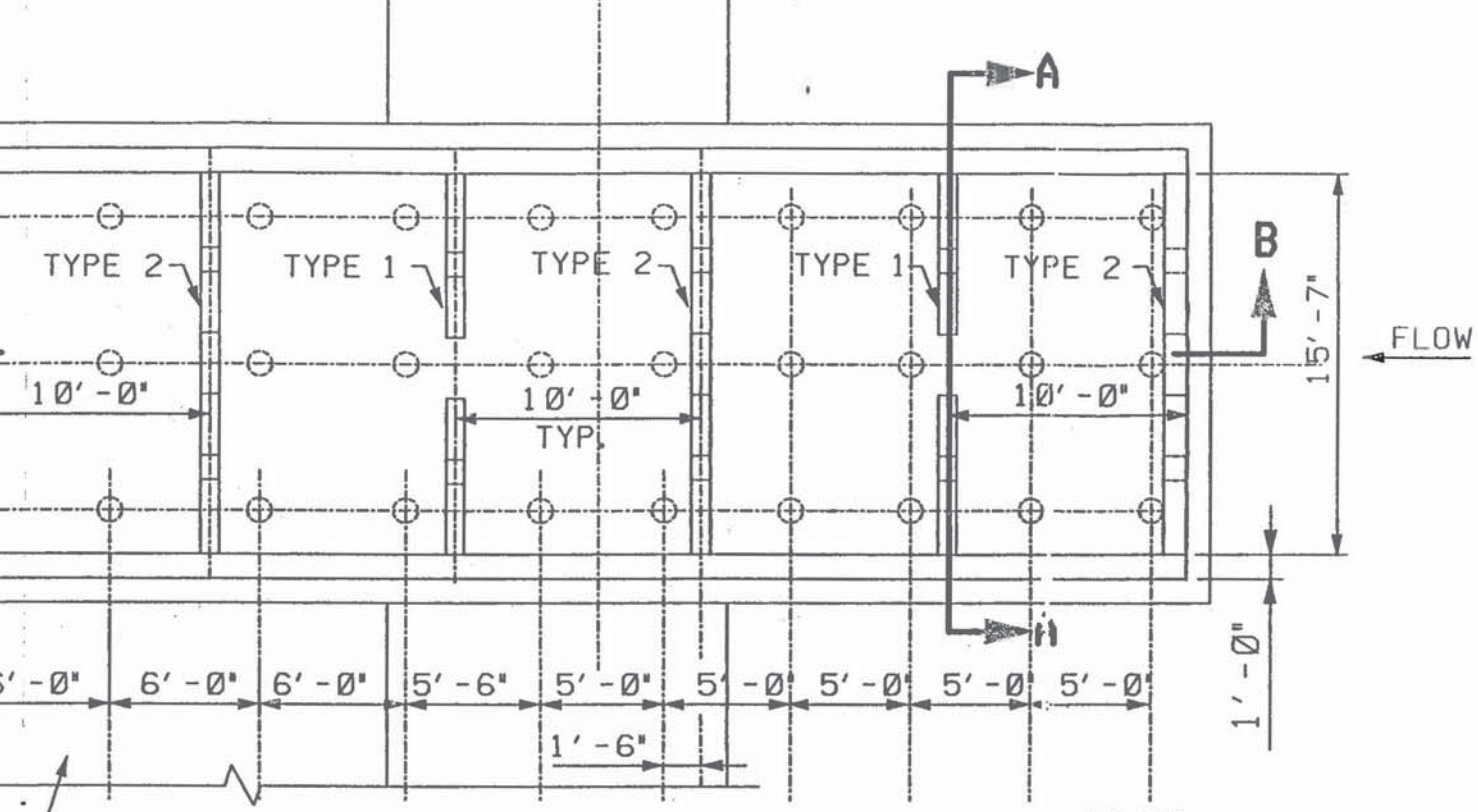
Caley, G., (Washington Department of Transportation). Personal Communication, December 1, 1999.

HDR Engineering, Inc., Stillaguamish River General Investigation Ecosystem Restoration Project Feasibility Study Report Field Note Submittal, Delivery Order No. 22, November 12, 1999.

Jacobsen, R., (Snohomish County Parks). Personal Communication, December 1, 1999.

US Army Corps of Engineers, Seattle District. Stillaguamish River Ecosystem Restoration General Investigation, December 1997.



EXISTING WEIR TO BE RESURFACED THIS SIDE.
CONCRETE FILL UNDERNEATH IF REQUIRED

PLAN
SCALE: 0" = 1'-0"

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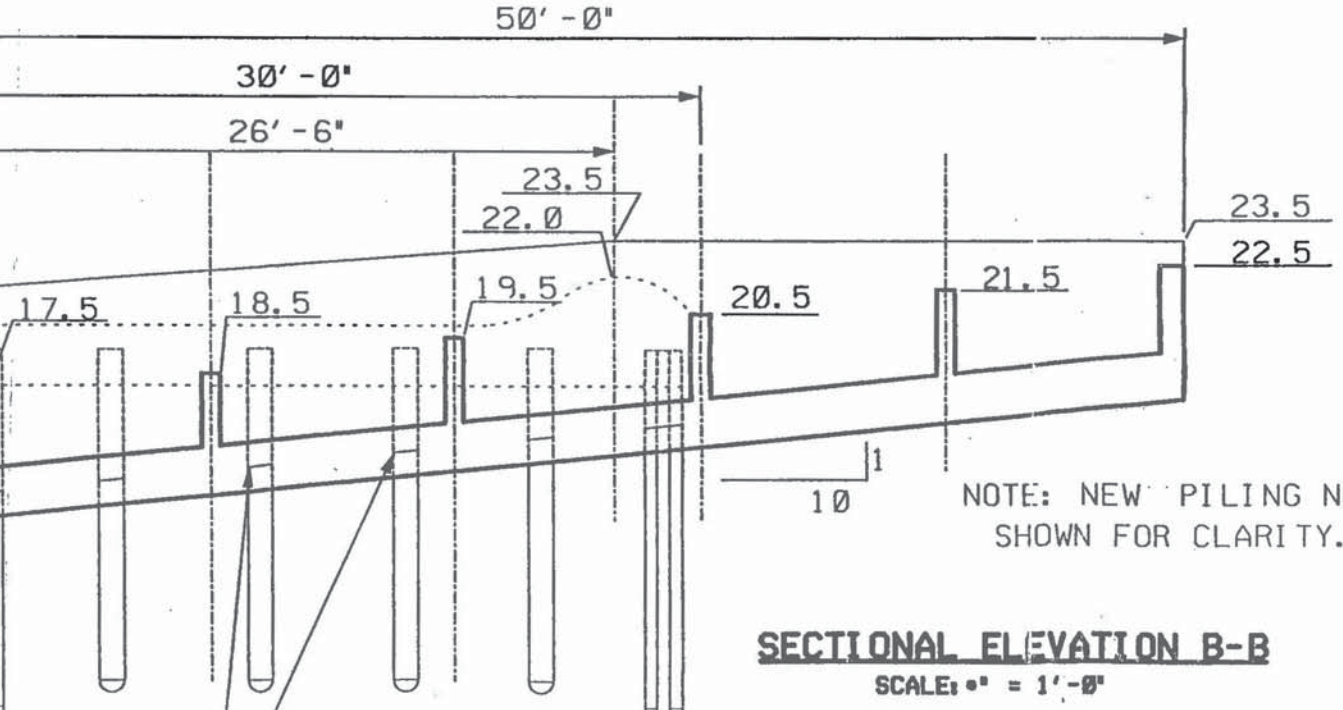

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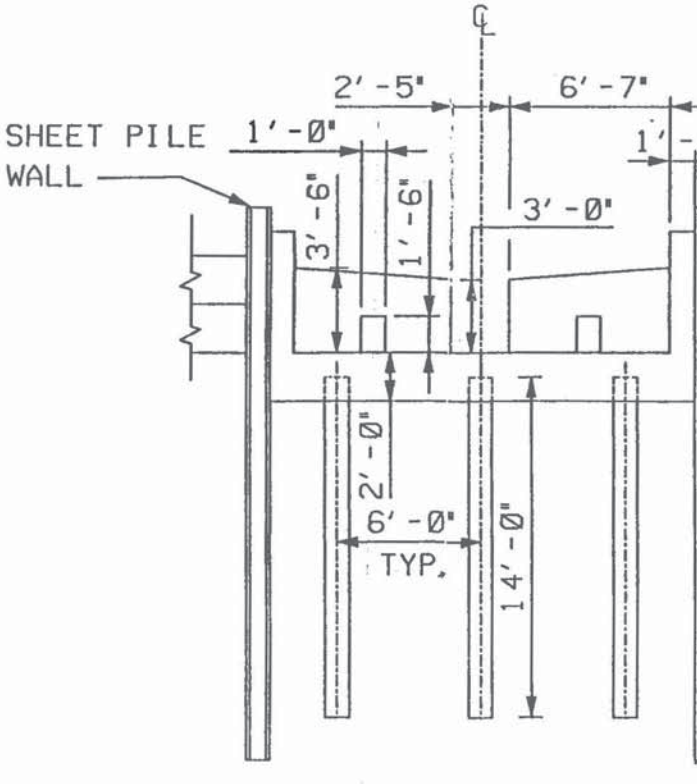

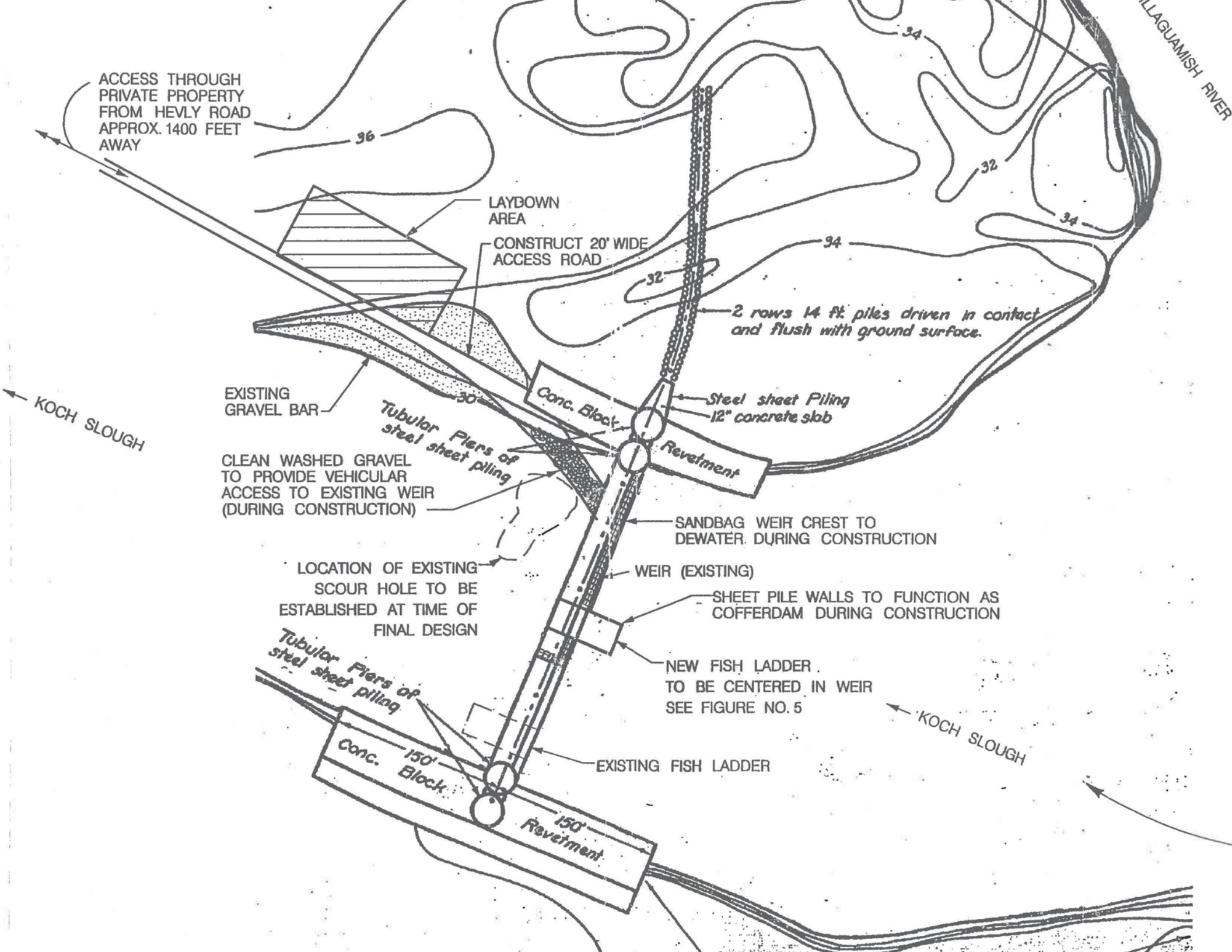
ACCESS THROUGH PRIVATE PROPERTY FROM HEVLY ROAD APPROX. 1400 FEET AWAY
LAYDOWN AREA
CONSTRUCT 20' WIDE ACCESS ROAD
2 rows 14 ft. piles driven in contact and flush with ground surface.
EXISTING GRAVEL BAR
KOCH SLOUGH
Tubular Piers of steel sheet piling
Conc. Block
Steel sheet Piling
12" concrete slab
Revetment
CLEAN WASHED GRAVEL TO PROVIDE VEHICULAR ACCESS TO EXISTING WEIR (DURING CONSTRUCTION)
SANDBAG WEIR CREST TO DEWATER DURING CONSTRUCTION
LOCATION OF EXISTING SCOUR HOLE TO BE ESTABLISHED AT TIME OF FINAL DESIGN
WEIR (EXISTING)
SHEET PILE WALLS TO FUNCTION AS COFFERDAM DURING CONSTRUCTION
NEW FISH LADDER. TO BE CENTERED IN WEIR SEE FIGURE NO. 5
KOCH SLOUGH
Tubular Piers of steel sheet piling
Conc. Block
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150' Revetment
EXISTING FISH LADDER
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PROJECT DESCRIPTION AND WRITE UP

9.0 SITE DESIGNATION: 26 MAINTENANCE SITES.

Site Description

This site is comprised of 26 individual maintenance sites that were part of the 1926-37 Works Project Administration projects. The Corps currently maintains these sites by brushing and cutting down small trees. The Corps also utilizes typical rip rap stabilization on these banks for bank maintenance. The Corps sites are distinguished by a lack of riparian canopy and habitat.

Project Objectives and Criteria

The primary objectives of the project are to restore and enhance channel complexity and riparian habitat on the 26 sites maintained by the Corps of Engineers by modifying the maintenance procedures used in order to include bioengineering principals and in some cases eliminate maintenance entirely. These actions should help to reintroduce habitat features into this reach of the river that have been missing since the mid 1930s.

Alternatives

- Alternative 1: No Action
  No action is recommended under this alternative. This alternative would not address the goals of an ecosystem restoration project. It would match the lack of maintenance done by the county and state on this site, which over time would provide riparian cover similar to that which exists on the rest of the river.

- Alternative 2: Riparian Enhancement and LWD placement
  This alternative establishes a new procedure on corps maintenance of this section of the Stillaguamish River. Step one would be to evaluate all 26 sites to determine if some or all of them could be eliminated from the annual or semi annual maintenance program. One example of this would be in areas accreting material. We would evaluate the current action of brushing and cutting down trees in this area. For other areas we would use accepted bio engineering alternatives for bank protection that would provide significant riparian edge over what is being done now.

Recommendations and Conclusions

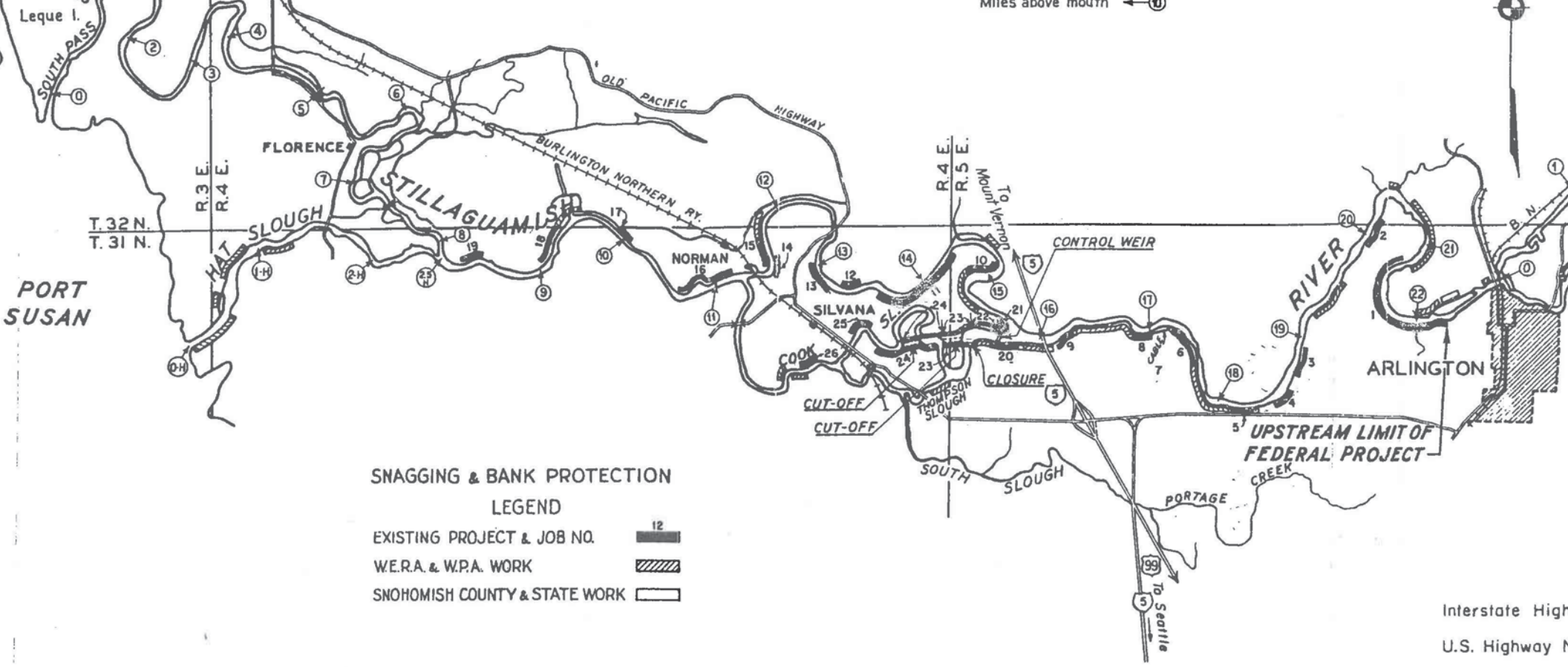
The main drawback of alternative 1, simply eliminating the requirement of maintenance of these sites, would be the actual and perceived effects of lack of maintenance on agricultural lands adjacent to these sites. The recommended alternative, however, establishes an ecosystem friendly system of maintaining these sites. It would also include seeing if any of the 26 sites could be abandoned with little or no effect to the adjacent property. In all cases environmentally friendly methods of bank restoration should be

used in maintenance of these projects. In some cases a minimum of fill may be required at some sites but these are issues that will be covered in the permit phase. Some of the alternative bank stabilization recommendations are shown in the attached drawings. Prior to project construction, a complete h&h analysis will be conducted on this plan to insure that the proposed plan will not have significant effects of flood flows and elevations.

Existing access routes would be used for the 26 sites.

Quantity and Cost Estimates

Quantity and cost estimates for this project are shown in the MCACES section of this attached engineering appendix.



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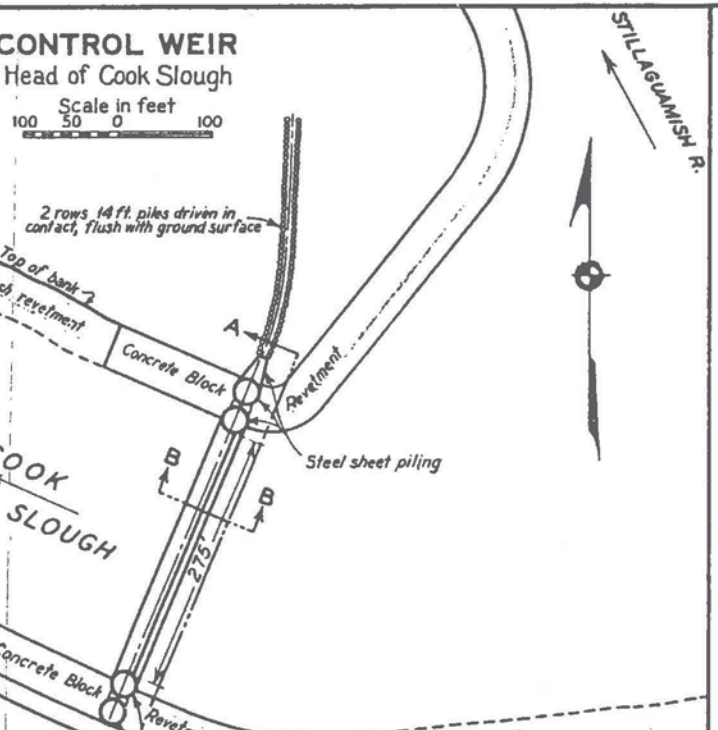
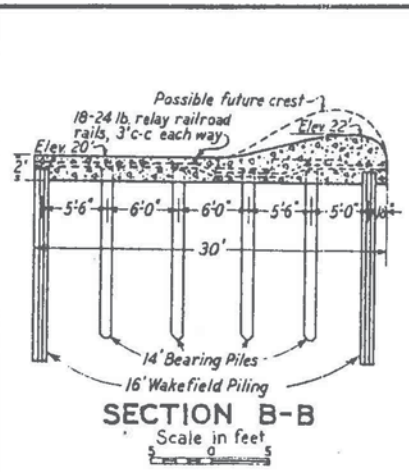
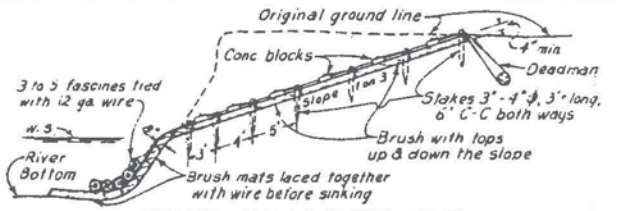
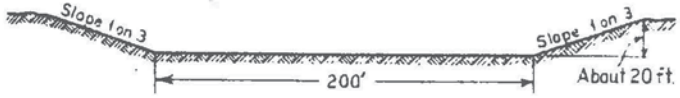




SECTION B-B
Scale in feet
5 0 5

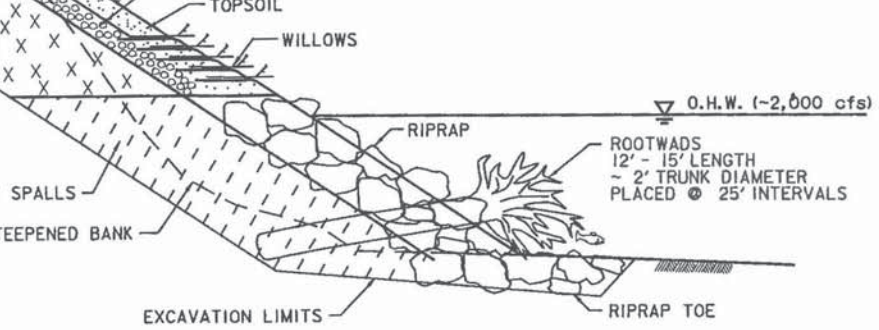


BRUSH MAT REVETMENT
Scale in feet
5 0 5 10



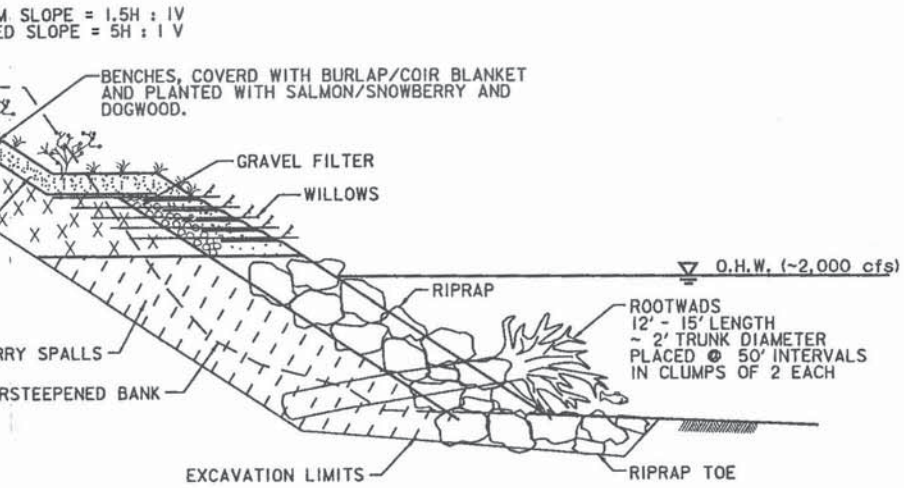
TYPICAL SECTION OF CUT-OFF CHANNEL
Scale in feet
50' 0 50'

SECTION A-A
Scale in feet
10 5 0 10 20



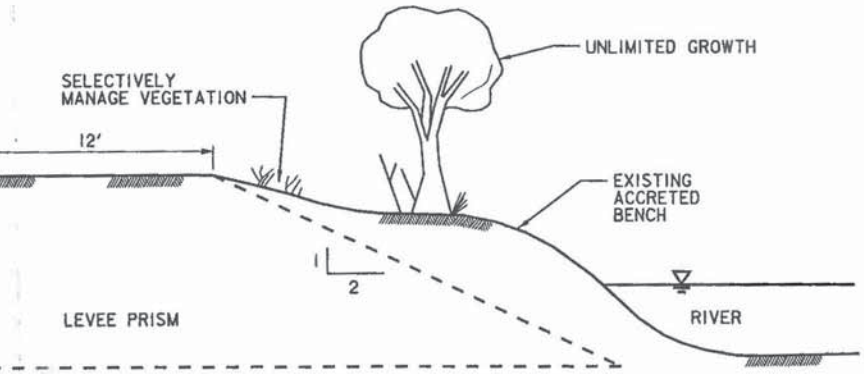
OPTION 1
ION AT ROOTWAD – FOR LEVEED BANK

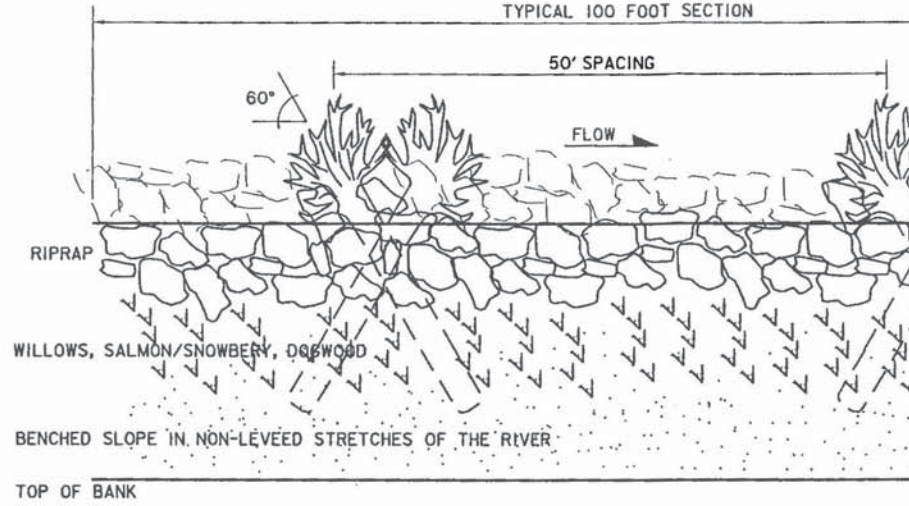
NOT TO SCALE



OPTION 2
N AT ROOTWAD – FOR NON-LEVEED BANK

NOT TO SCALE





OPTION 2 – PLAN VIEW
TYPICAL BANK REHABILITATION

NOT TO SCALE

PROJECT DESCRIPTION ->
STABILIZE EXISTING BANK THAT HAS BECOME OVERSTEEPENED D
UNDERCUTTING BY PLACING LARGE WOODY DEBRIS, RIPRAP, AND
INCLUDING: WILLOW CUTTINGS, SALMONBERRY, SNOWBERRY, AND G

QUANTITIES ARE GIVEN FOR A 500 FOOT BANK REHABILITATION SI
SECTIONS).
HEIGHT OF BANK IS 15 FEET ABOVE CHANNEL BOTTOM.
INCLUDE 10% QUANTITY CONTIGENCY.

EXCAVATION - 2400 CY

ROOTWAD - 21 EACH, CEDAR, HEMLOCK, SPRUCE, OR FIR ONLY. (EVE
A 5 MILE REACH)

QUARRY SPALLS - 1500 CY

RIPRAP - 1000 CY, CLASS IV

BACKFILL - 1500 CY, USE EXCAVATED MATERIAL.

GRAVEL FILTER - 500 CY

TOPSOIL - 1500 CY (FOR BENCHED SLOPE INCREASE TO 2200 CY)

WILLOW CUTTINGS - 1000 EACH

BURLAP/COIR BLANKET - 2800 SY (FOR BENCHED SLOPE INCREASE

SALMON/SNOWBERRY - 500 EACH (FOR BENCHED SLOPE INCREASE

115F

STILLAGUAMISH RIVER ECOSYSTEM RESTORATION FEASIBILITY STUDY

PROJECT DESCRIPTION AND WRITE UP

10. SITE DESIGNATION: PORTAGE CREEK

Site Description

This site is comprised of three contiguous reaches of Portage Creek, approximately six miles in total length as shown in Figure 6. The Upper Reach is contained within the existing Portage Creek Wildlife Refuge Area, owned by the Snohomish County Parks Department. The Middle Reach extends immediately downstream from the Upper Reach boundary to Interstate 5. The Lower Reach extends from Interstate 5 to its Koch Slough confluence. No federal projects have been identified within these project boundaries.

Several fish species are native to Portage Creek including coho, chum, steelhead, and cutthroat trout. Although construction of Interstate 5 reduced flows in Portage Creek from historic levels, current streamflow is adequate to provide fish spawning and rearing habitat. None of the culverts along the project site were noted as obstructions to fish passage.

The primary factors that currently limit Portage Creek's fish habitat value in the Lower and Middle Reaches are lack of shade and lack of channel complexity/diversity. Nearly all woody debris has been removed from the channel, reed canarygrass is the predominant bank cover, and it is estimated that adequate riparian cover exists over only 20% of the Lower and Middle Reaches.

Within the Upper Reach, Portage Creek flows are conveyed through a constructed ditch system, and are hydraulically disconnected from the former wetland area. The ditched conveyance system, combined with the network of drainage tiles installed throughout the site, collectively impede reestablishment of wetland conditions. Native riparian plantings are sparsely located throughout the project site. There are approximately seven miles of accessible spawning habitat available upstream of the Upper Portage Creek project reach.

Project Objectives and Criteria

The primary objectives of the project are to restore and enhance channel complexity and riparian habitat in the Lower and Middle Reaches of Portage Creek, and to create a forested wetland and coho rearing environment in the Upper Reach. Strategies for elimination of existing reed canarygrass and other noxious weeds must be developed for each reach. The growth of native riparian vegetation must be promoted in order to increase wood recruitment to the channel and provide adequate shade and cover for rearing. In addition, the recommended alternative in the Lower and Middle Reaches should not substantially alter channel hydraulics nor increased flooding risks to surrounding properties. It is critically important to primarily control reed canarygrass and Himalayan blackberry during the first several years after planting to allow the

survival of trees that will eventually shade out these species. Originally we had planned to scarify the first six inches of soil for the entire planting area. We are now recommending other less expensive methods of plant control. This one item is very critical and we should investigate it thoroughly before we initiate planting of the riparian areas. In some cases larger plants will be specified to help with this survival rate.

Alternatives

- Alternative 1: No Action
  No action is recommended under this alternative.

- Alternative 2: Riparian Enhancement and Wetland Restoration
  This alternative establishes a bank-to-bank riparian buffer within the old river channel area in the Lower Reach of Portage Creek and a 50' planting buffer in the Middle Reach. It is estimated that approximately 80% of the Lower and Middle reaches will require plantings. Plantings are adequate in the most downstream quarter-mile of the Lower Reach. It is estimated that approximately 20% of the banks in the Lower and Middle Reaches will need to be fenced, along individual properties where farmers run cattle. LWD and small woody debris should be added to the channel within the Lower and Middle Reaches at approximately two-ban width intervals, on alternating sides of the channel. LWD placement should occur in the summer months during non-migration periods.
  Suitable native plantings to be installed within the planting buffer include sitka spruce, western red cedar, hemlock, willow, pacific crabapple, cottonwoods, big leaf maple, wild cherry, hazelnut, and alders. No hybrids or horticultural varieties should be planted. Planting should occur during February or March. Large 5 to 10 gallon plantings or 6-foot willow stakes will be required to create the vegetated buffer. New plantings should be protected with tree wrap.

  This alternative includes a maintenance plan for the first two years after initial planting. Plantings should be watered fours times during July - September for the first two years. Vegetation maintenance will be scheduled three times a year for the first two years.

  Dense areas of reed canarygrass should be scarified where possible and removed prior to planting. Reed canarygrass will be further controlled through shading as the native plantings mature. It is anticipated that several years of reed canarygrass control will needed before it will be shaded out.

  Under this alternative, the Upper Reach of the Portage Creek would be redirected from its existing ditched channel into a shallow meandering channel excavated as shown in Figure 9. The conveyance of the existing ditch would be reduced using LWD and soil plugs. LWD placement will also help direct flow along the main channel. Approximately 750 feet of existing ditch located at the eastern end of the site would be filled and existing drainage tile removed throughout the site. 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 dendrites will also help to convey inflows from the northern and southern extents of the project to the main channel. During detailed design, dendrites would be configured and sized to insure that site water retention requirements are met. This analysis needs to insure that the sizing and depth and number of these dendrites does not effect water retention in the existing wetland.

The entire project boundary within the Upper Reach would be planted with native forested wetland species to create a high-quality rearing habitat. Plantings should consist of western red cedar, red alder, sitka spruce, pacific willow, sitka willow, red osier dogwood, western crabapple, pacific ninebark, currant, and thimbleberry and other native species as shown in Figure 10. Planting should commence only after any noxious weeds present on site, such as reed canarygrass and poison hemlock, are removed per applicable Snohomish County and Natural Resource Conservation Survey (NRCS) guidelines.

Snohomish County plans to construct a segment of the Centennial Trail along the alignment of a former farm road, which runs north–south and roughly bisects the site. An approximate 10-foot diameter CMP bottomless arch culvert should be installed where the trail crosses Portage Creek.

- Alternative 3: Wide Buffer Riparian Enhancement and Wetland Restoration
  This alternative is identical to the one previously described but calls for a wider buffer (up to 150') along the Lower and Middle Reaches of Portage Creek. It will further enhance the riparian environment and promote additional wood recruitment. The primary intent here is to investigate whether there are areas along Portage Creek where a wider buffer will be accepted by landowners.

Recommendations

Alternative 3, the wide buffer riparian enhancement alternative, should enhance wood recruitment, and offer greater channel protection to the Lower and Middle Reaches of Portage Creek than the smaller planting buffers proposed in the second alternative. However, landowners have preliminarily indicated that they will not support a 150-foot buffer width. Alternative 1, the no action alternative, does not provide viable rearing habitat for native fish species and is not consistent with project objectives.

Alternative 2, the recommended alternative, establishes a bank-to-bank riparian buffer in the Lower Reach of Portage Creek and a 50' planting buffer in the Middle Reach while restoring the Upper Reach to a forested wetland as previously described. Conceptual design drawings are attached. The new Upper Reach channel should be sized after completing a hydrologic analysis. Hydraulic and hydrologic analysis will need to be accomplished before construction of any of the reaches.

The land adjacent to the Middle and Lower Reaches of Portage Creek is primarily under active agricultural use. Farm access roads run parallel to both sides of Portage Creek, essentially throughout its length. Temporary construction and permanent access will

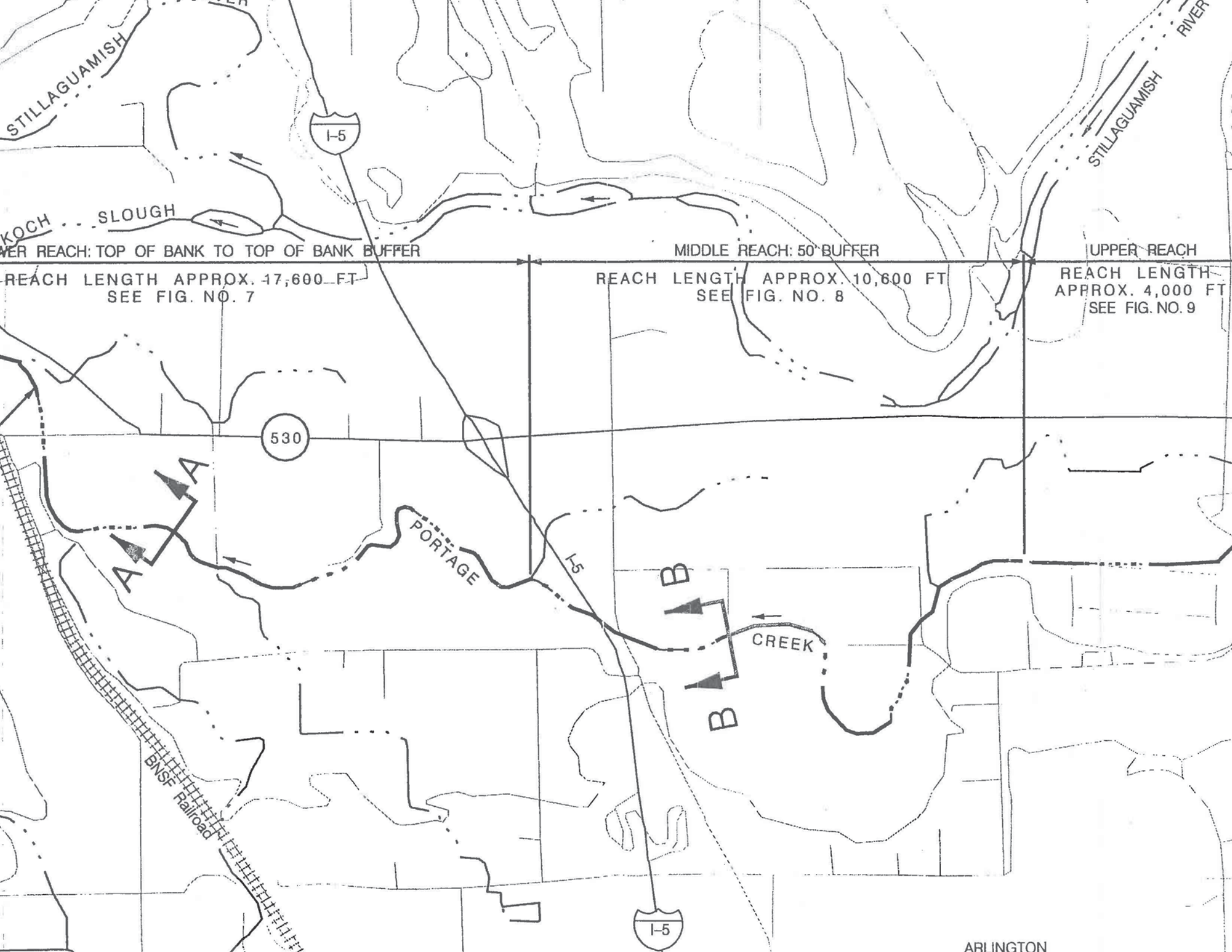
need to be secured from the adjoining property owners. Construction access at approximately one-half mile intervals on either side of the creek is recommended. The Upper Portage Creek Reach can be accessed via the main Snohomish County Park entrance off of Cemetery Road.

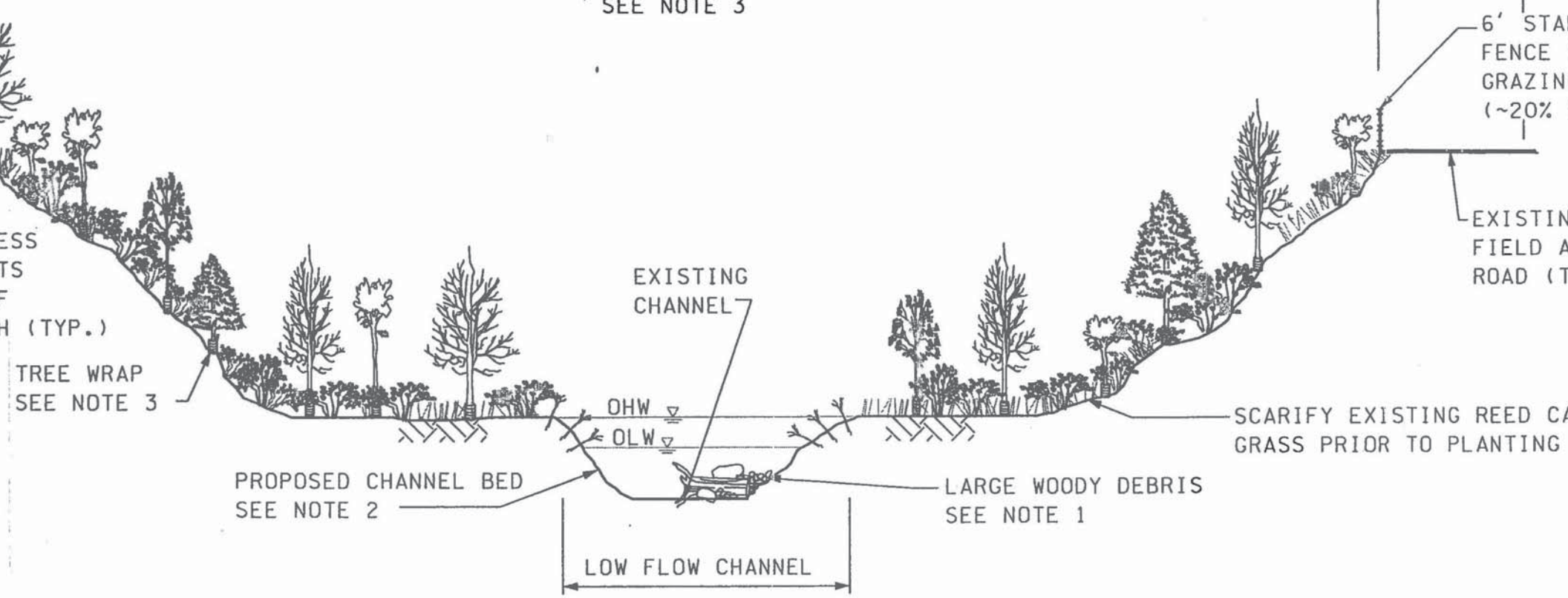
No significant excavation is expected within the Lower and Middle Portage Creek Reaches. Any excavated soil will be disposed onsite. Excavated soils within the Upper Portage Creek Reach will be used to fill a section of the north-south ditch as noted in the upper reach plan view. The east- west portion of this ditch will not be filled as it now picks up existing seeps and is good fish habitat. Excess excavated materials will be hauled offsite for disposal at a county disposal site.

Based on visual observation, no utility or facility relocations will be needed to implement these recommendations.

Quantity and Cost Estimates

Quantity and cost estimates for this project are shown in the MCACES section of this attached engineering appendix.


STILLAGUAMISH
I-5
KOCH
SLOUGH
STILLAGUAMISH
RIVER
WER REACH: TOP OF BANK TO TOP OF BANK BUFFER
REACH LENGTH APPROX. 17,600 FT
SEE FIG. NO. 7
MIDDLE REACH: 50' BUFFER
REACH LENGTH APPROX. 10,600 FT
SEE FIG. NO. 8
UPPER REACH
REACH LENGTH
APPROX. 4,000 FT
SEE FIG. NO. 9
530
A
A
PORTAGE
I-5
B
B
CREEK
BNSF Railroad
I-5
ARLINGTON



TYPICAL CROSS SECTION A-A

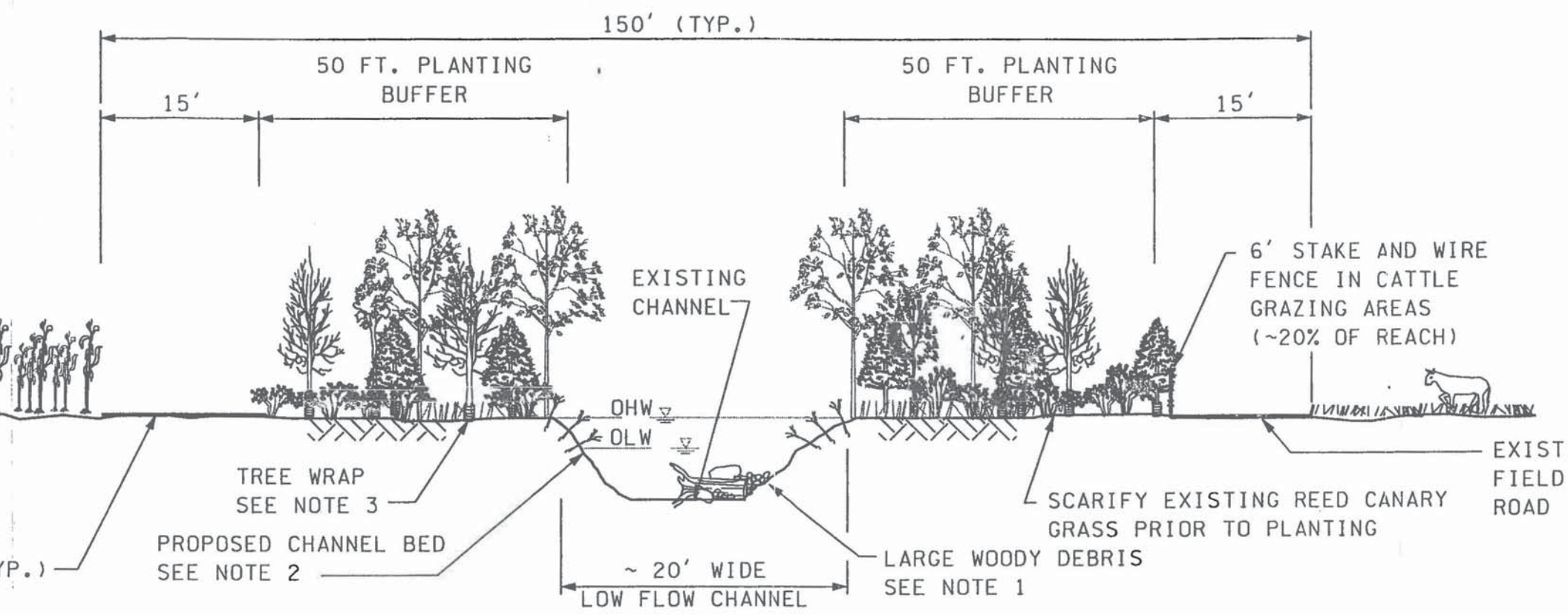
NOT TO SCALE

NOTES:

1. PLACE LARGE WOODY DEBRIS (LWD) ON ALTERNATING SIDES OF LOW FLOW CHANNEL, APPROXIMATELY EVERY 50'. kEY INTO BANK.

2. IN AREAS OF LWD PLACEMENT EXCAVATE AN EQUIVALENT AREA FROM EXISTING CHANNEL TO MAINTAIN CROSS SECTIONAL AREA FOR FLOW CONVEYANCE.

3. PLANT THOUGHOUT BANK TO BANK PLANTING BUFFER, ABOVE OLW LEVEL. NATIVE PLANTINGS TO CONSIST OF A MIXTURE OF SITKA SPRUCE, WESTERN RED CEDAR, HEMLOCK, WILLOW, PACIFIC CRABAPPLE, COTTONWOODS, BIG LEAF MAPLE, WILD CHERRY, HAZELNUT, AND ALDERS. NATIVE PLANTINGS ONLY. NO HYBRIDS OR HORTICULTURAL VARIETIES. USE LARGE 5 TO 10 GALLON CONTAINER PLANTINGS AND 6' LIVE WILLOWSTAKES. PLANTING TO OCCUR DURING FEBRUARY OR MARCH. ALL NEW PLANTINGS TO BE PROTECTED WITH TREE WRAP.



TYPICAL CROSS SECTION B-B

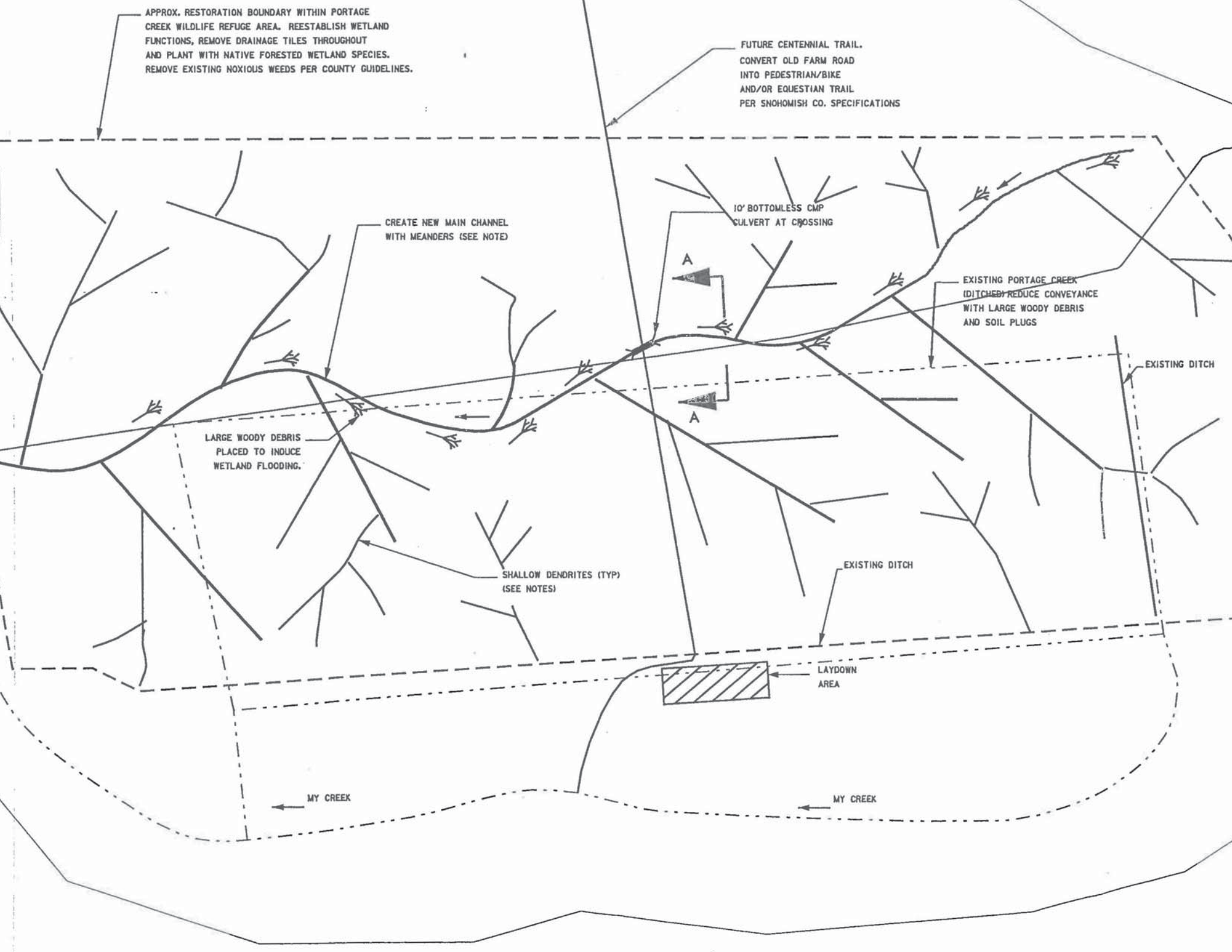
NOT TO SCALE

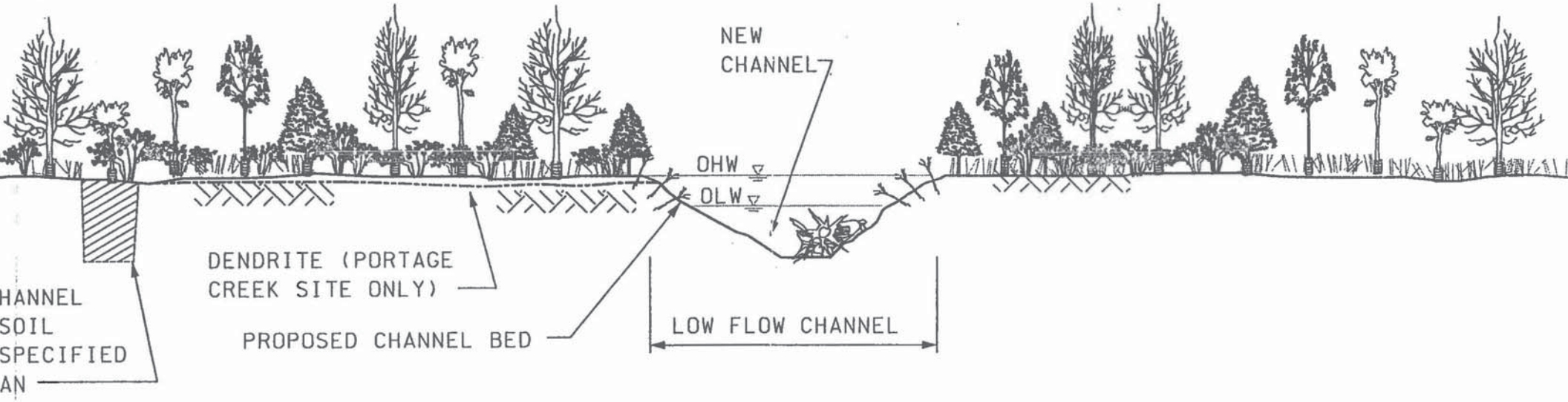
NOTES:

1. PLACE LARGE WOODY DEBRIS (LWD) ON ALTERNATING SIDES OF LOW FLOW CHANNEL, APPROXIMATELY EVERY 50'. kEY INTO BANK.

2. IN AREAS OF LWD PLACEMENT EXCAVATE AN EQUIVALENT AREA FROM EXISTING CHANNEL TO MAINTAIN CROSS SECTIONAL AREA FOR FLOW CONVEYANCE.

3. PLANT THOUGHOUT BANK TO BANK PLANTING BUFFER, ABOVE OLW LEVEL. NATIVE PLANTINGS TO CONSIST OF A MIXTURE OF SITKA SPRUCE, WESTERN RED CEDAR, HEMLOCK, WILLOW, PACIFIC CRABAPPLE, COTTONWOODS, BIG LEAF MAPLE, WILD CHERRY, HAZELNUT, AND ALDERS. NATIVE PLANTINGS ONLY. NO HYBRIDS OR HORTICULTURAL VARIETIES. USE LARGE 5 TO 10 GALLON CONTAINER PLANTINGS AND 6' LIVE WILLOWSTAKES. PLANTING TO OCCUR DURING FEBRUARY OR MARCH. ALL NEW PLANTINGS TO BE PROTECTED WITH TREE WRAP.


APPROX. RESTORATION BOUNDARY WITHIN PORTAGE CREEK WILDLIFE REFUGE AREA. REESTABLISH WETLAND FUNCTIONS, REMOVE DRAINAGE TILES THROUGHOUT AND PLANT WITH NATIVE FORESTED WETLAND SPECIES. REMOVE EXISTING NOXIOUS WEEDS PER COUNTY GUIDELINES.
FUTURE CENTENNIAL TRAIL. CONVERT OLD FARM ROAD INTO PEDESTRIAN/BIKE AND/OR EQUESTIAN TRAIL PER SNOHOMISH CO. SPECIFICATIONS
CREATE NEW MAIN CHANNEL WITH MEANDERS (SEE NOTE)
10' BOTTOMLESS CMP CULVERT AT CROSSING
A
A
EXISTING PORTAGE CREEK (DITCHED) REDUCE CONVEYANCE WITH LARGE WOODY DEBRIS AND SOIL PLUGS
EXISTING DITCH
LARGE WOODY DEBRIS PLACED TO INDUCE WETLAND FLOODING.
SHALLOW DENDRITES (TYP) (SEE NOTES)
EXISTING DITCH
LAYDOWN AREA
MY CREEK
MY CREEK



SECTION A-A

NOT TO SCALE

NOTES:

1. PLANT THROUGHOUT PLANTING BUFFER WITH NATIVE FORESTED WETLAND SPECIES INCLUDING WESTERN RED CEDAR, RED ALDER, SITKA SPRUCE, PACIFIC WILLOW, RED OSIER DOGWOOD, WESTERN CRABAPPLE, PACIFIC NINEBARK, COTTONWOOD, CURRANT AND THIMBLEBERRY. NATIVE PLANTINGS ONLY. NO HYBRIDS OR HORTICULTURAL VARIETIES.

11.0 SITE DESIGNATION: CLOVERDALE FARM SITE

Site Description

The Cloverdale Farm site is located off of State Route 530 and 115th Avenue NE in the Trafton area of Snohomish County (Figure 1). No other federal projects are in the site vicinity. The site includes the former Cloverdale Farm (briefly a public golf course), acquired by Snohomish County within the past year, as well as an adjacent grazed pasture that is under private ownership. The site is bounded by an abandoned Burlington Northern Railroad embankment to the northwest. The former railroad embankment is anticipated to be converted into the Whitehorse bike and pedestrian trail. Trail design is scheduled for the year 2000 (Jacobsen, 1999).

An unnamed tributary to the North Fork of the Stillaguamish River enters the site from a culvert under State Route 530. The existing culvert currently obstructs upstream fish passage, and replacement of the culvert by the Washington Department of Transportation or Washington Department of Fish and Wildlife is under consideration (Caley, 1999). If the culvert is replaced it should open up significant upstream spawning habitat to native fish species.

The tributary runs downslope through an existing wooded corridor, with good habitat quality. It is presumed that the entire length of the tributary was once within a wooded riparian buffer. At the bottom of the slope, the forested zone ends and the tributary enters the grazed pasture. The landowner has redirected the tributary off this property back towards an adjacent wetland zone on the County's land. The tributary continues through the wetland zone until it reaches the railroad embankment. Here it flows west through an existing channel that runs parallel to the embankment until its reaches its confluence with the North Fork of the Stillaguamish River. Just north of the wetland area, on the north side of the railroad embankment, is an overbank depression where fish reportedly become stranded as Stillaguamish flood flows recede.

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.

A second degraded wetland area runs along the toe of the hillside that bounds the site to the east, collecting groundwater runoff and conveying it to the tributary in the wooded zone just before entering the property. Vegetation in this wetland is of poor quality. Water is conveyed too effectively in this zone to support high quality wetland conditions that would provide adequate rearing habitat.

42B

Project Objectives and Criteria

The primary project objective at the Cloverdale site is to build a coho rearing system that connects upstream spawning habitat to the Stillaguamish River with a forested wetland rearing habitat on the project site. Existing project design should incorporate measures for sediment control.

Alternatives

- Alternative 1: No Action
  No action is recommended under this alternative.

- Alternative 2: Reestablishment of the Historical Tributary Channel and Forested Wetland
  This alternative includes the following components:
  - Acquisition of a portion of the privately owned grazing area.
  - Reestablishment of a meandering tributary channel through the existing grazing area. The existing ditch on the property would be filled. The new channel would be constructed and large wood placed in it to insure a recharge of the wetland area in high flow conditions.
  - Establishment of a riparian planting buffer, ranging in width from 150 feet to 400 feet. Native forested wetland plantings including western redcedar, red alder, sitka spruce, cottonwood, pacific willow, sitka willow, red osier dogwood, western crabapple, pacific ninebark, currant, and thimbleberry should be installed within the buffer.
  - Installation of an 18-inch diameter culvert with a debris rack through the railroad embankment directly north of the existing wetland area to allow fish egress to the tributary after flood events.
  - Construction of a gravel trail leading off of the proposed Whitehorse trail to the banks of the North Fork of the Stillaguamish. A 24" culvert should be installed to maintain fish passage in the small egress channel that currently exists along the north side of the embankment.

Conclusions/ Recommendations

The no action alternative does not create the desired rearing habitat. However, the restoration alternative requires acquisition of the privately owned pasture and replacement of the upstream culvert to be viable. If the culvert is replaced, the restoration alternative has significant potential habitat benefits.

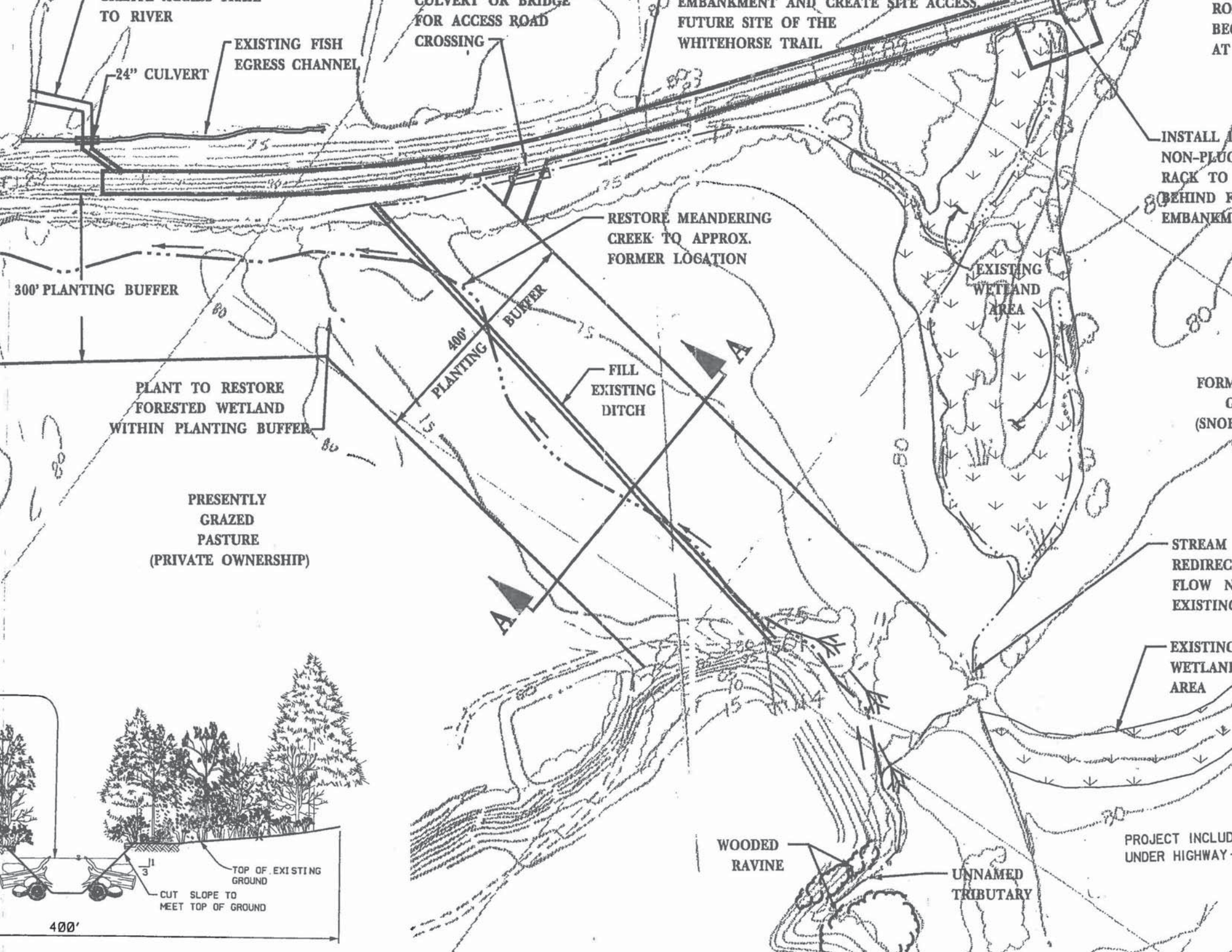
Alternative 2, the restoration alternative, is recommended. Conceptual design drawings are provided. Prior to construction, a sediment analysis needs to be done and incorporated into the project design. Also upstream sediment sources need to be indicated to see if they can be controlled. An h&h analysis will be accomplished prior to project construction

Temporary access to the site can be obtained by constructing a 20-foot wide access road from 115th Avenue northeast to the railroad embankment. Once cleared of blackberry and scrub, the embankment can be used as the primary access route to the site. A short access road can be created between the embankment and the area where new channel excavation is proposed, by bridging the existing tributary with a temporary culvert. Laydown areas can be established both on the embankment and in the other areas shown on Figure 11. No existing utility relocations are anticipated based on visual inspection. Coir Fabric may be needed for bank stabilization in addition to vegetation.

Excavated material will be used to fill the existing ditch in the grazed area. Excess excavated material will be disposed onsite in non-wetland areas or hauled off site to a county deposal site.

Quantity and Cost Estimates

Quantity and cost estimates for this project are shown in the MCACES section of this attached engineering appendix.


TO RIVER
EXISTING FISH EGRESS CHANNEL
24" CULVERT
CULVERT OR BRIDGE FOR ACCESS ROAD CROSSING
EMBANKMENT AND CREATE SITE ACCESS
FUTURE SITE OF THE WHITEHORSE TRAIL
INSTALL
NON-PLUG
RACK TO
(BEHIND F
EMBANKM
RESTORE MEANDERING CREEK TO APPROX. FORMER LOCATION
300' PLANTING BUFFER
400' PLANTING BUFFER
EXISTING WETLAND AREA
FILL EXISTING DITCH
PLANT TO RESTORE FORESTED WETLAND WITHIN PLANTING BUFFER
PRESENTLY GRAZED PASTURE (PRIVATE OWNERSHIP)
FORM
(SNOE
STREAM
REDIREC
FLOW N
EXISTING
EXISTING
WETLAN
AREA
PROJECT INCLUD
UNDER HIGHWAY
WOODED RAVINE
UNNAMED TRIBUTARY
A
A
TOP OF EXISTING GROUND
CUT SLOPE TO MEET TOP OF GROUND
1
3
400'

12.0 SITE DESIGNATION: HAZEL (Steelhead Haven) LANDSLIDE

Location

The Steelhead Haven Landslide (SHL) is located at approximately river mile (RM) 20 on the North Fork Stillaguamish (NFS) river.

Site Constraints/Problems

Investigations into the cause and effects of SHL date back to 1952 when Shannon and associates reported on the status of the slide to the State of Washington's Department of Game and Department of Fisheries. Thorsen (1969) documented the massive failure of January 7, 1967 that damned the NFS for approximately 4 hours. Williams (1975) noted the implications of the slide on the fisheries in a catalog of Washington streams and salmon utilization. The following is an excerpt from that report.

> "The principal factor limiting salmon production within the section is sedimentation resulting from a major mud and clay slide on the river's right bank, at approximately mile 20.4. Below that point, heavy silt deposits cover most of the gravel riffles, making them unsuitable for successful spawning and egg incubation. This condition also inhibits natural cycles of aquatic insect growth, reducing food production, and consequently lowering the rearing capacity of the stream below".

The factors affecting SHL have also been the subject of more recent reports (Benda 1988, Miller and Sias 1997). Benda (1988) identified the groundwater recharge areas of the slide and provided timber harvest recommendations within these areas. Miller and Sias (1997) more rigorously identified the factors affecting the slide and documented historical changes. Miller (1999) provided an update on the status of the slide and estimated the current failure potential of the slide.

A summary of status quo conditions for the landslide is listed below. For detailed analyses, please see the afore-mentioned reports.

Status Quo:

- Slope instability
- Fine sediment source
- Turbidity and temperature concerns: ie 303(d) list
- Located within an area considered habitat limited
- Downstream pool filling and redd entombing

- Catastrophic failure concerns
- Floodplain encroachment

Overview:

Steelhead Haven landslide is primarily composed of lacustrine clays underlying glacial-fluvial outwash. Post-glacial fluvial incision through these deposits has resulted in large-scale mass wasting over time and is the precursor to the landslide's current unstable conditions. Near vertical scarp faces can be seen sandwiched between intact slumps of forest as a result of multiple failure planes within the slide (figure 1). There are 3 main spring-fed streams that drain the slide as well as several other significant seeps. These streams deliver a steady flux of fine sediment to the river, which is promptly integrated into the river's flow and transported downstream. Turbidity is greatly increased downstream of the slide which can lead to an increase in temperature during summer months and smothering of salmon eggs due to fine sediment intrusion into redds. Turbidity has also prevented monitoring efforts from conclusively determining habitat use below the slide. The NFS has been characterized as "habitat limited" through the Hazel Watershed Analysis (1996). This designation suggests that any and all in-stream work on the NFS should be completed in a fashion consistent with habitat rehabilitation efforts. Hence, projects must address the current limiting factors to salmonid stock recovery.

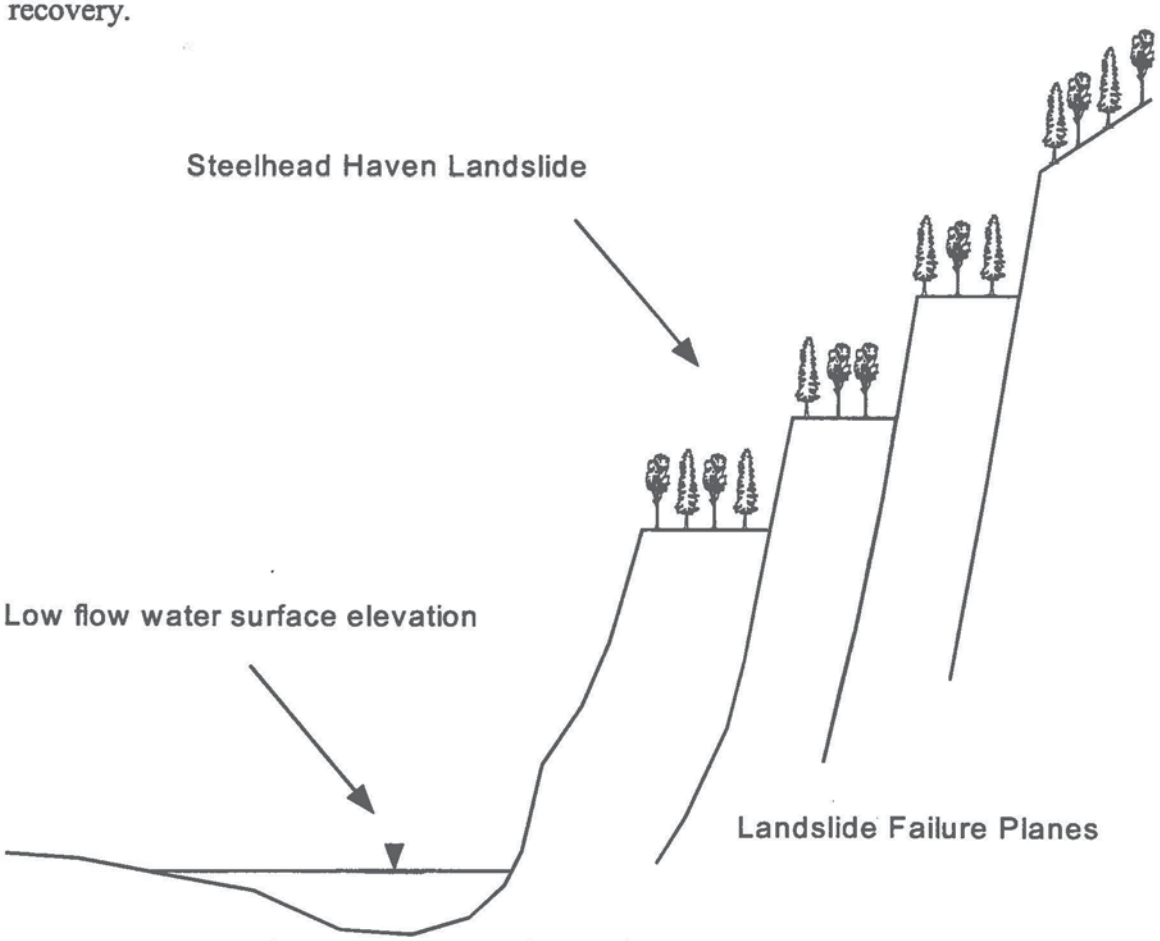


Figure 1: status quo for Steelhead Haven Landslide.

The current interaction of the river and SHL raises concerns about catastrophic failure. The river is currently located at the base of the slide and is actively cutting the toe. This toe cutting removes materials currently buttressing the slide and promoting the dormant state of several failure planes within the slide (figure 1). Continued toe cutting will undoubtedly result in reactivation of one or more of these failure planes. Miller (1999) estimated the current runout potential of the slide to be 900 ft south from the toe of the slide through an area which is currently owned and occupied by private citizens. The development of the floodplain has encroached on the river's natural channel migration and places current residents at risk. Prior to 1967, the river's location and landslide's condition were remarkably similar to the current state. The failure event of 1967 temporarily damned the river and runout from the landslide extended several hundred feet south of the rivers current location. This resulted in a new river channel running through the historical floodplain. Based on the available data, and assuming the future resembles the past, SHL poses a significant risk to human lives and private property, since human development of the floodplain in this area has steadily increased since the 1967 event. The persistence of this landslide, failure potential, and detrimental effects it induces emphasizes the assertion that immediate attention is given to addressing the current conditions.

Project Objectives and Criteria

The objectives developed for potential project remedies range from interruption of the imminent geomorphic processes and rehabilitation aimed at historical reconstruction to alteration of embedded human demographic patterns. These objectives aim to address the overall goal of restoring salmonids to healthy harvestable levels. Objectives are summarized below.

Objectives:

a. Eliminate toe cutting of slope
b. Reduce slope failure hazard
c. Stabilize slope
d. Create local holding habitat and increase cover
e. Create off-channel rearing habitat
f. Reduce fine sediment inputs
g. Reduce floodplain encroachment

Alternatives

Five alternative courses of action are evaluated based upon: ability to meet objectives, technical merit, and feasibility of implementation.

- Alternative 1: No Action
  Selecting the "No Action" alternative implies that status quo conditions are deemed acceptable or that no other alternative possesses technical merit and feasibility of implementation. In considering the acceptability of status quo conditions one must take into consideration that:
  - Large, persistent, deep-seated landslides don't just go away
  - Current slide activity has a detrimental effect on fisheries habitat

- Listing of Chinook under the Endangered Species Act mandates action
- Catastrophic failure potential places human lives and properties at risk

The remaining alternatives should be judged individually on the basis of technical merit and feasibility.

- Alternative 2: Stabilize toe of the slide
  Stabilization would be achieved by installing large wood debris at the base of the slide. The configuration of this debris would be in the form of a large wood revetment. This revetment would isolate the river from the toe of the landslide and would be constructed in a manor where scour pool development of the active channel would be acceptable (figure 2). Additional revetment components would be placed to promote entrainment of landslide materials within and behind the revetment. The immediate results of this installation would be the elimination of the toe cutting of the slide and the development of pools and cover for fisheries habitat. However, slopes are near vertical and cannot be maintained in their current form. Mass wasting and fluvial sediment transport would continue and the expected habitat benefits may be short lived. Landslide materials would quickly overrun this structure resulting in status quo fine sediment delivery to the river. Any medium or large scale slumping of the slide would be delivered directly to the river similar to status quo conditions. Further development of the existing failure potential may be curtailed, but this alternative does not address long-term major failure concerns.

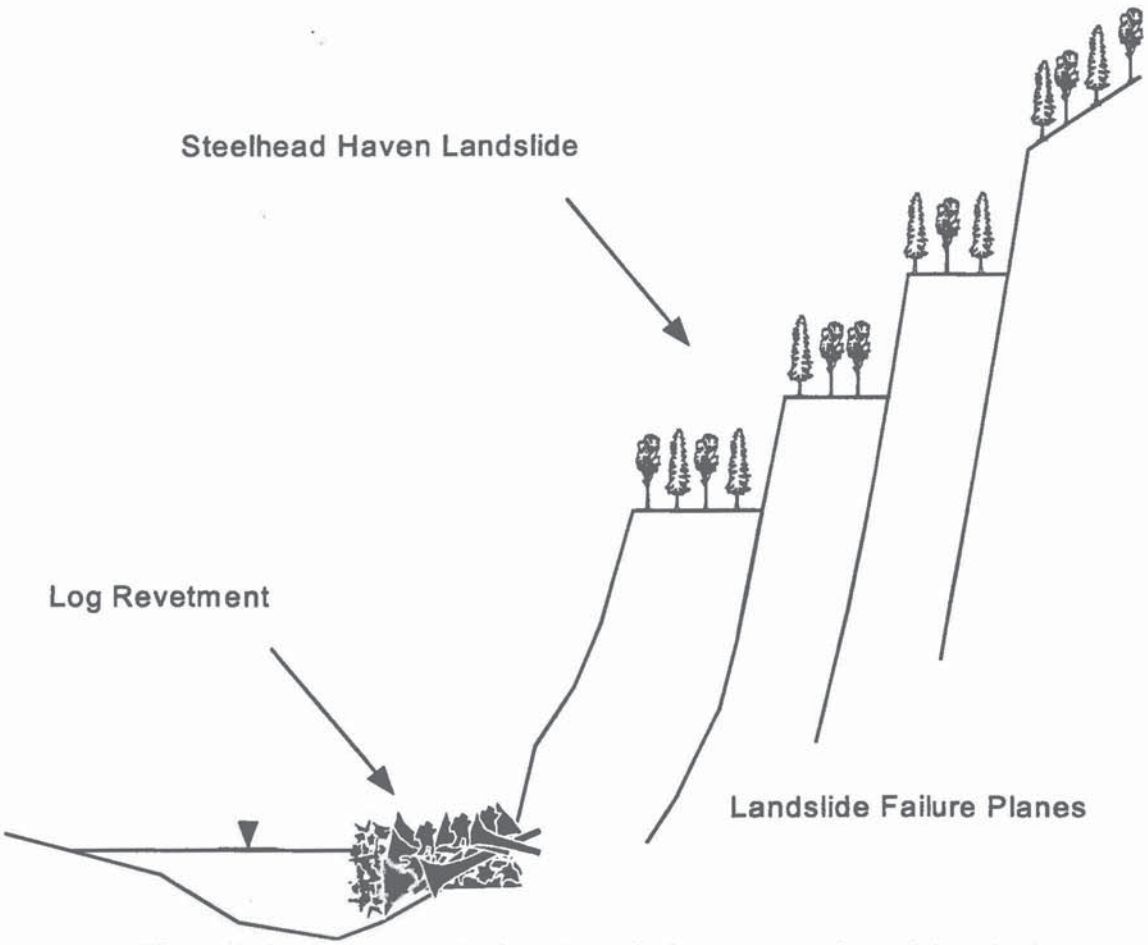


Figure 2: log revetment designed to eliminate toe cutting of the slide.

- Alternative 3: Provide storage area for landslide materials
  This alternative would include a large excavated and relocated river channel and proposes a series of permanent revetments to eliminate toe cutting of the slide and create settling ponds for fine materials that would otherwise be delivered to the mainstem from the multiple streams that drain the slide area. In addition, these structures will create adult Chinook holding habitat similar to that of the NFS Engineered Log Jams (ELJs) and mainstem off-channel habitat currently lacking in the NFS. Revetment A would isolate the landslide from the mainstem NFS and eliminate the toe cutting (Appendix A). The interaction of this structure with the NFS will also create deep pools critical for adult Chinook holding. Revetments B, C, and D will create a series of settling ponds to help decrease the magnitude of fine sediments delivered to the mainstem NFS. These revetments will also create a pseudo beaver-pond network providing mainstem off-channel habitat. Initially the area created between the landslide and revetment A will be quite expansive and largely a habitat component. As the creeks drain the slide and deliver fine sediment, an increasing volume of this area will be converted to fine sediment storage. Over time it is possible that the entire area between revetment A and the landslide will be converted to fine sediment storage. It is also possible that stabilization of the

landslide will occur prior to filling the entire storage area and that some off channel habitat will remain over time. Uncertainty remains with respect to the eventual equilibrium condition as well as the time frame of development. An additional habitat component that will develop is a log raft in the stagnation point that will be created by the interaction of the river and revetment A. This will result in an excellent feeding zone with cover for juveniles and adult stream fishes.

- Alternative 4: Protect area equivalent to landslide runout potential
  Miller (1999) estimated the current runout potential of the slide to be 900 ft from the toe. The design for alternative 3 can be altered to accommodate the full runout potential of the slide. This alternative would provide very similar habitat benefits as alternative 3, while providing greater storage area for mass wasting materials. Theoretically, even a worst-case failure scenario would be captured within the storage area.

- Alternative 5: Floodplain buyout
  This alternative suggests floodplain buyout and excavation of a new channel through the floodplain. This would move the river approximately 2000 ft away from the slide effectively isolating the slide from the river. Revetments discussed in alternatives 3 and 4 would not be constructed. However one revetment would be constructed across the current channel to insure that re-occupation of the current channel did not occur (Appendix A). Construction of the new channel would include the installation of several LWD structures similar to those built on the NFS during 1998 and 1999. These structures would assist in initial channel training and provide in-stream habitat components. The new channel could be multi-threaded providing both mainstem and off-channel habitat.

Discussion of Alternatives:

As a first order evaluation, the ability of these alternatives to meet the designated objectives was considered. For purposes of clarity, objectives and alternatives were compiled into a decision matrix where inputs into the matrix represent fulfillment of the objective (table 1).

Table 1: objectives meet by alternatives.

	Objectives						
	a	b	c	d	e	f	g
Alternatives 1							
2	X			X			
3	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X

From this matrix it can be seen that Alternatives 3, 4, and 5 meet all objectives. Therefore only these alternatives will be further evaluated for technical merit.

Alternative 3: provide storage area for landslide materials.

Initially, a first order approximation of the cross-sectional width currently being used by the river was delineated. From figure 3 it can be seen that the river currently uses approximately 500 ft and an additional 500 ft of floodplain is available before a floodplain terrace is encountered. Private properties, including some full time residences, are located on this floodplain terrace. It would be the objective of this alternative to isolate SHL from the river without increasing the frequency and magnitude of flood inundation on the floodplain terrace. Hence, it is suggested that the log revetment be located 500 ft from the slide (figure 3).

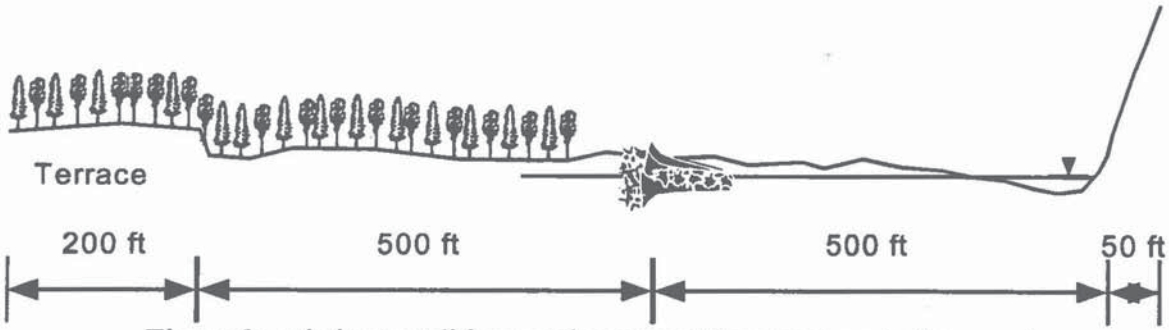


Figure 3: existing conditions and proposed log revetment placement.

This provides the river with approximately 500 ft of cross-sectional width matching its current use. The post construction expected conditions are shown in figure 4.

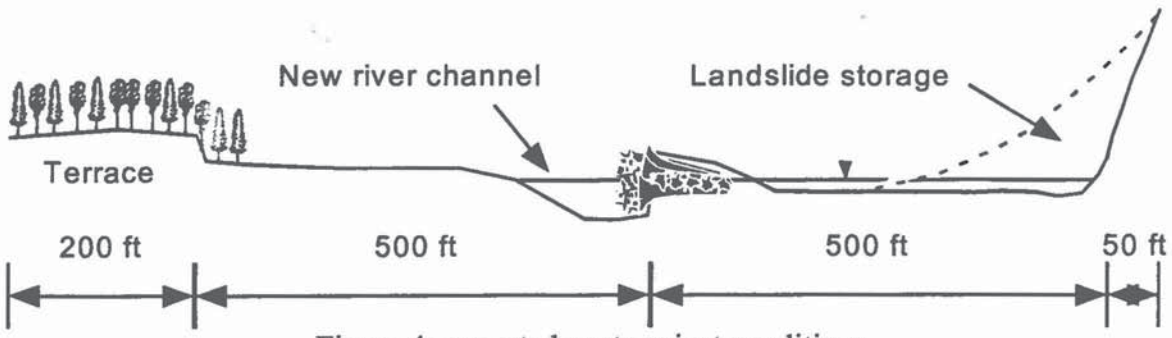


Figure 4: expected post project conditions.

In order to provide a more technical justification for this alternative's configuration, data collected and results determined through the study of the 1998 NFS ELJ project (Drury 1999) will be drawn from and applied to this site. The 1998 NFS ELJ project site is located approximately 1.0 miles upstream (approx. RM 21) from SHL. For purposes of this analysis, it is assumed that hydrologic and hydraulic conditions at the 1998 NFS ELJ project site are representative of conditions at Steelhead Haven. In addition, the effects induced by the installation of the 1998 NFS ELJ project can be drawn from when forecasting the expected post project conditions at Steelhead Haven.

Figure 5 shows actual conditions for the cross-section depicted in figures 3 and 4 from the base of the landslide (on the right of figure 5) to the edge of the vegetated floodplain. These data were collected August 1999 during low flow conditions.

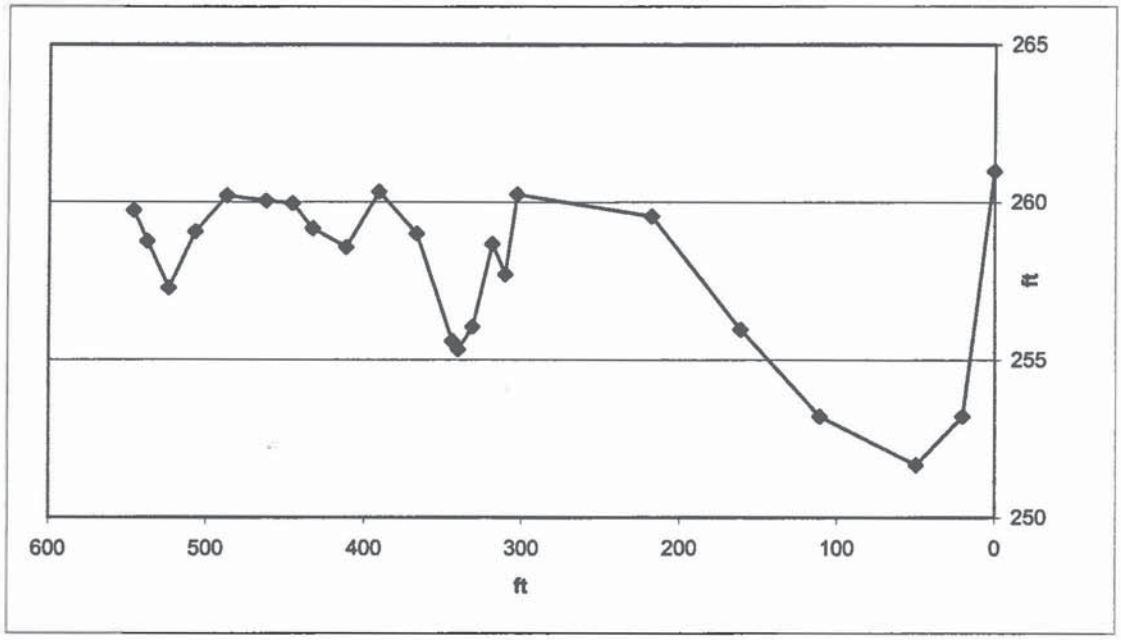


Figure 5: actual current conditions of NFS at Steelhead Haven Landslide.

It is shown that the actual cross-sectional width currently used by the river during high flow conditions is approximately 550 ft. It is also shown that the high-energy core of the river is located at the base of the slide. Figure 6 shows cross-sections for pre and post project conditions associated with the installation of ELJ #4 of the 1998 NFS ELJ project.

The translation of the left bank of the river, from left to right in figure 6, is due to placement of ELJ #4. The deepening of the thalweg is a direct result of ELJ installation and can be expected in the proximity of log revetment A, suggested as part of this alternative. The width of ELJ #4 was approximately 34 ft while the width of the cross-section was 410 ft. This reduced the width of the channel 8.3%, but no effects of this reduction were felt on the right bank. In fact, it is shown that effects were only felt approximately 200 ft from ELJ placement and that conditions at the right bank were not altered. In addition, data collected suggests no detectable change in water surface elevation for a given flow between pre and post ELJ placement conditions once channel alterations occurred.

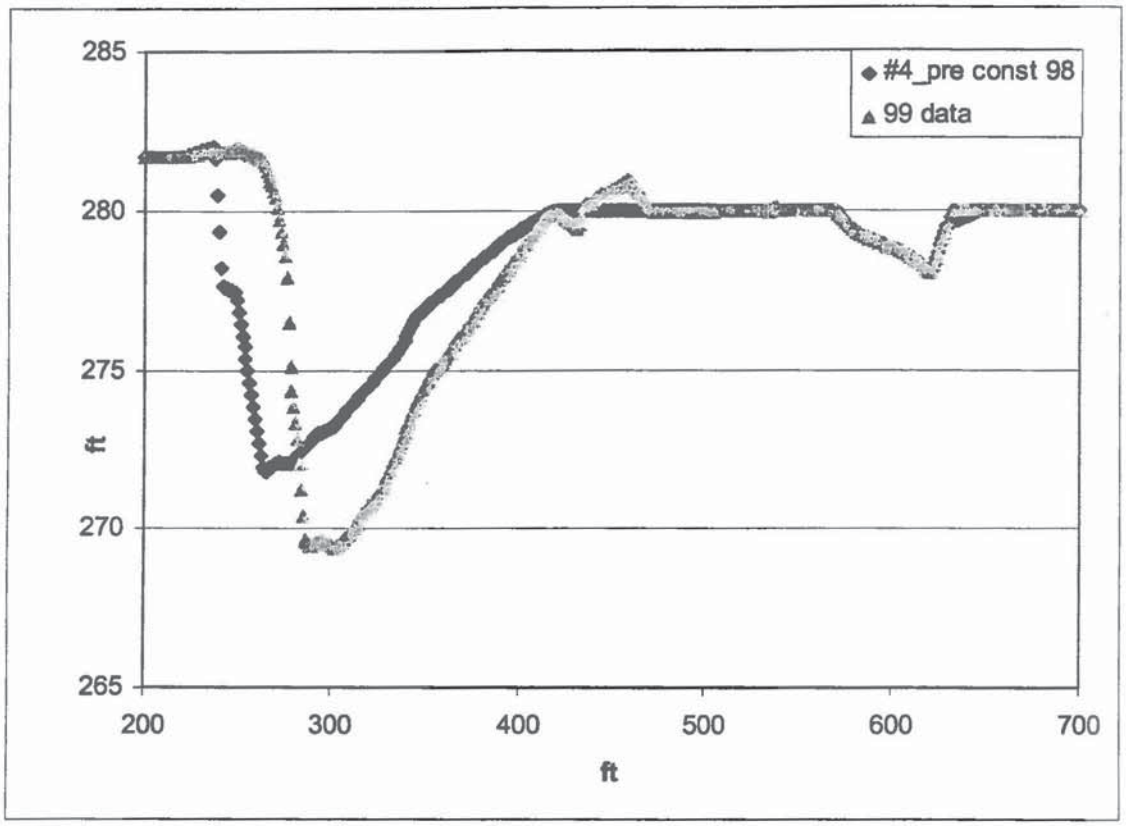


Figure 6: pre construction and 1-year post construction at ELJ 4, 1998 NFS ELJ project.

If one applies this 8.3% reduction in cross-section width observed at ELJ #4 to the current width at Steelhead Haven, one could infer that a post project channel width of approximately 504 ft would be sufficient to insure conveyance without impacting the far bank. It can also be inferred that water surface elevation will not detectable be altered do to project installation. Therefore the 1999 cross-section data for Steelhead Haven was analyzed to determine water surface elevation for post project conditions.

Using data from the 1998 NFS ELJ project and the Manning's Equation (simplified using the wide channel approximation):

$$Q = \frac{1.486\ A\ Y^{2/3} S^{1/2}}{n}$$

a value for roughness (Manning's n) of 0.022 was derived. The appropriate values and results are shown in table 2.

Table 2: determination of Manning's n.

Depth (Y) (ft)	Slope (S)	Discharge (Q) (ft^3/s)	Area (A) (ft^2)	n
4.10	0.0023	16339	1962	0.022

Using this roughness value and other site-specific parameters, the average depth of flow at Steelhead Haven was determined. These data are shown in table 3.

Table 3: average flow depth at Steelhead Haven.

n	Slope (S)	Discharge (Q) (ft^3/s)	Area (A) (ft^2)	Depth (Y) (ft)
0.022	0.0023	16339	2073	3.77

This resulted in a water surface elevation of 261.2 ft for this particular discharge. Keep in mind that this is for the largest flow recorded during the study period of the 1998 NFS ELJ project. Referring back to figure 4, the elevation of the terrace is approximately 264 ft. Therefore, post project conditions for this alternative at the given flow would result in a water surface elevation approximately 3 ft below that of the floodplain terrace. Since there are full time residences located on this floodplain terrace, the magnitude of flow required for inundation is of interest. Using a water surface elevation of 264 ft and backing out the other parameters, Manning's equation was used again to solve for the discharge that would induce the results. The discharge required was found to be in excess of 40,000 cfs. Results are shown in table 4.

Table 4: discharge resulting in floodplain terrace inundation.

Discharge (Q) (ft^3/s)	Slope (S)	n	Area (A) (ft^2)	Depth (Y) (ft)
40461	0.0023	0.022	3571	6.50

The likelihood of a discharge of this magnitude at Steelhead Haven is poor. Based on a 66-year hydrologic record at the NFS gauge near Arlington (USGS 12167000), the 100-year reoccurrence discharge at Arlington is 40300 cfs. This gauge is located approximately RM 5 compared to Steelhead Haven at approximately RM 20. The basin

area at Arlington is approximately 262 square miles compared to 144 at Steelhead Haven (Drury 1999). In summary, deriving a reoccurrence interval for a 40,000 cfs discharge at Steelhead Haven would be speculation, but it can be shown that it would be in excess of 100 years.

Alternative 4: protect area equivalent to landslide runout potential.

As shown previously in this document, the specifications of this alternative are very similar to those of alternative 3 although the location is different. Therefore, technical evaluation and results would be like those for alternative 3, but would be translated an additional 400 ft away from the toe of the slide. One difference between the two alternatives is the location and quantity of private properties that would need to be purchased in order to accommodate the proposed actions. This distinction is discussed in the feasibility section.

Alternative 5: floodplain buyout.

Alternative 5 involves the translation of the river south approximately 2000 ft and would require the excavation of a new river channel. This new channel could be designed with multiple threads and incorporate vegetated islands into the plan form. A specific design would be developed once all barriers to implementation are overcome and would be subject to a more detailed topographic map than currently available. In order to approximate the cross-sectional width of the new channel, a single thread channel was evaluated using similar methods as previously outlined. An average flow depth of 5.5 ft and discharge of 30,000 cfs were assumed. Roughness and slope were assumed to be identical to previously used values. The approximate channel width to accommodate this flow was 540 ft. Results are shown in table 5.

Table 5: width of new excavated channel.

Discharge	Slope	Depth	n	Area	Width
(ft^3/s)		(ft)		(ft^2)	(ft)
30,000	0.0023	5.50	0.022	2960	538

This channel width provides a first order approximation of the area that should be designated for a new channel. The results most likely oversize the channel and are to be used to delineate the appropriate properties that would need to be purchased in order to implement this alternative. More detailed analysis including justification of design flow is needed for final channel sizing.

Feasibility:

It has been shown that in order to successfully address the problems that Steelhead Haven landslide presents, the NFS river's course must be altered to some degree. In any case, private citizens own the majority of land in the vicinity of the slide. Therefore, the feasibility of implementing an alternative is evaluated based upon ability to secure the

private properties required for each installation. There are approximately 100 separate properties local to SHL. Many of these properties have common owners, but it may still be necessary to secure properties from over 30 landowners for a given alternative. Appendix B provides a summary of properties, landowners, landuse, and assessed values for these properties. In addition, each property has been given a buyout priority level. These levels represent the following:

I. Purchase property: no action required
II. Purchase required for alternative 3
III. Purchase required for alternative 4
IV. Purchase required for alternative 5

Level I buyout priority is given to land that is currently interacting with the river. Much of this land is host to the active channel at low flow, while some is floodplain with high connectivity and is within the ordinary high water mark. In all cases properties with level I buyout status are considered vacant, undeveloped, unused land and purchase of these properties most likely would be met with little resistance. Level II buyout includes property that would need to be purchased in order to implement alternative 3. In each case buyout requirements are cumulative in that level II requires that level I property be acquired. Level III requires that levels I and II properties are secured and so on. Therefore, level III priority adds the additional property needed for alternative 4 and level IV for alternative 5.

Alternative 3: provide storage area for landslide materials.

As noted prior, implementation of this alternative is contingent on securing the rights to properties with buyout priorities 1 and 2. The approximate cost to purchase level 1 properties is $181,500. Level 2 properties are estimated at an additional $94,500. Total buyout costs for this alternative are estimated to be $276,000. Construction related costs are approximately $1.0 million. (Appendix C). Therefore, the total cost estimate for this alternative is $1.3 million.

Alternative 4: protect area equivalent to landslide runout potential.

This alternative requires the additional purchase of level III properties at a cost of $832,500. Construction related costs are approximated to be on the order of $1.0 million. This brings the total cost of this course of action to approximately $2.1 million.

Alternative 5: floodplain buyout.

The additional cost to purchase level IV properties is estimated at $547,500, making total land purchases $1,656,000. However, construction related costs for this alternative are reduced to $586,760. Grand total for this alternative is approximately $2.2 million.

Cost estimates are summarized in table 6.

Table 6: cost estimates for alternatives 3, 4, and 5.

Alternative	3	4	5
Construction Costs	$1.0	$1.0	$0.6
Land Acquisition Costs	$0.3	$1.1	$1.6
Total Cost (million)	$1.3	$2.1	$2.2

In can be seen from table 6 that alternative 3 is the most cost effective of the three remaining alternatives. Perhaps more important is that securing properties required for implementing this alternative requires that the rights to only vacant, undeveloped, unused land be purchased. Each of alternatives 4 and 5 require that properties used as fulltime residences be bought out. The probability that all property owners within the areas needed for alternative 4 or 5's plan form are willing sellers is low. Therefore the feasibility of implementation of alternatives 4 and 5 is low.

Conclusions and Recommendations

Hence, it is recommended that implementing alternative 3 be pursued.
Prior to construction a complete h&h geomorphological and geotechnical analysis will be done for this site.

Quantity and Cost Estimates
Quantity and cost estimates for this project are shown in the MCACES section of this appendix.

NOTES:

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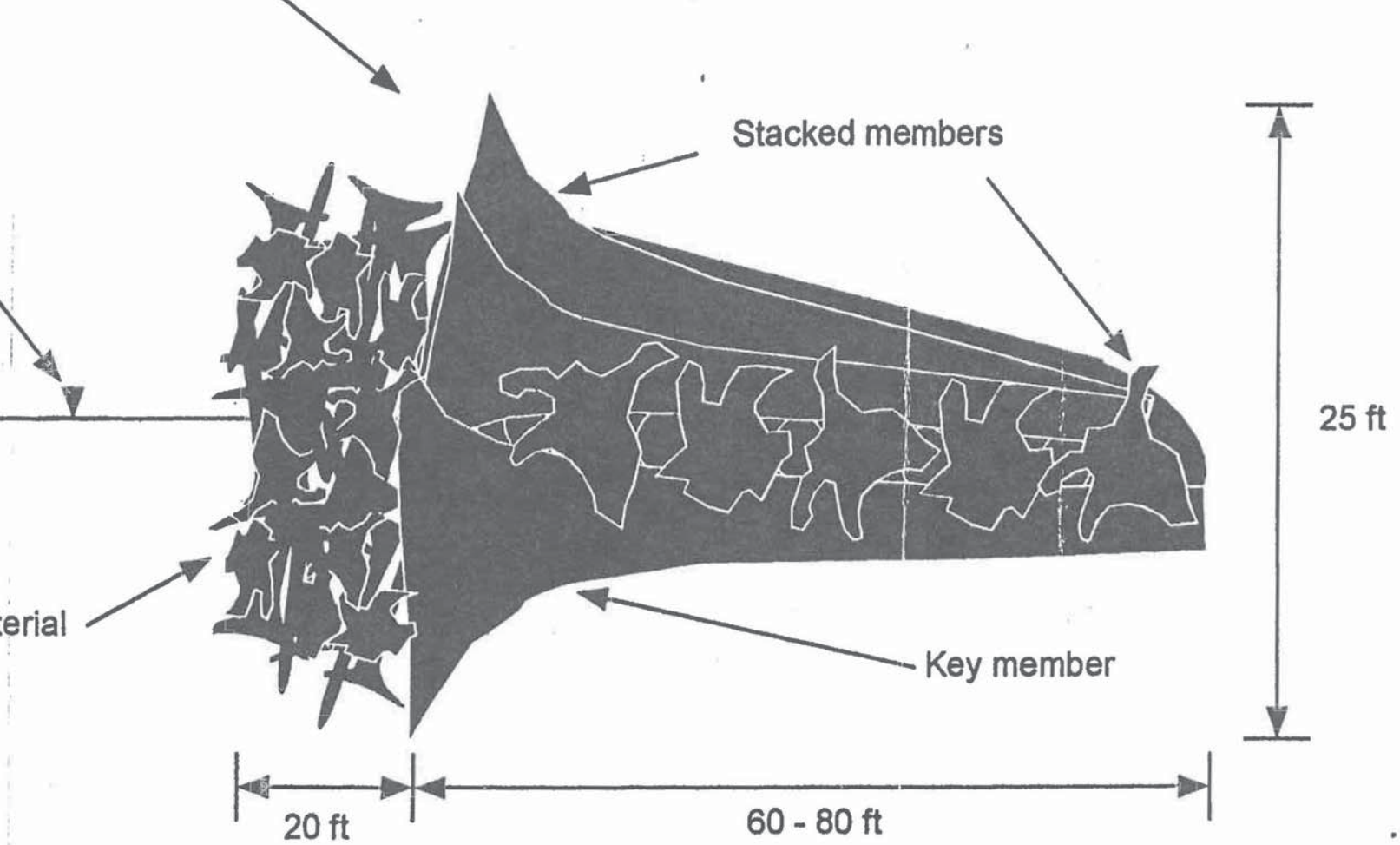

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Tracy Drury	Notes	Date
Tracy Drury		1/19/00

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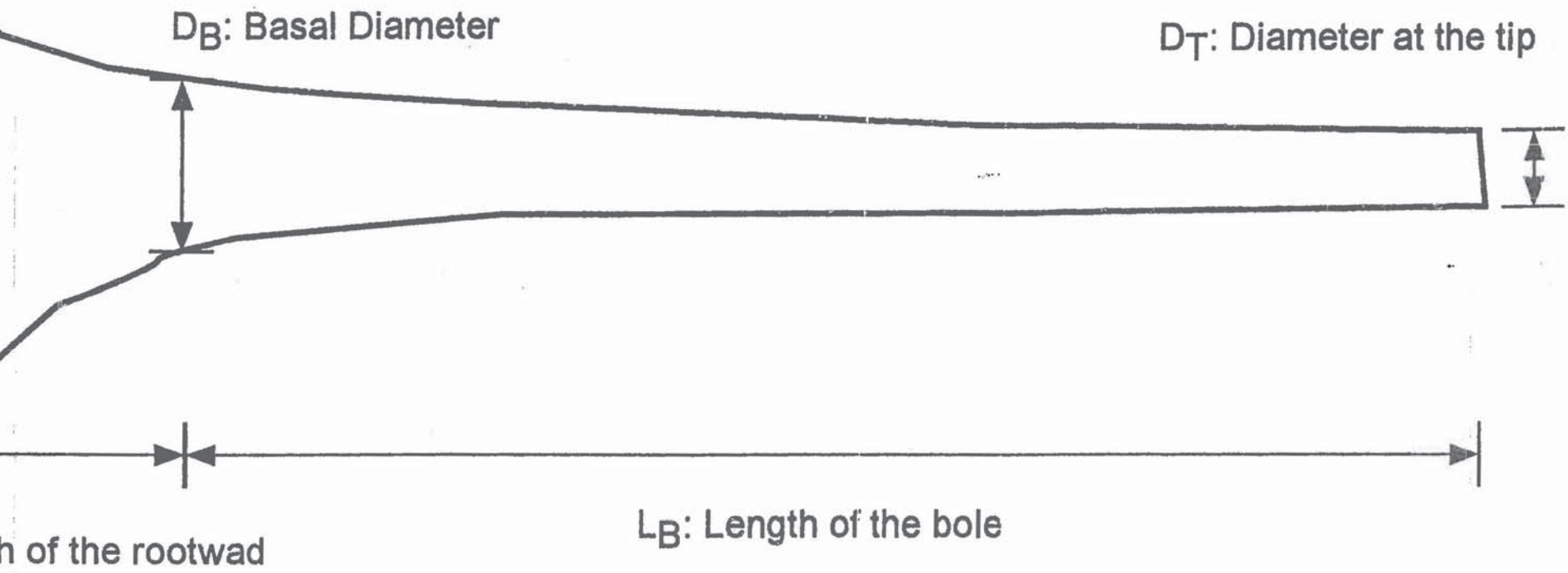

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Tracy Drury		1/25/00

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STILLAGUAMISH RIVER ECOSYSTEM RESTORATION
FEASIBILITY STUDY

PROJECT DESCRIPTION AND WRITE UP

13.0 SITE DESIGNATION: GOLD BASIN LANDSLIDE

Location
The Gold Basin Landslide (GBL) is located on the South Fork Stillaguamish (SFS) river approximately river mile (RM) 48.5.

Site Constraints/Problems
GBL is a composite of 3 individual headward-expanding lobes in very close proximity to one another. The material composition of these lobes is quite similar, but each appears to function individually with respect to activity and dormancy. This landslide was first investigated by Shannon and Wilson in 1954 who "...cast doubt on the wisdom of attempting corrective action for the purpose of reducing the turbidity of the river". Williams (1975) identified the negative impacts of the slide on the fisheries resource in a catalog of Washington streams and salmon utilization. The following is an excerpt from the publication:

> "The major limiting factor (to salmon utilization) in the South Fork Stillaguamish system is the massive earth slide located in the right back approximately RM 48.7. This causes heavy silt loading on spawning beds during periods of heavy runoff. ... Containment of the slide would improve all of the spawning riffles for anadromous fish use."

Benda and Collins (1992) investigated the slope stability of GBL relative to adjacent properties. GBL displayed maximum landslide activity, relative to adjacent properties, and possessed soil composition conducive to debris flows. These debris flows are capable of reaching the SFS river from the heads of the respective gullies, approximately 0.3 miles. Benda and Collins (1992) go on to state that: "Landslide activity in Gold Basin will cease only when the gully heads have migrated back to the ridgecrest, thereby obliterating the groundwater accumulation zones. This could take several centuries". Miller (1999) indicated that reduction in sediment delivery to the SFS is contingent upon long-term storage along the sub-basin valley floors and in fans at the mouths of the respective lobes.

A summary of status quo conditions for GBL are listed below. For detailed analyses, please refer to the afore-mentioned reports.

Status Quo:

- Slope instability
- Fine sediment source to SFS and mainstem
- Turbidity and temperature concerns

- Downstream pool filling and redd entombing
- Catastrophic failure potential
- Floodplain encroachment

Overview:

Gold Basin Landslide is composed of glacial deposited sand and silt. These deposits are stratified both vertically and laterally (Benda and Collins 1992). Sand deposits grade abruptly into think sequences of horizontally bedded silt. Groundwater flow patterns through these deposits are complex and unpredictable due to spatial heterogeneity (Miller 1999). The complex nature of groundwater flow patterns is predicated on the juxtaposition of the effects of variable permeability and gradient. Zones of perched groundwater have contributed to countless seeps with variable elevation and volume. Over time, overland flow has channelized forming 3 individual channels that drain the slide area. These channels have headcut and incised independently resulting in 3 distinct headscarp lobes within a larger bowl-shaped basin draining to the SFS. The streams draining these lobes deliver a steady flux of fine sediment to the river, which is promptly integrated into the river's flow and transported downstream. Turbidity is greatly increased downstream of the slide; which can lead to an increase in temperature during summer months and smothering of salmon eggs due to fine sediment intrusion into redds. It is estimated the containment of this slide (and Steelhead Haven on the North Fork) would double the total natural fish production of the river system (Snohomish County Planning Department 1974).
Based upon interpretation of the aerial photo record, the three lobes of GBL appear to function independently with respect to their periods of activity and dormancy. In addition, there does not appear to be correlation between lobes in terms of the direction and rate of headward expansion. In the early 90's (personal communication with Pat Stevenson), a massive debris flow from the head of the upstream lobe made its way to the SFS forming an extensive fan at the base of the lobe. This fan has since vegetated and vegetation has lined much of the channel draining this lobe. The stream is slightly colored, but does not currently pose a turbidity concern for the SFS. A debris flow from the middle lobe in 1998 blocked the SFS from the channel north of the forested island. All SFS flow currently travels through the channel south of this island. This blockage creates an area where fluvial sediment can deposit and be stored; and isolates the channel from a large scarp face located between the middle and downstream lobes. However, the available storage area is small in relation to the volume of material delivered. Annual sediment delivery from the downstream lobe has already filled much of the available area, and future debris flows would be hindered little in reaching the mainstem SFS.

Project Objectives and Criteria
The objectives developed for potential project remedies range from interruption of the imminent geomorphic processes and rehabilitation aimed at historical reconstruction to alteration of embedded human demographic patterns. These objectives aim to address the overall goal of restoring salmonids to healthy harvestable levels. Objectives are summarized below.

Objectives:

h. Eliminate toe cutting of slope
i. Reduce slope failure hazard
j. Stabilize slope
k. Create local holding habitat and increase cover
l. Reduce fine sediment inputs
m. Reduce floodplain encroachment

Alternatives

Five alternative courses of action were evaluated based upon ability to meet objectives, technical merit, and feasibility of implementation

- Alternative 1: No action
  Selecting the "No Action" alternative implies that status quo conditions are deemed acceptable or that no other alternative possesses technical merit and feasibility of implementation. In considering the acceptability of status quo conditions one must take into consideration that:
  - Large, persistent, deep-seated landslides don't just go away
  - Current slide activity has a detrimental effect on fisheries habitat
  - Listing of Chinook under the Endangered Species Act mandates action
  - Catastrophic failure potential places human lives and properties at risk

  The remaining alternatives should be judged individually on the basis of technical merit and feasibility

- Alternative 2: Stabilize toe of the debris flow from the middle lobe
  Slope failures in lobe #2 that occurred in 1998 and 1999 have filled the channel north of the forested island that was toe cutting the landslide. This has forced the river away from the landslide and into the southern channel. Local fisheries managers have considered this relocation desirable (personal communication with Pat Stevenson and Bob Penhale). The main objective within this alternative is to prevent the river from eroding its way back through these fines to the toe of the slope re-establishing undesirable conditions. This would be accomplished by installing a Large Wood Debris (LWD) revetment at the interface of the toe of the debris flow from lobe two and the SFS. Post project conditions would improve holding habitat for adult Chinook due to scour pool development local to the LWD revetment, as well as increase cover and complexity for juvenile salmonids and resident stream fishes. This revetment would be placed so that its existence does not constrict the existing channel. Revetment construction, specifications, and log metrics are outlined in the appendix section.

- Alternative 3: Create storage area for sediment delivered from lobes

- Alternative 4: Prevent catastrophic effects from future debris flows

- Alternative 5: Retire campground and excavate new channel

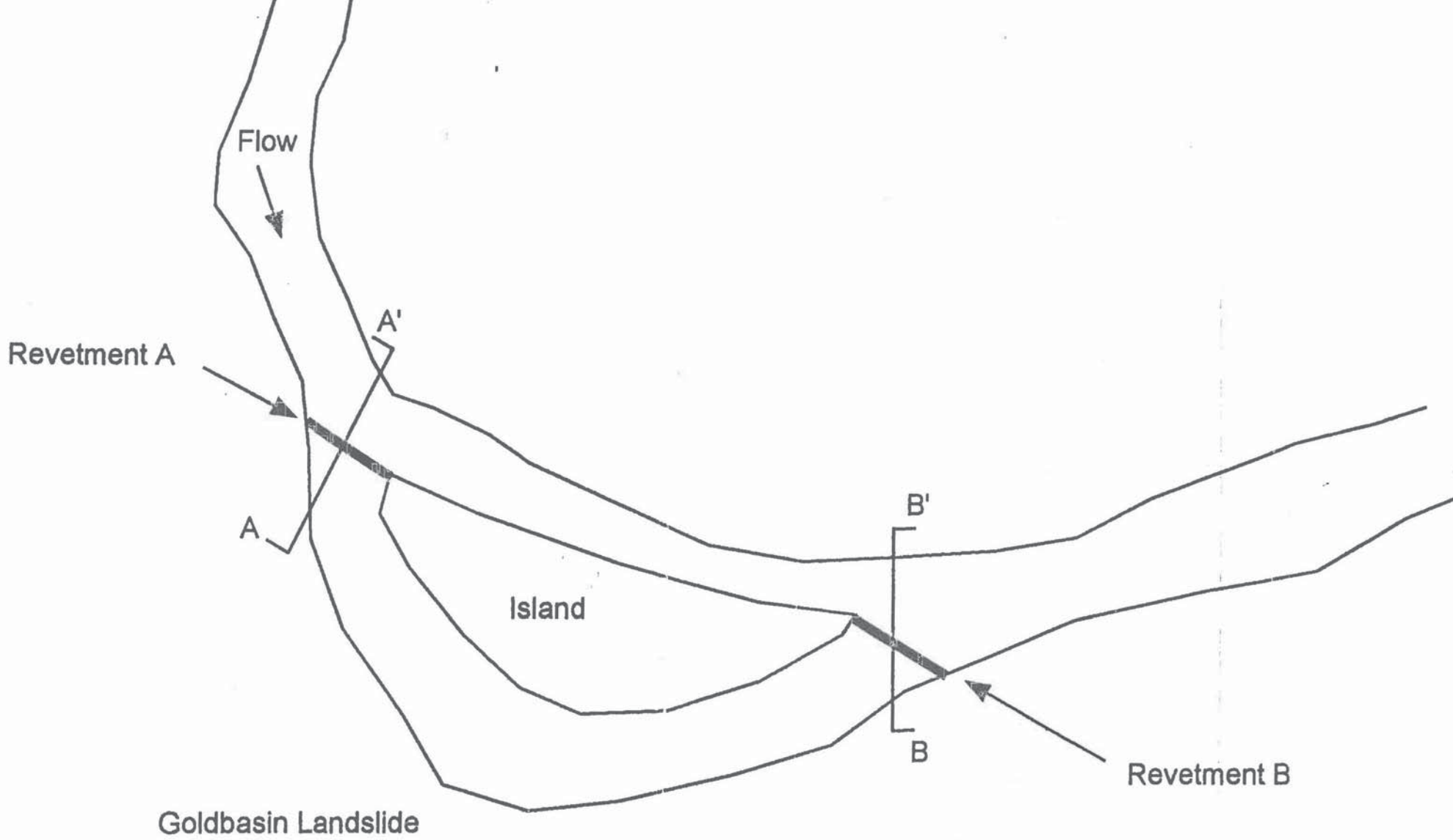
This report is in feasibility form and full evaluation of alternatives 3, 4, and 5 has not been completed.

Conclusions and Recommendations

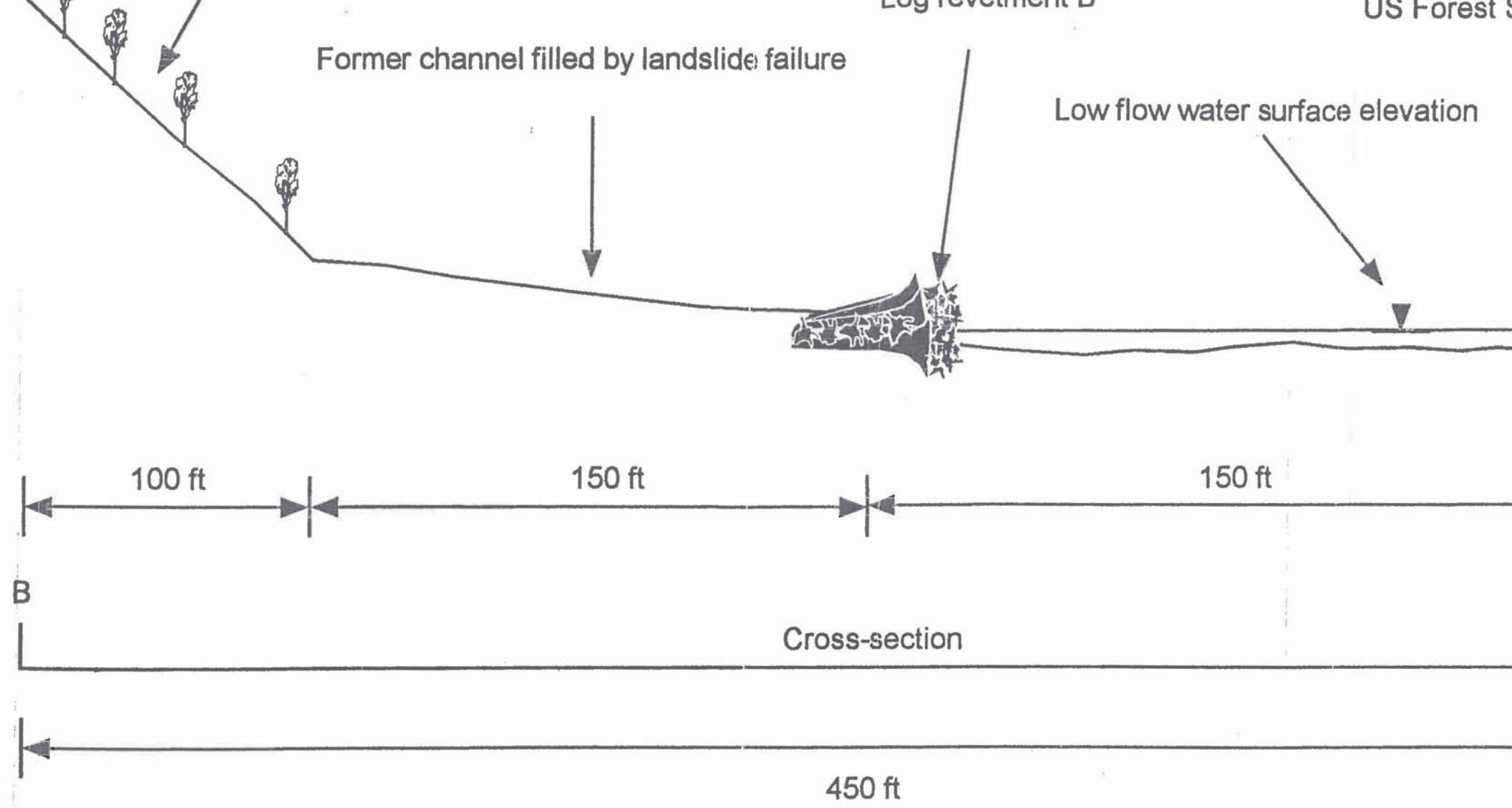
Alternative No. 2 is recommended however analysis of alternatives 3,4, and 5 should be done during pre construction studies and some aspects of these alternatives may be added to 2 prior to construction. A full h&h and geomorphological and geotechnical analysis will be conducted prior to project construction. Also as part of any alternative the Forest Service should reconsider the use of those campsites adjacent to this slide area during periods when the slides are possible.

Cost Items and Quantities

A complete cost and quantity estimate is included in the MCACES section of this appendix.

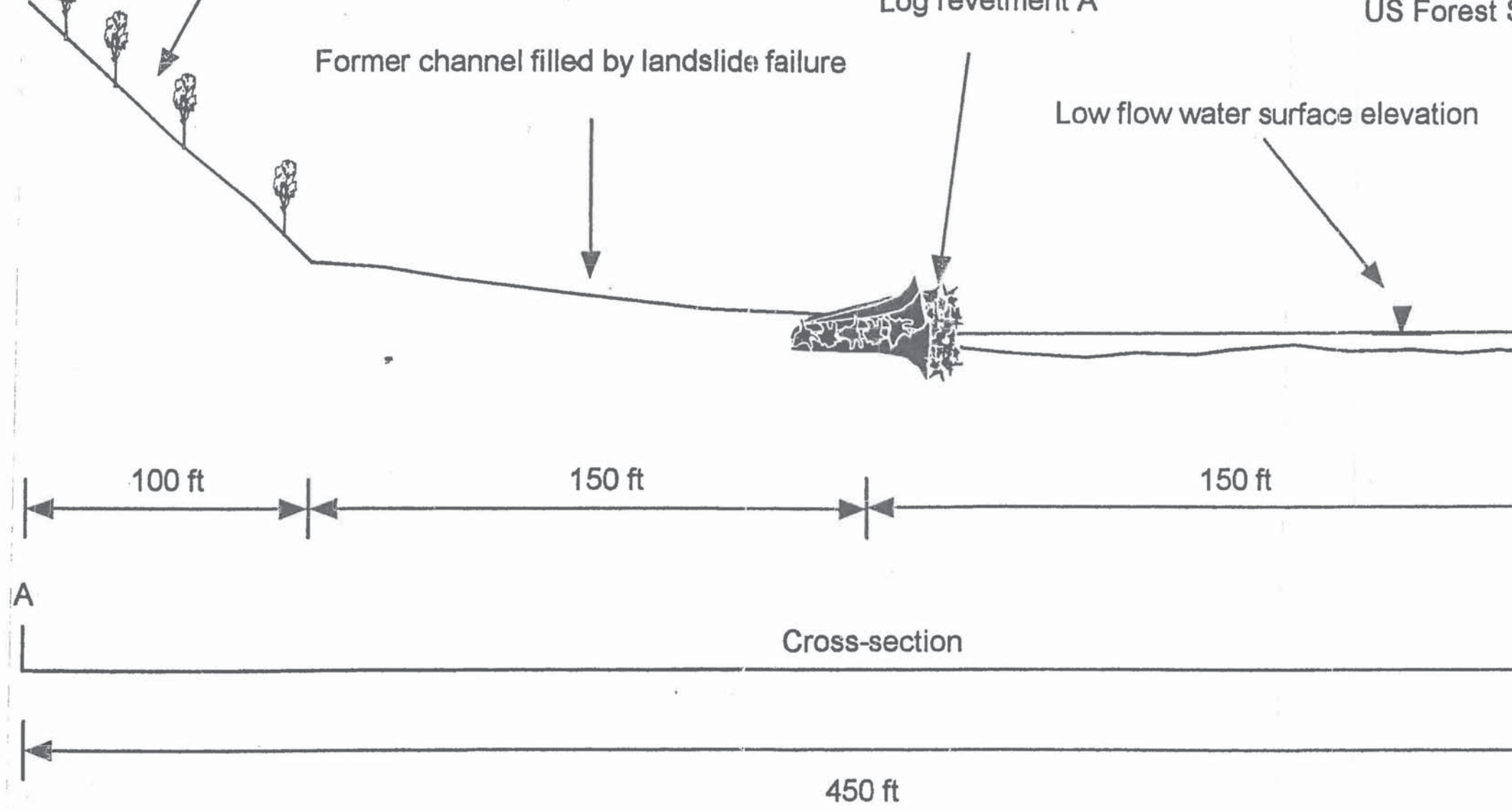


Project:	Goldbasin Landslide, South Fork Stillaguamish river at Verlot	
Typical:	Plan view of existing conditions and proposed project placement	
Design By	Tracy Drury	Notes



Project:	Goldbasin Landslide, South Fork Stillaguamish river at Verlot
Typical:	Proposed placement of log revetment B and existing conditions for cross-section B -

Design By	Tracy Drury	Notes



Project:	Goldbasin Landslide, South Fork Stillaguamish river at Verlot
Typical:	Proposed placement of log revetment A and existing conditions for cross-section A - A

Design By	Tracy Drury	Notes

APPENDIX E

MCACES COST ESTIMATE

AND

QUANTITY TAKE OFFS

BASED ON THE FEASIBILITY LEVEL REPORT DATED SEPTEMBER 2000

PROJECT: Stilliguamish River Ecosystem Restoration Study
LOCATIO Snohomish County, Washington

DISTRICT: Seattle
POC: Denny Dodge, Chief, Contract Admin/Cost Engr.

ACCOUNT NUMBER	FEATURE DESCRIPTION	CURRENT MCACES ESTIMATE PREPARED: Oct 00 EFFECTIVE PRICING LEVEL: Oct 00 COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZED/BUDGET YEAR: EFFECTIVE PRICING LEVEL: COST ($K)	CNT ($K)	OTAL ($K)	FULLY FUNDED ESTIMATE COST ($K)	CNTG ($K)	FULL ($K)
06	FISH AND WILDLIFE FACILITIES	11,802	2,360	20%	14,162				14,463	2,891	17,354
01	LANDS AND DAMAGES										
	Lands and Damages	1,430	360	25%	1,790				1,582	316	1,898
	Non-Federal Sponsor's Admin Costs	626	159	25%	785				689	134	823
	Federal Review and Assistance Costs	149	37	25%	186				163	33	196
30	PLANNING, ENGINEERING AND DESIGN	1,230	246	20%	1,476				1,486	297	1,783
31	CONSTRUCTION MANAGEMENT	4,853	971	20%	5,824				6,730	1,347	8,077
	TOTAL PROJECT COSTS	$20,090	$4,133		$24,223				$25,113	$5,018	$30,131

THIS TPCS REFLECTS A PROJECT COST CHANGE OF $0

DISTRICT APPROVED:

Stephen R Pierce for CHIEF, CONTACT ADMINISTRATION/COST ENGINEERING

CHIEF, REAL ESTATE

CHIEF, PLANNING

CHIEF, ENGINEERING

CHIEF, CONSTRUCTION

CHIEF, OPERATIONS

CHIEF, PROGRAMS MANAGEMENT

Bill Gilbrough PROJECT MANAGER

DDE (PM)

BASED ON THE FEASIBILITY LEVEL REPORT DATED SEPTEMBER 2000

PROJECT: Stilliguamish River Ecosystem Restoration Study
LOCATIO Snohomish County, Washington

DISTRICT: Seattle
POC: Denny Dodge, Chief, Contract Admin/Cost Engr.

ACCOUNT NUMBER	FEATURE DESCRIPTION	CURRENT MCACES ESTIMATE PREPARED: Oct 00 / EFFECTIVE PRICING LEVEL: Oct 00 COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZED/BUDGET YEAR: / EFFECTIVE PRICING LEVEL: COST ($K)	CNT ($K)	OTAL ($K)	FULLY FUNDED ESTIMATE FEATUR MIDPT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
06	FISH AND WILDLIFE FACILITIES												
06.03	WILDLIFE FACILITIES AND SANCTUARIES												
06.03.05	HABITAT AND FEEDING FACILITIES												
	1 Port Susan	839	168	20%	1,007				Jun 07	23.70%	1,038	208	1,246
	2 South Pass	1,329	266	20%	1,595				Jun 04	12.50%	1,495	299	1,794
	3 Hat Slough	698	140	20%	838				Jun 04	12.50%	786	157	943
	6 North Meander	769	154	20%	923				Jun 04	12.50%	865	173	1,038
	8 Koch Slough Weir	431	86	20%	517				Jun 03	9.10%	470	94	564
	9 Portage Creek	3,462	692	20%	4,154				Jun 11	40.30%	4,857	971	5,828
	10 Cloverdale	802	160	20%	962				Jun 04	12.50%	902	180	1,082
	11 Hazel Slide	1,290	258	20%	1,548				Jun 05	16.10%	1,498	299	1,797
	12 Gold Basin Slide	601	120	20%	721				Jun 03	9.10%	656	131	787
	14 South Meander	1,581	316	20%	1,897				Jun 06	19.90%	1,896	379	2,275
	TOTAL CONSTRUCTION COST	$11,802	$2,360		$14,162						$14,463	$2,891	$17,354
01	LANDS AND DAMAGES												
	1 Port Susan												
	Lands and Damages	6	2	33%	8				Oct 01	3.70%	7	1	8
	Non-Federal Sponsor's Admin Costs	7	2	29%	9				Oct 01	3.70%	8	1	9
	Federal Review and Assistance Cost	5	1	20%	6				Oct 01	3.70%	5	1	6
	2 South Pass												
	Lands and Damages	480	120	25%	600				Sep 02	4.20%	521	104	625
	Non-Federal Sponsor's Admin Costs	27	7	26%	34				Sep 02	4.20%	29	6	35
	Federal Review and Assistance Cost	8	2	25%	10				Sep 02	4.20%	8	2	10
	3 Hat Slough Entrance												
	Lands and Damages	434	109	25%	543				Jan 03	8.50%	491	98	589
	Non-Federal Sponsor's Admin Costs	14	4	29%	18				Jan 03	8.50%	17	3	20
	Federal Review and Assistance Cost	5	1	20%	6				Jan 03	8.50%	6	1	7

BASED ON THE FEASIBILITY LEVEL REPORT DATED SEPTEMBER 2000

PROJECT: Stilliguamish River Ecosystem Restoration Study
LOCATIO Snohomish County, Washington

DISTRICT: Seattle
POC: Denny Dodge, Chief, Contract Admin/Cost Engr.

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6	North Meander												
	Lands and Damages	14	4	29%	18				Jan 02	5.30%	16	3	19
	Non-Federal Sponsor's Admin Costs	14	4	29%	18				Jan 02	5.30%	16	3	19
	Federal Review and Assistance Cost	9	2	22%	11				Jan 02	5.30%	10	2	12
8	Koch Slough Weir												
	Lands and Damages	1	0	0%	1				Jun 02	4.20%	1	0	1
	Non-Federal Sponsor's Admin Costs	7	2	29%	9				Jun 02	4.20%	8	1	9
	Federal Review and Assistance Cost	3	1	33%	4				Jun 02	4.20%	3	1	4
9	Portage Creek												
	Lands and Damages	298	75	25%	373				Dec 01	4.20%	324	65	389
	Non-Federal Sponsor's Admin Costs	324	81	25%	405				Dec 01	4.20%	352	70	422
	Federal Review and Assistance Cost	68	17	25%	85				Dec 01	4.20%	74	15	89
10	Cloverdale												
	Lands and Damages	35	9	26%	44				May 03	8.50%	40	8	48
	Non-Federal Sponsor's Admin Costs	20	5	25%	25				May 03	8.50%	23	4	27
	Federal Review and Assistance Cost	6	2	33%	8				May 03	8.50%	8	1	9
11	Hazel Slide												
	Lands and Damages	72	18	25%	90				Jul 02	4.20%	78	16	94
	Non-Federal Sponsor's Admin Costs	159	40	25%	199				Jul 02	4.20%	173	34	207
	Federal Review and Assistance Cost	28	7	25%	35				Jul 02	4.20%	30	6	36
12	Gold Basin Slide												
	Lands and Damages	0	0	0%	0					0.00%	0	0	0
	Non-Federal Sponsor's Admin Costs	7	2	29%	9				Jun 02	4.20%	8	1	9
	Federal Review and Assistance Cost	3	1	33%	4				Jun 02	4.20%	3	1	4
14	South Meander												
	Lands and Damages	58	15	26%	73				Nov 03	12.40%	68	14	82
	Non-Federal Sponsor's Admin Costs	33	8	24%	41				Nov 03	12.40%	38	8	46
	Federal Review and Assistance Cost	9	2	22%	11				Nov 03	12.40%	10	2	12

BASED ON THE FEASIBILITY LEVEL REPORT DATED SEPTEMBER 2000

PROJECT: Stilliguamish River Ecosystem Restoration Study
LOCATIO Snohomish County, Washington

DISTRICT: Seattle
POC: Denny Dodge, Chief, Contract Admin/Cost Engr.

ACCOUNT NUMBER	FEATURE DESCRIPTION	CURRENT MCACES ESTIMATE PREPARED: Oct 00 EFFECTIVE PRICING LEVEL: Oct 00 COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZED/BUDGET YEAR: EFFECTIVE PRICING LEVEL: COST ($K)	CNT ($K)	OTAL ($K)	FULLY FUNDED ESTIMATE FEATUR MIDPT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
	15 Kline Farm Disposal Site and Access												
	Lands and Damages	32	8	25%	40				Dec 02	8.50%	36	7	43
	Non-Federal Sponsor's Admin Costs	14	4	29%	18				Dec 02	8.50%	17	3	20
	Federal Review and Assistance Cost	5	1	20%	6				Dec 02	8.50%	6	1	7
	TOTAL LANDS AND DAMAGES												
	Lands and Damages	1,430	360		1,790						1,582	316	1,898
	Non-Federal Sponsor's Admin Costs	626	159		785						689	134	823
	Federal Review and Assistance Cost	149	37		186						163	33	196
30	PLANNING, ENGINEERING AND DESIGN	1,230	246	20%	1,476				Apr 06	20.80%	1,486	297	1,783
31	CONSTRUCTION MANAGEMENT	2,093	419	20%	2,512				Jun 07	25.20%	2,620	525	3,145
	MONITORING	2,760	552	20%	3,312				Jun 12	48.90%	4,110	822	4,932
	TOTAL PROJECT COSTS	$20,090	$4,133		$24,223						$25,113	$5,018	$30,131

Stilliguamish River
Ecosystem Restoration Study
Washington

Designed By: HDR, Druwry, USACE Seattle Dist
Estimated By: Contract Admin/Cost Engr. Sec.

Prepared By: Garrott and Pierce

Preparation Date: 09/19/00
Effective Date of Pricing: 10/01/00
Est Construction Time: 900 Days

Sales Tax: 8.2%

Construction Narrative

No overtime is anticipated for this project. All construction equipment is locally available. All of the anticipated construction is conventional.

Excavated materials will be disposed of at nearby commercial sites.

The projects will be completed over a 7 year period.

		QUANTITY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	INS&BOND	B&O TAX	TOTAL COST	UNIT COST
06	Fish and Wildlife Facilities									
06.03	Wildlife Facilities & Sanctuary									
06.03.73	Habitat									
06.03.73. 1	Port Susan Estuary Restoration		641,119	97,121	33,221	46,828	16,366	4,173	838,827	
06.03.73. 2	South Pass (Smith Farms)		1,015,582	153,846	52,624	74,179	25,925	6,611	1,328,766	
06.03.73. 3	Hat Slough Entrance		533,433	80,808	27,641	38,962	13,617	3,472	697,933	
06.03.73. 6	North Meander/Cook Slough		588,020	89,077	30,469	42,949	15,010	3,828	769,354	
06.03.73. 8	Koch (Cook) Slough Weir		329,172	49,865	17,057	24,043	8,403	2,143	430,682	
06.03.73. 9	Portage Creek		2,645,816	400,804	137,098	193,252	67,539	17,223	3,461,732	
06.03.73.10	Cloverdale		612,767	92,826	31,752	44,757	15,642	3,989	801,732	
06.03.73.11	Hazel Slide		985,861	149,344	51,084	72,008	25,166	6,417	1,289,881	
06.03.73.12	Gold Basin Slide		459,385	69,590	23,804	33,554	11,727	2,990	601,050	
06.03.73.14	South Meander/Thomsen Slough		1,208,407	183,057	62,616	88,263	30,847	7,866	1,581,055	
	TOTAL Habitat		9,019,563	1,366,338	467,366	658,793	230,241	58,712	11,801,013	
	TOTAL Wildlife Facilities & Sanctuary		9,019,563	1,366,338	467,366	658,793	230,241	58,712	11,801,013	
	TOTAL Fish and Wildlife Facilities		9,019,563	1,366,338	467,366	658,793	230,241	58,712	11,801,013	
	TOTAL Stilliguamish River	1.00 EA	9,019,563	1,366,338	467,366	658,793	230,241	58,712	11,801,013	11801013

SUMMARY REPORTS SUMMARY PAGE

DETAILED ESTIMATE DETAIL PAGE

No Backup Reports...

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0. 5. Prime Contractor	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST

0. 5. Prime Contractor

				QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
0. 5. Prime Contractor													
0. 5. 0. Overhead Items - AA													
MIL	<01036 0300 >	Field personnel, general superintendent		30.00	MO	UFLDSUGE1	5,172	177,299	0	0	0	177,299	5909.97
USR	< >	4x2 pickup truck		30.00	MO	FA-AGENS	0	178,244	0	0	8,250	186,494	6216.47
MIL	<01036 0580 >	Field personnel, field engineer		30.00	MO	UFLDFENG1	5,172	145,677	0	0	0	145,677	4855.90
USR	< >	4x4 pickup truck		30.00	MO	FA-AGENS	0	178,244	0	0	13,500	191,744	6391.47
AF	<01594 1400 >	Toilet, portable chemical, rent per month		90.00	EA	N/A	0	0	0	6,979	0	6,979	77.55
AF	<01594 0450 >	Office trailer, rent per month, furnished, no hookups, 50' x 10'		30.00	MO	N/A	0	0	0	9,089	0	9,089	302.96
USR	< >	Power usage		30.00	MO	FA-AGENS	0	178,244	0	0	3,000	181,244	6041.47
USR	< >	Phone		30.00	MO	FA-AGENS	0	178,244	0	0	4,500	182,744	6091.47
USR	< >	Water/Sewer		30.00	MO	FA-AGENS	0	178,244	0	0	2,250	180,494	6016.47
L CIV	< >	Schedule updates		14.00	EA	UFLDCSPE1	56	1,457	0	417	0	1,874	133.82
CIV	<01533 0200 >	Barricades, 5' high, 3 rail @ 2" x 8", movable		50.00	LF	CODLB6	5	177	20	1,488	0	1,685	33.69
AF	<01534 0100 >	Fencing, 11 ga, chain link, 6' high		14.00	CLF	ALABCLAB2	299	9,948	0	5,802	0	15,750	1124.99
AF	<01580 0010 >	Sign, hi-intensity reflectorized, buy		400.00	SF	N/A	0	0	0	4,376	400	4,776	11.94
AF	<01594 1350 >	Office, storage boxes, 28' x 10', rent per month		30.00	MO	N/A	0	0	0	3,084	0	3,084	102.79
AF	<01714 0300 >	Cleanup, site debris clean up & removal		17.00	ACR	ULABA5	156	5,227	304	0	0	5,531	325.36
L MIL	<01036 0640 >	Field personnel, surveyor		2.00	MO	UFLDSRVS1	345	7,480	0	0	0	7,480	3739.95
USR	< >	4x4 pickup truck		2.00	MO	FA-AGENS	0	11,883	0	0	900	12,783	6391.47
B MIL	< >	Traffic Control		75.00	DAY		0	36,000	750	0	0	36,750	490.00
USR	< >	Straw bales		1000.00	EA		0	0	0	5,410	0	5,410	5.41
USR	< >	Mechanical Application of Straw		1.00	LS	CLABB64	200	6,738	2,193	0	0	8,931	8931.33
M HTW	< >	Proj documentation photos, 5" x 7", color, 24 count		60.00	ROL	N/A	0	0	0	519	0	519	8.66
	TOTAL	Overhead Items - AA		1.00	EA		11,406	1,293,106	3,268	37,163	32,800	1,366,337	1366337.00

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06. Fish and Wildlife Facilities										
06.03. Wildlife Facilities & Sanctuary										
06.03.73. Habitat										
06.03.73. 1. Port Susan Estuary Restoration										
06.03.73. 1_05. Mob, Demob & Prep Work										
USR AA < > Mobilization & Demobilization	1.00	JOB		0	10,000	25,000	5,410	0	40,410	40410.00
TOTAL Mob, Demob & Prep Work				0	10,000	25,000	5,410	0	40,410	
06.03.73. 1_10. Island Construction										
MIL AA <02224 7110 > Excavating, bulk, dozer, large area, open site, shaping w/small dozer	900.00	CY	CODTB10L	29	1,093	493	0	0	1,587	1.76
MIL AA <02232 0135 > Excavate & load, hydr excavator, 2 CY, lt matl	1800.00	CY	CODEB12C	25	954	1,112	0	0	2,066	1.15
L AF AA < > Hauling, hwy haulers, 12 CY, 6 mi round trip	4625.00	CY	COEIB34B	385	14,119	13,536	0	0	27,655	5.98
USR AA < > Fill Dirt	5460.00	CY		0	0	0	29,539	0	29,539	5.41
B MIL AA <02215 1220 > River Gravel, front-end loader, 40 - 60 HP, no compaction	1200.00	CY	CODFB10N	60	2,278	1,085	25,968	0	29,331	24.44
RSM AA <02270 0100 > Rip-rap, random, machine placed for slope protection	3600.00	CY	CODET	929	34,485	43,317	61,778	0	139,580	38.77
L MIL AA <02234 0340 > Hauling, hwy haulers, 12 CY, 1 mi round trip @ 20 MPH (4.2 cyc/hr)	5460.00	CY	COEIB34B	218	8,001	7,671	0	0	15,671	2.87
MIL AA <02224 7110 > Excavating, bulk, dozer, large area, open site, shaping w/small dozer	5460.00	CY	CODTB10L	175	6,633	2,992	0	0	9,625	1.76
RSM AA <02220 5000 > Compaction, riding, vibrating roller, 6" lifts, 2 passes	5460.00	CY	COFCB10Y	22	829	328	0	0	1,157	0.21
TOTAL Island Construction	12.00	EA		1,843	68,391	70,535	117,284	0	256,211	21350.88
06.03.73. 1_20. Rootwads										
B MIL AA < > LWD	324.00	EA	CODEB12C	108	4,186	4,880	140,227	0	149,294	460.78
TOTAL Rootwads	324.00	EA		108	4,186	4,880	140,227	0	149,294	460.78
06.03.73. 1_35. Landscaping										
MIL LS <02241 0805 > Loam or topsoil, furnish & place, imported, 6" deep	2400.00	CY	CODFB10S	212	9,572	3,969	51,389	0	64,930	27.05
B RSM LS < > Salmonberry	3480.00	EA	ULABM	87	3,487	166	13,450	0	17,103	4.91
B RSM LS < > Snowberry	3480.00	EA	ULABM	50	1,993	95	12,329	0	14,417	4.14
B RSM LS < > Flowering Currant	3480.00	EA	ULABM	87	3,487	166	12,329	0	15,982	4.59
B RSM LS < > Red Alder	3480.00	EA	CLABB80	116	4,868	595	13,450	0	18,913	5.43
B RSM LS < > Oregon Grape	180.00	EA	ULABM	5	180	9	812	0	1,001	5.56

06.03. Wildlife Facilities & Sanctuary		QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
B RSM LS <	> Salal	180.00	EA	ULABM	5	180	9	754	0	943	5.24
TOTAL	Landscaping	1.00	JOB		560	23,767	5,008	104,514	0	133,289	133288.53
06.03.73. 1_40.	Floating Plant										
USR LS <	> Crane with Operator	100.00	HR		0	4,763	29,768	0	0	34,530	345.30
USR LS <	> Tug with Operator	100.00	HR		0	4,763	11,907	0	0	16,670	166.70
USR LS <	> Small Barge	18.00	DAY		0	0	10,716	0	0	10,716	595.35
TOTAL	Floating Plant	12.00	EA		0	9,526	52,391	0	0	61,916	5159.70
TOTAL	Port Susan Estuary Restoration				2,511	115,870	157,813	367,435	0	641,119	

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06.03.73. 2. South Pass (Smith Farms)										
06.03.73. 2_05. Mob, Demob & Prep Work										
USR AA < > Mobilization & Demobilization	1.00	JOB		0	5,000	10,000	2,705	0	17,705	17705.00
TOTAL Mob, Demob & Prep Work				0	5,000	10,000	2,705	0	17,705	
06.03.73. 2_10. Excavation of Levee/Fill Ditch										
L MIL AA <02232 0140 > Excavate & load, hydr excavator, 2 CY, medium matl	48530	CY	CODEB12C	1,140	44,264	51,597	0	0	95,861	1.98
MIL AA <02224 7100 > Excavating, bulk, dozer, small area, open site, shaping w/small dozer	48530	CY	CODTB10L	1,165	44,216	19,946	0	0	64,162	1.32
RSM AA <02220 5000 > Compaction, riding, vibrating roller, 6" lifts, 2 passes	48530	CY	COFCB10Y	194	7,367	2,917	0	0	10,284	0.21
MIL AA <02220 9010 > Compaction, water, truck, 3000 gal, 6 mile haul	4830.00	CY	COKBB45	54	2,058	1,262	1,045	0	4,365	0.90
L MIL AA <02232 0140 > Excavate & load, hydr excavator, 2 CY, medium matl	10500	CY	CODEB12C	247	9,577	11,164	0	0	20,741	1.98
TOTAL Excavation of Levee/Fill Ditch	59030	CY		2,800	107,482	86,885	1,045	0	195,412	3.31
06.03.73. 2_15. Levee Construction										
L MIL AA <02234 0340 > Hauling, hwy haulers, 12 CY, 1 mi round trip @ 20 MPH (4.2 cyc/hr)	10500	CY	COEIB34B	420	15,386	14,751	0	0	30,137	2.87
USR AA < > Fill Dirt	23111	CY		0	0	0	125,031	0	125,031	5.41
B AF AA < > Hauling, hwy haulers, 12 CY, 24 mi round trip, soil	23111	CY	COEIB34B	2,311	84,660	81,170	0	0	165,831	7.18
MIL AA <02224 7110 > Excavating, bulk, dozer, large area, open site, shaping w/small dozer	23111	CY	CODTB10L	740	28,075	12,665	0	0	40,740	1.76
RSM AA <02220 5000 > Compaction, riding, vibrating roller, 6" lifts, 2 passes	23111	CY	COFCB10Y	92	3,508	1,389	0	0	4,897	0.21
MIL AA <02220 9010 > Compaction, water, truck, 3000 gal, 6 mile haul	2311.00	CY	COKBB45	26	985	604	500	0	2,089	0.90
B MIL AA <02244 0100 > Crushed Gravel, 3/4" stone, 6" deep areas	1200.00	SY	CODTA	7	278	123	3,506	0	3,907	3.26
B MIL AA <02215 1220 > River Gravel, front-end loader, 40 - 60 HP, no compaction	1500.00	CY	CODFB10N	75	2,847	1,357	32,460	0	36,664	24.44
TOTAL Levee Construction	6000.00	LF		3,671	135,739	112,060	161,496	0	409,295	68.22

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06.03.73. 2_20. Culvert Removal										
CIV AA <02046 3000 > Culvert removal, 36"	240.00	LF	CODLB6	64	2,260	262	0	0	2,522	10.51
AF AA < > Haul off culvert	40.00	CY	CODEB30	3	95	108	0	200	403	10.08
TOTAL Culvert Removal	2.00	EA		67	2,354	370	0	200	2,925	1462.29
06.03.73. 2_25. Rootwads										
B MIL AA < > Rootwad	540.00	EA	CODEB12C	180	6,977	8,133	233,712	0	248,823	460.78
TOTAL Rootwads	540.00	EA		180	6,977	8,133	233,712	0	248,823	460.78
06.03.73. 2_30. Maintenance Road										
MIL AA <02224 7110 > Excavating, bulk, dozer, large area, open site, shaping w/small dozer	1333.00	CY	CODTB10L	43	1,619	730	0	0	2,350	1.76
M MIL AA < > Basecourse for road, 12" thick areas	4000.00	SY	COFGB36B	57	2,124	1,744	16,230	0	20,098	5.02
USR AA < > Geotextile, woven	4000.00	SY	CLABB80	30	1,044	128	3,030	0	4,202	1.05
TOTAL Maintenance Road	4000.00	SY		129	4,788	2,602	19,260	0	26,649	6.66
06.03.73. 2_35. Landscaping										
B MIL LS < > Hydroseeding	32.00	ACR	COFWI	373	16,914	10,105	41,227	0	68,246	2132.69
B RSM LS < > Salmonberry	2370.00	EA	ULABM	59	2,375	113	9,160	0	11,648	4.91
B RSM LS < > Snowberry	2370.00	EA	ULABM	34	1,357	65	8,397	0	9,818	4.14
B RSM LS < > Flowering Currant	2370.00	EA	ULABM	59	2,375	113	8,397	0	10,884	4.59
B RSM LS < > Red Alder	2370.00	EA	CLABB80	79	3,315	405	9,160	0	12,881	5.43
B RSM LS < > Oregon Grape	120.00	EA	ULABM	3	120	6	541	0	667	5.56
B RSM LS < > Salal	120.00	EA	ULABM	3	120	6	502	0	628	5.24
TOTAL Landscaping	1.00	JOB		611	26,576	10,812	77,384	0	114,772	114772.34
TOTAL South Pass (Smith Farms)				7,457	288,917	230,863	495,602	200	1,015,582	

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06.03.73. 3. Hat Slough Entrance										
06.03.73. 3_02. Mob, Demob & Prep Work										
USR AA < > Mobilization & Demobilization	1.00	JOB		0	2,000	5,000	1,082	0	8,082	8082.00
TOTAL Mob, Demob & Prep Work				0	2,000	5,000	1,082	0	8,082	
06.03.73. 3_05. Excavation of Levee and Marsh										
L MIL AA <02232 0140 > Excavate & load, hydr excavator, 2 CY, medium matl	52800	CY	CODEB12C	1,241	48,159	56,137	0	0	104,296	1.98
L MIL AA <02234 0340 > Hauling, hwy haulers, 12 CY, 1 mi round trip @ 20 MPH (4.2 cyc/hr)	46200	CY	COEIB34B	1,848	67,697	64,906	0	0	132,603	2.87
MIL AA <02224 7100 > Excavating, bulk, dozer, small area, open site, shaping w/small dozer	17500	CY	CODTB10L	420	15,944	7,193	0	0	23,137	1.32
TOTAL Excavation of Levee and Marsh	52800	CY		3,509	131,800	128,236	0	0	260,036	4.92
06.03.73. 3_10. Levee Construction										
MIL AA <02224 7110 > Excavating, bulk, dozer, large area, open site, shaping w/small dozer	6400.00	CY	CODTB10L	205	7,775	3,507	0	0	11,282	1.76
MIL AA <02232 0135 > Excavate & load, hydr excavator, 2 CY, lt matl	6400.00	CY	CODEB12C	88	3,393	3,955	0	0	7,347	1.15
L AF AA < > Hauling, hwy haulers, 12 CY, 6 mi round trip	6400.00	CY	COEIB34B	533	19,537	18,732	0	0	38,269	5.98
L MIL AA <02234 0340 > Hauling, hwy haulers, 12 CY, 1 mi round trip @ 20 MPH (4.2 cyc/hr)	2000.00	CY	COEIB34B	80	2,931	2,810	0	0	5,740	2.87
MIL AA <02224 7110 > Excavating, bulk, dozer, large area, open site, shaping w/small dozer	2000.00	CY	CODTB10L	64	2,430	1,096	0	0	3,526	1.76
RSM AA <02220 5000 > Compaction, riding, vibrating roller, 6" lifts, 2 passes	2000.00	CY	COFCB10Y	8	304	120	0	0	424	0.21
MIL AA <02220 9010 > Compaction, water, truck, 3000 gal, 6 mile haul	200.00	CY	COKBB45	2	85	52	43	0	181	0.90
B MIL AA <02244 0100 > Crushed Gravel, 3/4" stone, 6" deep areas	1998.00	SY	CODTA	12	463	205	5,837	0	6,505	3.26
TOTAL Levee Construction	2015.00	LF		992	36,917	30,477	5,880	0	73,274	36.36

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06.03.73. 3_15. Landscaping										
B MIL LS < > Hydroseeding	3.00	ACR	COFWI	35	1,586	947	3,865	0	6,398	2132.69
B RSM LS < > Salmonberry	6400.00	EA	ULABM	160	6,413	305	24,736	0	31,454	4.91
B RSM LS < > Snowberry	6400.00	EA	ULABM	92	3,665	175	22,675	0	26,514	4.14
B RSM LS < > Flowering Currant	6400.00	EA	ULABM	160	6,413	305	22,675	0	29,392	4.59
B RSM LS < > Red Alder	6400.00	EA	CLABB80	213	8,953	1,094	24,736	0	34,783	5.43
B RSM LS < > Oregon Grape	350.00	EA	ULABM	9	351	17	1,578	0	1,946	5.56
B RSM LS < > Salal	350.00	EA	ULABM	9	351	17	1,465	0	1,833	5.24
TOTAL Landscaping	1.00	JOB		677	27,730	2,859	101,730	0	132,319	132319.06
06.03.73. 3_20. Culvert Removal										
CIV AA <02046 3000 > Culvert removal, 36"	240.00	LF	CODLB6	64	2,260	262	0	0	2,522	10.51
AF AA < > Haul off culvert	40.00	CY	CODEB30	3	95	108	0	200	403	10.08
TOTAL Culvert Removal	2.00	EA		67	2,354	370	0	200	2,925	1462.29
06.03.73. 3_25. Rootwads										
B MIL AA < > Rootwad	50.00	EA	CODEB12C	17	646	753	21,640	0	23,039	460.78
TOTAL Rootwads	50.00	EA		17	646	753	21,640	0	23,039	460.78
06.03.73. 3_30. Maintenance Road										
MIL AA <02224 7110 > Excavating, bulk, dozer, large area, open site, shaping w/small dozer	1689.00	CY	CODTB10L	54	2,052	926	0	0	2,977	1.76
M MIL AA < > Basecourse for road, 12" thick areas	5067.00	SY	COFGB36B	72	2,691	2,209	20,559	0	25,459	5.02
USR AA < > Geotextile, woven	5067.00	SY	CLABB80	37	1,323	162	3,838	0	5,322	1.05
TOTAL Maintenance Road	5067.00	SY		163	6,066	3,296	24,397	0	33,759	6.66
TOTAL Hat Slough Entrance				5,424	207,513	170,991	154,730	200	533,433	

06.03. Wildlife Facilities & Sanctuary			QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06.03.73. 6. North Meander/Cook Slough												
06.03.73. 6_05. Mob, Demob & Prep Work												
USR AA <	> Mobilization & Demobilization		1.00	JOB		0	2,000	5,000	1,082	0	8,082	8082.00
	TOTAL Mob, Demob & Prep Work					0	2,000	5,000	1,082	0	8,082	
06.03.73. 6_10. Side Channel												
MIL AA <02232 0145 >	Excavate & load, hydr excavator, 2 CY, wet matl		37930	CY	CODEB12C	759	29,403	34,277	0	0	63,681	1.68
MIL AA <02224 7110 >	Excavating, bulk, dozer, large area, open site, shaping w/small dozer		19000	CY	CODTB10L	608	23,081	10,412	0	0	33,493	1.76
B AF AA <	> Hauling, hwy haulers, 12 CY, 24 mi round trip, soil		37930	CY	COEIB34B	3,793	138,945	133,218	0	0	272,163	7.18
B RSM AA <	> Quarry Spalls		100.00	CY	CODTA	2	77	34	1,407	0	1,518	15.18
	TOTAL Side Channel		2600.00	LF		5,162	191,507	177,941	1,407	0	370,855	142.64
06.03.73. 6_20. Rootwads												
B MIL AA <	> LWD		50.00	EA	CODEB12C	17	646	753	21,640	0	23,039	460.78
	TOTAL Rootwads		50.00	EA		17	646	753	21,640	0	23,039	460.78
06.03.73. 6_25. Maintenance Road Construction												
M MIL AA <	> Basecourse for road, 12" thick areas		1067.00	SY	COFGB36B	15	567	465	4,329	0	5,361	5.02
USR AA <	> Geotextile, woven		1067.00	SY	CLABB80	8	279	34	808	0	1,121	1.05
B RSM AA <	> Quarry Spalls		200.00	CY	CODTA	4	155	69	2,813	0	3,036	15.18
	TOTAL Maintenance Road Construction		1067.00	SY		27	1,000	568	7,951	0	9,518	8.92
06.03.73. 6_30. Landscaping												
USR LS <	> Coir fabric		16625	SY	ULABM	499	19,989	950	77,107	0	98,047	5.90
B RSM LS <	> Willow Stakes		5000.00	EA	ULABM	25	1,002	48	3,865	0	4,915	0.98
B RSM LS <	> Salmonberry		3750.00	EA	ULABM	94	3,757	179	14,494	0	18,430	4.91
B RSM LS <	> Snowberry		3750.00	EA	ULABM	54	2,147	102	13,286	0	15,536	4.14
B RSM LS <	> Flowering Currant		3750.00	EA	ULABM	94	3,757	179	13,286	0	17,222	4.59
B RSM LS <	> Red Alder		3750.00	EA	CLABB80	125	5,246	641	14,494	0	20,381	5.43
B RSM LS <	> Oregon Grape		185.00	EA	ULABM	5	185	9	834	0	1,028	5.56
B RSM LS <	> Salal		185.00	EA	ULABM	5	185	9	775	0	969	5.24
	TOTAL Landscaping		1.00	JOB		899	36,270	2,116	138,140	0	176,526	176526.25
	TOTAL North Meander/Cook Slough					6,104	231,423	186,378	170,220	0	588,020	

06.03. Wildlife Facilities & Sanctuary			QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06.03.73. 8. Koch (Cook) Slough Weir												
06.03.73. 8_05. Mob, Demob & Prep Work												
USR AA <	>	Mobilization & Demobilization	1.00	JOB		0	9,000	15,000	1,082	0	25,082	25082.00
	TOTAL	Mob, Demob & Prep Work				0	9,000	15,000	1,082	0	25,082	
06.03.73. 8_10. Fishway												
MIL AA <02046 2000	>	Site dml, conc to 6" thick, rod reinforced	100.00	SY	CLADB38	20	722	333	0	0	1,056	10.56
L AF AA <	>	Hauling, hwy haulers, 12 CY, 6 mi round trip	30.00	CY	COEIB34B	2	92	88	0	0	179	5.98
L MIL AA <02366 4510	>	Cut H Piles	18.00	EA	SIWWE14	12	483	121	1,769	0	2,373	131.82
USR AA <	>	Disposal Fee	90.00	CY		0	0	0	0	270	270	3.00
L MIL AA <02228 0374	>	Excavate trench, hvy, wet soil, 6'-10' D, 2 CY excavator	50.00	CY	CODEB12C	4	155	181	0	0	336	6.72
MIL AA <02216 5510	>	Backfill, strl, 6" lifts, by machine, no compaction, around foundation	40.00	CY	CODEB12A	1	25	17	0	0	43	1.07
L MIL AA <02366 0500	>	Pile, steel, "H" sections, HP10 x 57	70.00	VLF	CPIDB19	56	2,197	1,121	1,126	0	4,444	63.49
RSM AA <03217 0500	>	Reinforcing in place, footings, #4 to #7	10.00	TON	SIWRRODM4	152	6,100	0	5,525	0	11,625	1162.50
MIL CP <03158 0050	>	Forms in place, 2 use, footings, continuous wall, plywood	800.00	SF	ACARC1	58	2,520	0	1,288	0	3,808	4.76
RSM AA <03326 0150	>	Concrete ready mix, regular weight, 3000 psi	125.00	CY	N/A	0	0	0	7,574	0	7,574	60.59
L MIL AA <	>	Concrete Pumping	125.00	CY	ACMAC8E	50	1,811	1,111	0	3,125	6,048	48.38
RSM AA <02161 0010	>	Sheet piling, stl,15' exc,22 PSF,left in place, no wales	38.50	TON	CPIDB40	228	8,941	3,846	31,243	0	44,030	1143.63
RSM AA <02161 0010	>	Sheet piling, stl,15' exc,22 PSF,left in place, no wales	17.60	TON	CPIDB40	104	4,087	1,758	14,282	0	20,128	1143.63
MIL AA <02368 1000	>	Pile, wd, 12" butts, 8" pt, trtd, to 30' L, friction/end brg,ASTM B	1400.00	LF	CPIDB19	143	5,624	2,870	11,543	0	20,036	14.31
B RSM AA <	>	Sandbags, in place	3150.00	EA	ULABH	32	1,056	0	5,965	0	7,021	2.23
	TOTAL	Fishway				863	33,814	11,446	80,315	3,395	128,970	
06.03.73. 8_15. Construction Haul Road												
USR AA <	>	Construction Access Road	192000	SF		0	9,600	38,400	72,710	0	120,710	0.63
USR AA <	>	Construction Access Road Removal	192000	SF		0	9,600	38,400	0	0	48,000	0.25
B RSM AA <	>	Quarry Spalls	100.00	CY	CODTA	2	77	34	1,407	0	1,518	15.18
B MIL AA <02215 1220	>	Clean washed gravel compaction	210.00	CY	CODTB10L	6	239	108	4,544	0	4,891	23.29
	TOTAL	Construction Haul Road	389.00	SY		8	19,516	76,942	78,661	0	175,120	450.18

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
TOTAL Koch (Cook) Slough Weir				871	62,331	103,388	160,058	3,395	329,172	

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06.03.73. 9. Portage Creek										
06.03.73. 9_ 1. Lower Reach										
06.03.73. 9_ 1_05. Mob, Demob & Prep Work										
USR AA < > Mobilization & Demobilization	1.00	JOB		0	1,000	3,000	1,082	0	5,082	5082.00
06.03.73. 9_ 1_10. Site Work										
MIL FE <02834 7060 > Fence, misc metal, barbed wire fence post, std 3-wire fence	6512.00	LF	CLABB80A	521	20,673	3,128	14,430	0	38,231	5.87
B MIL AA < > LWD	440.00	EA	CODEB12C	147	5,685	6,627	95,216	0	107,528	244.38
MIL AA <02266 1120 > Erosion control, w/7.5' posts, silt fence, 3' high, polypropylene	500.00	LF	ALABCLAB2	23	762	0	124	0	886	1.77
06.03.73. 9_ 1_15. Landscaping										
B RSM LS < > Riparian Corridor Plantings	40.00	AC	ULABM	2,661	106,639	5,069	439,941	0	551,650	13791.25
B CIV LS < > Plant Establishment	2.00	YR	N/A	0	23,814	3,572	3,865	1,191	32,442	16220.91
TOTAL Lower Reach				3,351	158,573	21,396	554,659	1,191	735,819	
06.03.73. 9_ 2. Middle Reach										
06.03.73. 9_ 2_05. Mob, Demob & Prep Work										
USR AA < > Mobilization & Demobilization	1.00	JOB		0	1,000	3,000	1,082	0	5,082	5082.00
06.03.73. 9_ 2_10. Site Work										
MIL FE <02834 7060 > Fence, misc metal, barbed wire fence post, std 3-wire fence	4240.00	LF	CLABB80A	339	13,460	2,037	9,396	0	24,892	5.87
B MIL AA < > LWD	265.00	EA	CODEB12C	88	3,424	3,991	57,346	0	64,761	244.38
MIL AA <02266 1120 > Erosion control, w/7.5' posts, silt fence, 3' high, polypropylene	500.00	LF	ALABCLAB2	23	762	0	124	0	886	1.77
06.03.73. 9_ 2_15. Landscaping										
B RSM LS < > Riparian Corridor Plantings	25.00	AC	ULABM	1,663	66,650	3,168	274,963	0	344,781	13791.25
B CIV LS < > Plant Establishment	2.00	YR	N/A	0	19,051	2,381	2,577	1,191	25,200	12599.99
TOTAL Middle Reach				2,113	104,347	14,578	345,488	1,191	465,603	
06.03.73. 9_37. Upper Reach										
06.03.73. 9_37_05. Mob, Demob & Prep Work										
USR AA < > Mobilization & Demobilization	1.00	JOB		0	1,000	3,000	1,082	0	5,082	5082.00
06.03.73. 9_37_10. Site Work										
MIL AA <02224 7110 > Excavating, bulk, dozer, large area, open site, shaping w/small dozer	7000.00	CY	CODTB10L	224	8,504	3,836	0	0	12,340	1.76

06.03. Wildlife Facilities & Sanctuary			QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
MIL AA	<02224 7100 >	Excavating, bulk, dozer, small area, open site, shaping w/small dozer	1050.00	CY	CODTB10L	25	957	432	0	0	1,388	1.32
RSM AA	<02220 5000 >	Compaction, riding, vibrating roller, 6" lifts, 2 passes	1050.00	CY	COFCB10Y	4	159	63	0	0	222	0.21
MIL AA	<02220 9010 >	Compaction, water, truck, 3000 gal, 6 mile haul	105.00	CY	COKBB45	1	45	27	23	0	95	0.90
L MIL AA	<02234 0340 >	Hauling, hwy haulers, 12 CY, 1 mi round trip @ 20 MPH (4.2 cyc/hr)	1050.00	CY	COEIB34B	42	1,539	1,475	0	0	3,014	2.87
L AF AA	< >	Noxious Weed Removal conditions	1.00	ACR	COMCB88	140	5,500	5,189	0	0	10,689	10689.30
B MIL AA	< >	LWD	80.00	EA	CODEB12C	27	1,034	1,205	17,312	0	19,551	244.38
MIL AA	<02266 1120 >	Erosion control, w/7.5' posts, silt fence, 3' high, polypropylene	500.00	LF	ALABCLAB2	23	762	0	124	0	886	1.77
06.03.73. 9_37_15. Landscaping												
B RSM LS	< >	Riparian Corridor Plantings	96.00	AC	ULABM	6,386	255,935	12,166	1,055,859	0	1,323,960	13791.25
B CIV LS	< >	Plant Establishment	2.00	YR	N/A	0	47,628	11,907	6,442	1,191	67,167	33583.69
		TOTAL Upper Reach				6,872	323,061	39,300	1,080,842	1,191	1,444,394	
06.03.73. 9_42. Landscaping												
		TOTAL Landscaping				0	0	0	0	0	0	
		TOTAL Portage Creek				12,336	585,980	75,274	1,980,990	3,572	2,645,816	

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06.03.73.10. Cloverdale										
06.03.73.10_05. Mob, Demob & Prep Work										
USR AA < > Mobilization & Demobilization	1.00	JOB		0	9,000	15,000	1,082	0	25,082	25082.00
TOTAL Mob, Demob & Prep Work				0	9,000	15,000	1,082	0	25,082	
06.03.73.10_10. Side Channel										
MIL AA <02224 7110 > Excavating, bulk, dozer, large area, open site, shaping w/small dozer	1600.00	CY	CODTB10L	51	1,944	877	0	0	2,820	1.76
TOTAL Side Channel				51	1,944	877	0	0	2,820	
06.03.73.10_15. Site Work										
B MIL AA < > LWD	440.00	EA	CODEB12C	147	5,685	6,627	95,216	0	107,528	244.38
MIL AA <02266 1120 > Erosion control, w/7.5' posts, silt fence, 3' high, polypropylene	500.00	LF	ALABCLAB2	23	762	0	124	0	886	1.77
TOTAL Site Work				170	6,447	6,627	95,340	0	108,414	
06.03.73.10_17. Pedestrian Path										
USR PV < > Pedestrian Pathway	225.00	LF		0	1,340	804	1,160	0	3,303	14.68
TOTAL Pedestrian Path				0	1,340	804	1,160	0	3,303	
06.03.73.10_25. Culverts										
MIL LS <02228 0322 > Excavate trench, mdm soil, 4'-6' D, 1 CY excavator	100.00	CY	CODEB12A	2	72	49	0	0	121	1.21
CIV LS <02764 2800 > Piping, storm drain, CMP, plain, end section, 18" dia	2.00	EA	CLABB14	3	131	8	186	0	326	162.78
CIV LS <02764 2810 > Piping, storm drain, CMP, plain, end section, 24" dia	2.00	EA	CLABB14	4	158	9	268	0	435	217.64
MIL LS <02764 2600 > Piping, storm drain, 16 ga, CMP, galv, 20' lengths, 18" dia	40.00	LF	CLABB14	9	385	23	595	0	1,002	25.05
MIL LS <02764 2620 > Piping, storm drain, 14 ga, CMP, galv, 20' lengths, 24" dia	15.00	LF	CLABB14	4	169	10	383	0	562	37.47
CIV LS <02764 2855 > Piping, storm drain, CMP, plain, coupling, 18" dia	3.00	EA	N/A	0	0	0	55	0	55	18.38
CIV LS <02764 2860 > Piping, storm drain, CMP, plain, coupling, 24" dia	2.00	EA	N/A	0	0	0	68	0	68	34.19
MIL LS <02216 5530 > Backfill, strl, 6" lifts, w/loader, no compaction, around foundation	90.00	CY	CODFB10N	2	87	42	0	0	129	1.43

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
MIL LS <02220 8720 > Compaction, by hand, around structures & trenches, air tamper	90.00	CY	CODTB11B	2	99	131	0	0	230	2.55
MIL LS <05542 0622 > Debris Rack, non plugging	16.00	SF	SIWSE4	1	41	3	281	0	325	20.30
TOTAL Culverts	2.00	EA		27	1,141	274	1,837	0	3,253	1626.48
06.03.73.10_30. Landscaping										
B MIL LS < > Hydroseeding	17.00	ACR	COFWI	198	8,986	5,368	21,902	0	36,256	2132.69
B RSM LS < > Riparian Corridor Plantings	14.70	AC	ULABM	2,005	80,339	3,819	331,425	0	415,583	28270.96
B CIV LS < > Plant Establishment	2.00	YR	N/A	0	11,907	2,381	2,577	1,191	18,056	9027.89
TOTAL Landscaping				2,203	101,232	11,569	355,903	1,191	469,895	
TOTAL Cloverdale				2,451	121,103	35,151	455,322	1,191	612,767	

06.03. Wildlife Facilities & Sanctuary		QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06.03.73.11. Hazel Slide											
06.03.73.11_05. Mob, Demob & Prep Work											
USR AA <	> Mobilization & Demobilization	1.00	JOB		0	9,000	15,000	1,082	0	25,082	25082.00
TOTAL Mob, Demob & Prep Work					0	9,000	15,000	1,082	0	25,082	
06.03.73.11_10. Engineered Log Jams											
B MIL AA <	> Key Member,2.8'-3.6'dia,35-47LF conifer/black cottonwood w/rootw	80.00	EA		0	0	0	216,400	0	216,400	2705.00
B MIL AA <	> Stacked Member, size and wood type varies	240.00	EA		0	0	0	421,980	0	421,980	1758.25
B MIL AA <	> Racked Member, size and wood type varies	428.00	EA		0	0	0	115,774	0	115,774	270.50
MAP AA <	> DOZER,CWLR, D-8N,PS (ADD ATTACHMENTS)	240.00	HR	T15CA016	0	0	20,837	0	0	20,837	86.82
MIL AA <	> DOZER,CWLR, TD-8H, /HYD BLADE,PS	240.00	HR	T15ID002	0	0	5,900	0	0	5,900	24.58
MIL AA <	> GRAPPLE, 6.50CY, 3-TINE/ 4-TINE (ADD 2.30 CY HYD EXCAVATR)	480.00	HR	H25LU027	0	0	3,730	0	0	3,730	7.77
GEN AA <	> HYD EXCV, CRAWLER, 2.50 CY (1.9 M3) BKT	480.00	HR	H25Z3200	0	0	44,704	0	0	44,704	93.13
GEN AA <	> HYD EXCV, CRAWLER, 2.00 CY (1.5 M3) BKT	240.00	HR	H25Z3190	0	0	21,689	0	0	21,689	90.37
MIL AA <	> LOG SKIDDER, GRAPL, 46861#L-PULL	240.00	HR	L60JD005	0	0	9,678	0	0	9,678	40.32
USR AA <	> Tubes, dewatering	240.00	HR		0	0	11,760	0	0	11,760	49.00
MIL AA <	> Outside Equip. Operators, Medium	1200.00	HR	X-EQOPRMED	1,200	48,336	0	0	0	48,336	40.28
MIL AA <	> Outside Laborers, (Semi-Skilled)	1200.00	HR	X-LABORER	1,200	39,992	0	0	0	39,992	33.33
TOTAL Engineered Log Jams		4.00	EA		2,400	88,328	118,298	754,154	0	960,779	240194.84
TOTAL Hazel Slide					2,400	97,328	133,298	755,236	0	985,861	

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06.03.73.12. Gold Basin Slide										
06.03.73.12_05. Mob, Demob & Prep Work										
USR AA < > Mobilization & Demobilization	1.00	JOB		0	9,000	15,000	1,082	0	25,082	25082.00
TOTAL Mob, Demob & Prep Work				0	9,000	15,000	1,082	0	25,082	
06.03.73.12_10. Engineered Log Jams										
B MIL AA < > Key Member,2.8'-3.6'dia,35-47LF conifer/black cottonwood w/rootw	20.00	EA		0	0	0	54,100	0	54,100	2705.00
B MIL AA < > Stacked Member, size and wood type varies	90.00	EA		0	0	0	158,243	0	158,243	1758.25
B MIL AA < > Racked Member, size and wood type varies	300.00	EA		0	0	0	81,150	0	81,150	270.50
MAP AA < > DOZER,CWLR, D-8N,PS (ADD ATTACHMENTS)	160.00	HR	T15CA016	0	0	13,891	0	0	13,891	86.82
MIL AA < > DOZER,CWLR, TD-8H, /HYD BLADE,PS	160.00	HR	T15ID002	0	0	3,933	0	0	3,933	24.58
MIL AA < > GRAPPLE, 6.50CY, 3-TINE/ 4-TINE (ADD 2.30 CY HYD EXCAVATR)	360.00	HR	H25LU027	0	0	2,797	0	0	2,797	7.77
GEN AA < > HYD EXCV, CRAWLER, 2.50 CY (1.9 M3) BKT	360.00	HR	H25Z3200	0	0	33,528	0	0	33,528	93.13
GEN AA < > HYD EXCV, CRAWLER, 2.00 CY (1.5 M3) BKT	160.00	HR	H25Z3190	0	0	14,459	0	0	14,459	90.37
MIL AA < > LOG SKIDDER, GRAPL, 46861#L-PULL	160.00	HR	L60JD005	0	0	6,452	0	0	6,452	40.32
USR AA < > Tubes, dewatering	80.00	HR		0	0	3,920	0	0	3,920	49.00
MIL AA < > Outside Equip. Operators, Medium	840.00	HR	X-EQOPRMED	840	33,835	0	0	0	33,835	40.28
MIL AA < > Outside Laborers, (Semi-Skilled)	840.00	HR	X-LABORER	840	27,994	0	0	0	27,994	33.33
TOTAL Engineered Log Jams	2.00	EA		1,680	61,829	78,981	293,493	0	434,303	217151.59
TOTAL Gold Basin Slide				1,680	70,829	93,981	294,575	0	459,385	

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
06.03.73.14. South Meander/Thomsen Slough										
06.03.73.14_05. Mob, Demob & Prep Work										
USR AA < > Mobilization & Demobilization	1.00	JOB		0	5,000	10,000	1,082	0	16,082	16082.00
TOTAL Mob, Demob & Prep Work				0	5,000	10,000	1,082	0	16,082	
06.03.73.14_10. Side Channel										
L MIL AA <02232 0140 > Excavate & load, hydr excavator, 2 CY, medium matl	70000	CY	CODEB12C	1,645	63,847	74,424	0	0	138,271	1.98
MIL AA <02232 0145 > Excavate & load, hydr excavator, 2 CY, wet matl	5000.00	CY	CODEB12C	100	3,876	4,519	0	0	8,395	1.68
MIL AA <02224 7110 > Excavating, bulk, dozer, large area, open site, shaping w/small dozer	37500	CY	CODTB10L	1,200	45,555	20,550	0	0	66,105	1.76
B AF AA < > Hauling, hwy haulers, 12 CY, 24 mi round trip, soil	75000	CY	COEIB34B	7,500	274,740	263,415	0	0	538,155	7.18
B MIL AA < > Rootwad	96.00	EA	CODEB12C	32	1,240	1,446	41,549	0	44,235	460.78
USR AA < > Coir fabric	38000	SY	ULABM	1,140	38,372	1,824	148,018	0	188,214	4.95
TOTAL Side Channel	5000.00	LF		11,617	427,631	366,177	189,566	0	983,375	196.67
06.03.73.14_35. Maintenance Road										
MIL AA <02224 7110 > Excavating, bulk, dozer, large area, open site, shaping w/small dozer	2756.00	CY	CODTB10L	88	3,348	1,510	0	0	4,858	1.76
M MIL AA < > Basecourse for road, 12" thick areas	8267.00	SY	COFGB36B	117	4,391	3,604	33,543	0	41,538	5.02
USR AA < > Geotextile, woven	8267.00	SY	CLABB80	61	2,159	264	6,261	0	8,684	1.05
B RSM AA < > Quarry Spalls	100.00	CY	CODTA	2	77	34	1,407	0	1,518	15.18
TOTAL Maintenance Road	8267.00	SY		269	9,974	5,412	41,211	0	56,598	6.85
06.03.73.14_45. Landscaping										
B RSM LS < > Salmonberry	7195.00	EA	ULABM	180	7,209	343	27,809	0	35,361	4.91
B RSM LS < > Snowberry	7195.00	EA	ULABM	103	4,120	196	25,491	0	29,807	4.14
B RSM LS < > Flowering Currant	7195.00	EA	ULABM	180	7,209	343	25,491	0	33,043	4.59
B RSM LS < > Red Alder	7195.00	EA	CLABB80	240	10,065	1,230	27,809	0	39,104	5.43
B RSM LS < > Oregon Grape	355.00	EA	ULABM	9	356	17	1,601	0	1,973	5.56
B RSM LS < > Salal	355.00	EA	ULABM	9	356	17	1,486	0	1,859	5.24
B RSM LS < > Willow Stakes	11400	EA	ULABM	57	2,285	109	8,812	0	11,205	0.98
TOTAL Landscaping	1.00	JOB		777	31,599	2,254	118,500	0	152,353	152352.69
TOTAL South Meander/Thomsen Slough				12,663	474,204	383,843	350,359	0	1,208,407	

06.03. Wildlife Facilities & Sanctuary	QUANTY	UOM	CREW ID	MANHRS	LABOR	EQUIPMNT	MATERIAL	OTHER	TOTAL COST	UNIT COST
TOTAL Habitat				53,898	2,255,498	1,570,980	5,184,527	8,558	9,019,563	
TOTAL Wildlife Facilities & Sanctuary				53,898	2,255,498	1,570,980	5,184,527	8,558	9,019,563	
TOTAL Fish and Wildlife Facilities				53,898	2,255,498	1,570,980	5,184,527	8,558	9,019,563	
TOTAL Stilliguamish River	1.00	EA		53,898	2,255,498	1,570,980	5,184,527	8,558	9,019,563	9019563.38