

5. Habitat Restoration Strategy

10-Year Habitat Restoration Projects

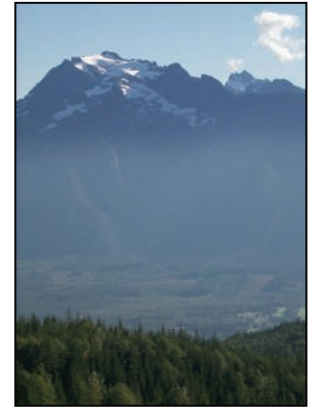
As described in Chapter 4, the SIRC has chosen to pursue an ambitious ten-year recovery strategy in the Stillaguamish Watershed that will result in a projected increase in Chinook salmon populations to 30% of the TRT planning target. Recognizing that there are many uncertainties associated with a strategy over a ten-year time period, such as political, economic, and social support for this strategy, poaching impacts, and natural climatic occurrences, the SIRC agreed to a prioritized list of habitat projects that will benefit Chinook salmon populations throughout the Stillaguamish Watershed. Factors such as feasibility, landowner willingness, permitting, engineering and coordination were considered in developing habitat project lists.

Over 50 projects have been completed in the Stillaguamish Watershed since 1998 to manage and restore Chinook salmon habitat and watershed functions. These have included riparian enhancements, engineered log jams, road decommissioning, landslide hazard mapping, bank stabilization, erosion and sediment control, wetland buffer restoration, and conservation easements.

The Stillaguamish Lead Entity Strategy (Waller and Stevenson 2004) was prepared in 2004 to guide and prioritize future voluntary actions and projects in the watershed for funding by the Washington state Salmon Recovery Funding Board. The Lead Entity Strategy organized habitat restoration projects into six main categories (riparian, estuary, large woody debris, floodplain, sediment, and hydrology), corresponding to the limiting factors for Chinook salmon populations in the Stillaguamish Watershed.

The ten-year habitat restoration strategy adopted by the SIRC reflects the categories and geographic priorities identified in the Lead Entity Strategy. Addressing all habitat categories and watershed processes is essential for salmon recovery efforts to be successful. The habitat management and restoration actions proposed by the Stillaguamish Watershed Chinook Salmon Recovery Plan follow the geographically-based criteria described below for each limiting factor.

The SIRC has prioritized locations within the Stillaguamish Watershed where management or restoration projects would assist in returning properly



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functioning conditions. Projects are ranked by criteria linked to the overall watershed strategy for Chinook salmon recovery. Priorities for restoration projects focus on key reaches where Chinook salmon are currently productive, including spawning grounds, migration corridors and rearing areas. Some projects will be implemented first in order for subsequent projects to be effective (e.g. reduce upstream sediment sources before creating downstream spawning habitat). However, individual projects identified by the community, such as the Steelhead Haven landslide, are prioritized if they have the potential to address multiple limiting factors.

The SIRC recognizes that some individual habitat restoration actions can have potential liabilities. Impacts on adjacent or downstream properties should be analyzed and addressed in project design and monitored during project implementation. Adjacent property owners and other stakeholders should be informed during feasibility and design phases to ensure broad-based community support and appropriate project design.

Riparian

Riparian Project Types

Potential actions for protecting, restoring, and enhancing ecological functions of the riparian zone include measures listed below:

Overall habitat enhancement:

- Planting native vegetation in the riparian corridor, especially in locations where poor riparian conditions are present
- Streambank stabilization using native plants
- Exclusion of livestock
- Removal and control of noxious weeds
- Pest control measures

Restoring hydrologic processes:

- Inventory and evaluation of existing levees, dikes, roads, and railroads for potential removal, relocation, or vegetation enhancement

Preservation actions:

- Protection of existing riparian corridors with fee-simple or conservation easement acquisition
- Maintenance of existing vegetation communities in the riparian corridor

Riparian Geographic Criteria

Riparian restoration project sites will be selected using one or more of the following criteria:

- Areas where Chinook salmon use is highest or adjacent to these areas
- Potential to restore basic riparian function:

- ◆ reduction in water temperature
- ◆ large wood recruitment
- ◆ bank stabilization
- ◆ cover and nutrients for salmon
- In areas lacking properly functioning riparian forest cover located in upper watersheds that will contribute to the greatest area of downstream conditions for Chinook salmon.
- Predominantly in rural, urban, and agricultural land uses and private ownership.³⁵

Riparian priority areas in the Stillaguamish Watershed are shown on Figure 18.

Approved Riparian Projects

The SIRC approved the following riparian restoration actions, including riparian planting, maintenance, thinning, fencing, and weed control. Projects are listed in the order that they may be implemented, according to the geographic priorities described above.

1. ■ Restore 135 acres in Upper North Fork, Squire Creek, French-Selgelsen subbasin
 - Restore 65 acres in Lower South Fork Stillaguamish
2. ■ Restore 65 acres in Middle North Fork Stillaguamish
 - Restore 35 acres in Lower South Fork Stillaguamish
3. ■ Restore 65 acres in Middle North Fork Stillaguamish
 - Restore 35 acres in Lower South Fork Stillaguamish

Riparian buffers in the upper watershed regulated under the USFS Northwest Forest Plan, the DNR Habitat Conservation Plan, and the Forests and Fish Rules will provide a large percentage of the 8,000 acres needed for properly functioning conditions in the Stillaguamish Watershed. Other portions of the riparian zone throughout the Stillaguamish Watershed are in public ownership under the jurisdiction of Snohomish County, WDFW, the cities of Arlington, Stanwood, Granite Falls, and Darrington, and the Stillaguamish and Tulalip Tribes. SIRC stakeholders have worked with numerous private landowners to install and maintain voluntary buffers of varying widths. Private landowners can also enroll in programs such as the Conservation Reserve Enhancement Program (CREP) to be compensated for taking land out of production to maintain riparian buffers.

³⁵ Effective riparian restoration and management on state, federal and private industrial forestlands is a critical component of salmon recovery in the Stillaguamish. However, this criterion recognizes that most opportunities for community sponsored riparian restoration will not focus on state, federal and private industrial forestlands. Riparian policy and project implementation in these areas are administered according to established forest policies in federal and state laws as well as adopted habitat conservation plans such as the Forests and Fish HCP (see Edwards 2003).

Estuary/Nearshore

Estuary/Nearshore Project Types

Potential actions for restoration and enhancement of lost or degraded estuarine and nearshore habitat areas include measures listed below.

Overall habitat enhancement:

- Restoration or enhancement of blind tidal channels and salt marsh habitats through dike removal and/or setback (Hood 2004)
- Restoration of pocket estuaries
- Shoreline restoration to remove bulkheads and enhance native vegetation
- Construction of log-jams to enhance tidal channel formation in the river delta
- Removal of noxious weeds in the estuarine environment

Restoring hydrologic processes and improving water quality:

- Removal of existing levees, dikes and revetments, where appropriate
- Dike setbacks to restore tidal processes and re-establish cut-off sloughs
- Tide gate retrofits
- Reduction of pollutants entering the estuary

Preservation actions include the following:

- Protection of functioning estuary, pocket estuary, and marine shoreline habitats
- Purchase of fee-simple or conservation easements on estuary and marine shoreline property

Estuary/Nearshore Geographic Criteria

Restoration project sites in estuaries and the nearshore will be selected using one or more of the following criteria:

- Transition zones from fresh water to salt water, migratory corridors, opportunities to escape predators, and foraging opportunities for Chinook salmon
- Adjacent to areas subject to frequent tidal or seasonal flooding
- Shoreline areas that border Chinook salmon migration routes
- Evidence of historic blind tidal channel or salt marsh habitat
- Exhibit sustainable project development attributes:
 - ◆ large parcels
 - ◆ parcels with less development and utility infrastructure
 - ◆ transportation or flood control structures
 - ◆ parcels with marginal economic use that may improve through habitat restoration

Estuary priority areas in the Stillaguamish Watershed are shown on Figure 18.

Approved Estuary/Nearshore Projects

The SIRC approved the following estuarine actions, including estuary restoration through dike setback and channel reconfiguration, estuary creation by placing large wood in tidal areas, and increasing blind tidal and distributary channels for Chinook salmon. Projects are listed in the order that they may be implemented, according to the geographic priorities described above.

1. ▪ Restore 115 acres of salt marsh estuarine habitat including 18 acres of blind tidal channel habitat at Leque Island
2. ▪ Restore 80 acres of salt marsh estuarine habitat at The Nature Conservancy property
3. ▪ Attempt to create 120 acres of salt marsh estuarine habitat by placing 10 engineered log jams on the mud/sand flats (experimental pilot project: to be monitored by adaptive management process)

Potential Estuary/Nearshore Projects

Restoration and protection of nearshore pocket estuary sites in Port Susan is needed for the recovery of Stillaguamish Chinook salmon and bull trout populations. However, there are only a few potential pocket estuary restoration sites in WRIA 5. Most of the significant pocket estuary restoration opportunities are located within the Lower Skagit River basin (WRIA 4), Island County (WRIA 6), and the Snohomish River basin (WRIA 7). Therefore, it is recommended that in addition to pursuing nearshore and pocket estuary restoration in WRIA 5, the SIRC and TAG coordinate with WRIs 4, 6 and 7 to promote and support nearshore and pocket estuary protection and restoration actions throughout Whidbey Basin and especially in Port Susan and Skagit Bay. This coordination could include the following SIRC and TAG actions:

- Review and understand the Port Susan and Skagit Bay nearshore elements of the WRIA 6 and WRIA 7 salmon conservation plans;
- Explore opportunities to support protection and restoration nearshore projects in WRIs 4, 6 and 7;
- Support studies that improve scientific knowledge of the Whidbey Basin nearshore habitat conditions and how they influence the recovery of natal and non-natal salmonid populations; and
- Support public education, outreach, and technical assistance that addresses the need for Port Susan and Skagit Bay nearshore habitat protection and restoration.

Large Woody Debris (LWD)

Large Woody Debris Project Types

Habitat enhancement:

- Placement of engineered log-jams and or individual wood pieces in mainstem rivers to enhance instream habitat
- Use of large wood revetments or smaller structures to stabilize streambanks or attenuate landslides
- Enhancement of riparian features in locations where poor riparian conditions are present

Preservation actions:

- Purchase of fee simple or conservation easements to protect existing riparian function
- Retention of mature forest characteristics in floodplain and stream corridors

Large Woody Debris Geographic Criteria

Large woody debris project sites will be selected using one or more of the following criteria:

- Areas where Chinook salmon use is highest or adjacent to these areas
- Promote effective restoration of Chinook salmon habitat upstream of the confluence of the North and South Fork Stillaguamish Rivers.³⁶:
 - ◆ side channel connections
 - ◆ pool development
 - ◆ in-channel cover
- Sites where placement of large wood will also work to prevent chronic landslides.
- Reaches where instream refugia are needed.
- Reaches where placing LWD will not jeopardize personal safety of residents or cause damage to private property.

Large woody debris priority areas in the watershed are shown on Figure 20.

Approved Large Woody Debris Projects

The SIRC approved the following large woody debris actions, including large wood placement in stream channels to increase pools, roughness, flow variability, scour, and habitat types for Chinook salmon. Projects are listed in the order that they may be implemented, according to the geographic priorities described above.

³⁶ Areas upstream of the confluence present more favorable floodplain connectivity and instream conditions that make large wood placement more likely to produce habitat benefits. While the Lower Stillaguamish floodplain lacks significant wood, it has more hardened banks that decrease the effectiveness of wood placement.

1.
 - 5 engineered log jams (ELJs) in Lower South Fork-Upper (SF 3)
 - 10 ELJs in French Segelsen and Middle North Fork (NF 7 & 4)
 - 2 ELJs at North Meander
 - 2 ELJs at Smokes Farm
2.
 - 6 ELJs in Lower South Fork (SF 2)
 - 9 ELJs in Lower North Fork (NF 2 & 3)
 - 2 ELJs in North Fork (NF 3 & 5)
3.
 - 9 ELJs in Lower North Fork (NF 2 & 3)
 - 6 ELJs In Lower South Fork (SF 3)

Floodplain

Floodplain Project Types

The natural dynamics of a watershed are dependent on a natural rate of stream meandering for recruitment of large woody debris (LWD), sediment management for spawning gravels, and side channel habitat development. These dynamics are necessary at a certain level for natural watershed processes to be restored. Actions that may be utilized to improve floodplain conditions include:

- Restoration of fish access to abandoned side channels and sloughs
- Re-connection of floodplains and forested wetlands to main river channels
- Dike setback and excavation to achieve either of the above

Floodplain Geographic Criteria

Floodplain restoration project sites will be selected using one or more of the following criteria:

- Provide peak flow refugia and juvenile rearing and adult holding capacity at a normal range of stream flows
- Promote instream connectivity between existing intact floodplain habitats
- Restore floodplain functions directly downstream of key spawning areas to improve conditions for all juveniles and particularly stream-type Chinook salmon
- Provide flood storage and mitigate peak flows consistent with the Stillaguamish River Comprehensive Flood Hazard Management Plan
- Identified by willing landowners where hardened banks may be removed
- Owned by existing public entities or conservation organizations
- Low risk to life or property
- Marginal economic uses that may increase through restoration
- Threatened by development

Floodplain priority areas in the watershed are shown on Figure 19.

Approved Floodplain Projects

The SIRC approved the following floodplain restoration actions including dike setbacks, channel re-configuration, and creation of off-channel habitat. Projects are listed in the order that they may be implemented, according to the geographic priorities described above.

1. ▪ Restore 10 acres of new side channel at North Meander and Smokes Farm
2. ▪ Restore 14 acres of new side channel in Lower and Middle North Fork Stillaguamish
3. ▪ Restore 6 acres of new side channel in Lower South Fork Stillaguamish
4. ▪ Remove 4.1 miles of bank armoring in North and South Fork Stillaguamish

The SIRC will look for additional opportunities to include removal of hardened bank throughout the watershed in other types of projects, such as those addressing flood hazard management. If bank stabilization is preventing available side channel flood relief and juvenile Chinook flood refuge, and other approaches are acceptable to the current landowners, bank armoring removal is recommended. Future outreach and stewardship efforts will inform landowners of the importance of removing bank armoring throughout the watershed. Information on alternative methods of bank stabilization should also be provided to landowners.

Sediment

Sediment Project Types

Restoration of natural sediment regimes must address sediment sources where mass wasting or land use activities route fine sediment directly to streams. Potential actions to restore natural sediment regimes include the following:

- Engineered slope stabilization to reduce direct inputs from chronic and deep-seated landslides that are active near main river channels
- Targeted road decommissioning and treatment
- Wetland restoration to stabilize small tributary sediment regimes
- Plant riparian vegetation and add LWD to protect and stabilize streambanks

Sediment Geographic Criteria

Sediment project sites will be selected using one or more of the following criteria:

- Where sediment routing has been documented from landslides or road networks

- In areas identified by landslide hazard zoning maps
- In subbasins with road densities greater than 2 miles of road per square mile in conjunction with greater than 5% of the total road network on unstable geology and traversing steep slopes

Sediment priority areas in the watershed are shown on Figure 20.

Approved Sediment Projects

The SIRC approved the following sediment actions including forest road treatment and decommissioning, and landslide remediation to improve embeddedness, turbidity and fine sediment. Projects are listed in the order that they may be implemented, according to the geographic priorities described above.

1.
 - Landslide remediation at Steelhead Haven - Lower North Fork
 - Landslide remediation at Gold Basin - Lower South Fork
 - Treat 48 miles of roads in Upper North Fork (federal, state, and private)
 - Treat 5 miles of roads in the French-Segelsen subbasin (federal only)
 - Treat 11 miles of roads in Deer Creek subbasin (state, private)
 - Treat 6 miles of roads in Middle North Fork (state, private)
 - Treat 12 miles of roads in the Upper Canyon Creek subbasin (federal)
 - Treat 7 miles of roads in the Robe Valley subbasin (federal)
 - Treat 4 miles of roads in the Robe Valley subbasin (state, private)
 - Treat 3 miles of roads in the Lower Canyon Creek subbasin (state, private)

Forest road treatment options range from storm-proofing to total road obliteration, where the entire road prism is removed. Sediment reduction and transport of water to natural channels is the primary objective. Many forest roads were built by old standards and are brought up to current standards. In most cases, culverts are replaced, upgraded, or removed, side-cast material is pulled back, and ditches are maintained to carry water to the next natural channel. Installation of numerous cross drains is another solution to sediment and water problems. At a minimum, removing culverts can save roads from being completely washed out in the absence of ongoing maintenance. Responsible agencies have standards for different types of road decommissioning projects, which may include re-vegetation, based on existing conditions. The SIRC supports coordination among the appropriate agencies and stakeholders to ensure the success of these road treatment and decommissioning projects.

Hydrology

Hydrology Project Types

The following actions have the potential for improving hydrological conditions in the Stillaguamish Watershed:

- Restoration of floodplains, including wetlands, to increase infiltration, slow runoff, and reduce downstream peak flow impacts
- Development of plans in forested regions that target the reduction of road density and de-commissioning of under-utilized forest roads
- Improve the age class and cumulative acres of forested land cover
- Identification of optimum instream flow levels and actions to reduce water consumption throughout the watershed.

Hydrology Geographic Criteria

Hydrology project sites will be selected using one or more of the following criteria:

- Floodplain and wetland restoration in higher elevation watersheds upstream of Chinook salmon spawning areas impacted by peak flows
- Forest protection strategies in the rain-on-snow zone (1000–3000 feet elevation)

Hydrology priority areas in the watershed are shown on Figure 19.

10-Year Habitat Project Costs

A summary of habitat projects, with estimated cost information, included in the SIRC’s approved 10-year strategy, is shown in Table 10.

Table 10. SIRC 10-Year Watershed Goal: Habitat Project Costs

Project Type	Units	Quantity	Cost/Unit	Total Costs
Riparian	Acres Planted	400	\$7,500	\$3,000,000
Estuary	Acres Restored	195	\$20,000	\$3,900,000
	Acres Created	120	\$6,700	\$804,000
Large Wood	Engineered Log Jams	51	\$67,000	\$3,417,000
Floodplain	Acres Restored	30.0	\$100,000	\$3,000,000
	Armoring Removed	4.1	\$250,000	\$1,025,000
Sediment	Landslide Treatments	2	\$2,250,000	\$4,500,000
	Forest Road Treatment (miles)	106	\$30,000	\$3,180,000
Acquisition	Acres Acquired	1445	\$6,000	\$8,670,000
Subtotal				\$31,496,000
+40% Contingency & Inflation				\$12,598,400
Total				\$44,094,400

These costs can include acquisition or compensation if necessary, depending on the wants of the public or private landowner. As stated earlier, most salmon recovery funding at this time comes from the Washington State Salmon Recovery Funding Board. The CREP program pays farmers for cropland taken out of production while a buffer is planted to restore the riparian zone. Many of the landowners in the Stillaguamish valley value the forests, streams and wildlife and want to participate in the restoration process voluntarily, but compensation will be considered when appropriate.

Figure 18. Riparian and Estuary Priority Areas.

Figure 19. Floodplain and Hydrology Priority Areas

Figure 20. Large Wood and Sediment Priority Areas.

Anticipated Results

Table 11 presents EDT model results for current conditions, the SIRC watershed goal, properly functioning conditions, the Shared Strategy target, and historical conditions (Mobrand Biometrics 2004).

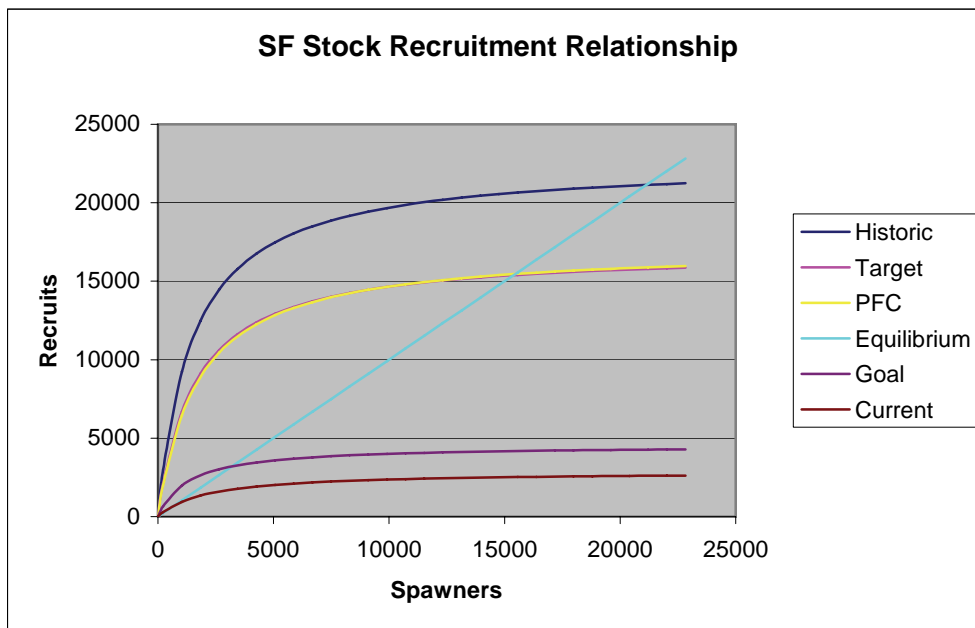
Table 11. Chinook salmon population performance for a range of habitat conditions (Mobrand Biometrics 2004)

Scenario	Chinook Population	Life History Diversity	Intrinsic Productivity	Capacity	Equilibrium Abundance
Current	South Fork	45%	1.4	3,028	861
10-Year Goal	South Fork	79%	3.4	4,543	3,196
PFC	South Fork	100%	10.0	17,170	15,460
Target	South Fork	100%	10.7	16,973	15,387
Historical	South Fork	100%	15.1	22,638	21,141
Current	North Fork	58%	2.7	3,839	2,430
10-Year Goal	North Fork	86%	5.4	7,316	5,950
PFC	North Fork	100%	10.6	19,297	17,482
Target	North Fork	100%	11.9	19,435	17,795
Historical	North Fork	100%	15.6	26,725	25,012

Figures 21 and 22 graphically represent the expected results of the 10-year strategy on the two Chinook salmon populations in the Stillaguamish Watershed (Mobrand Biometrics 2004).

The short-term (10-year) goal for South Fork Stillaguamish Chinook salmon is an equilibrium abundance of 3,196 spawners. Assuming that the South Fork population has been self-sustaining under the current degraded habitat conditions and harvest management guidelines, this population should respond in a positive manner to the implementation of the proposed habitat improvements. The population should show an increase in both abundance and productivity as the fish take advantage of a broader range of habitat conditions. As the population increases, a response in the distribution of spawners over a larger geographic range and time period should be anticipated. This assumption has been documented with the transfer of west coast Chinook salmon to the Great Lakes region and New Zealand (Quinn et al. 2000).

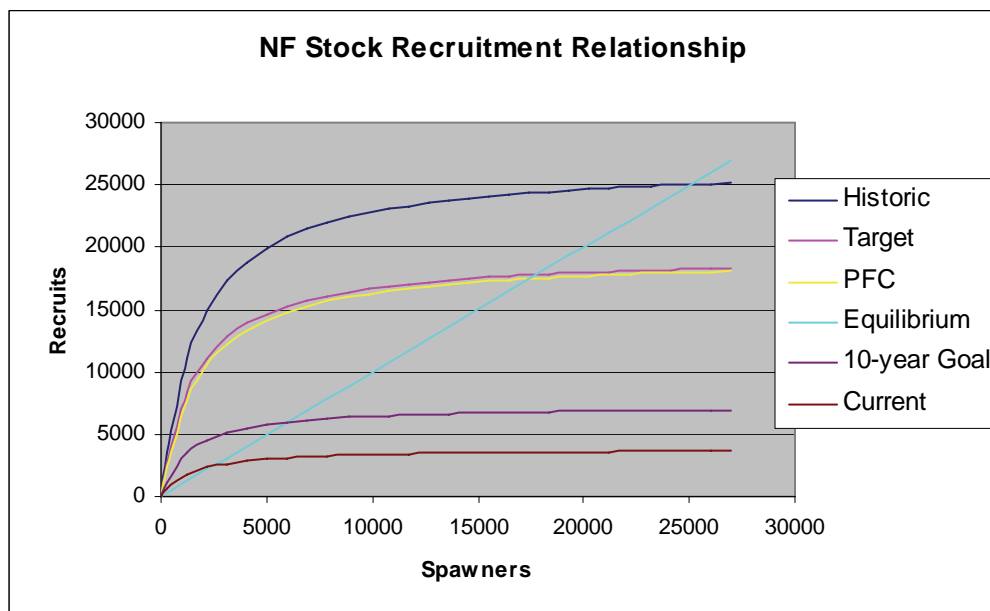
Figure 21. South Fork Population Performance



The long-term (11-50 years) goal for South Fork Stillaguamish Chinook salmon is an equilibrium abundance of 15,387 spawners. That equilibrium abundance will be achieved through the implementation of additional habitat restoration plans. If the co-managers determine that the South Fork population is not self-sustaining or does not respond positively to the habitat restoration activities, a natural stock hatchery restoration program would be considered under an adaptive management scenario.

The short-term (10-year) goal for North Fork Stillaguamish Chinook salmon is an equilibrium abundance of 5,950 spawners. This population should respond in a positive manner to the implementation of the proposed habitat improvements in the North Fork Stillaguamish. The population should show an increase in both abundance and productivity as the fish take advantage of a broader range of habitat conditions.

Figure 22. North Fork Population Performance



The long-term population planning target for North Fork Chinook salmon is an equilibrium abundance of 17,795. These fish will be distributed throughout the known historic range of usage for both the mainstem North Fork and its tributaries with a population productivity (11.9) sufficient to support terminal area fisheries in most years.

Long-Term Habitat Restoration Projects

Following the implementation of restoration projects outlined in the SIRC's approved 10-year strategy, the watershed will reach approximately 30% of properly functioning conditions and the Chinook salmon population target. In years 11-50, the restoration actions shown in Table 12, if fully implemented, should result in reaching both the properly functioning conditions and population targets for the watershed. All restoration efforts are contingent upon protecting existing habitat using a combined enforcement and incentive program, and assume natural oceanographic conditions and predictable harvest and natural predation levels.

Table 12. Habitat project costs, years 11-50

Project Type	Units	Quantity	Cost/Unit	Total Costs
Riparian	Acres Planted	7600	\$7500	\$57,000,000
Estuary	Acres Restored	1,055	\$20,000	\$21,100,000
	Acres Created	650	\$6,700	\$4,355,000
Large Wood	Engineered Log Jams	11	\$67,000	\$737,000
Floodplain	Acres Restored	120	\$100,000	\$12,000,000
	Armoring Removed	18	\$250,000	\$4,500,000
Sediment	Landslide Treatments	8	\$2,250,000	\$18,000,000
	Forest Road Treatment	424	\$30,000	\$12,720,000
Acquisition	Acres Acquired	5780	\$6,000	\$34,680,000
Subtotal				\$165,092,000
+40% Contingency and Inflation				\$66,036,800
Cost for Years 11-50				\$231,128,800
Cost for Years 1-10 (from Table 10)				\$44,094,400
SIRC 50 Year Plan Total Costs				\$275,223,200

Stakeholders for Implementation

A wide variety of Stillaguamish Watershed stakeholders are capable of implementing the habitat projects described above. These agencies and organizations were influential in the development of the project concepts through the SIRC and will be involved in implementation of project actions, as well as overseeing progress toward the overall goals of this plan. Implementing the habitat project actions identified in this chapter will require commitments from a number of stakeholder organizations. In many cases, meeting these commitments will require certain conditions such as funding from federal or state sources, willing landowner support, permitting, technical assistance, or a formal public review process. These commitments and conditions will evolve over time with ongoing analysis and coordination related to on-the-ground project actions. Assumed capabilities and past project implementation experience of habitat restoration project stakeholders are shown below (subject to refinement):

- Snohomish County – All project types
- Stillaguamish Tribe – All project types
- Tulalip Tribe – All project types

- Washington Department of Fish and Wildlife – Estuarine wetland restoration, fish passage improvements, riparian fencing, re-vegetation, off-channel rearing, technical assistance
- Stillaguamish Flood Control District – Estuarine, floodplain, riparian
- Snohomish Conservation District – Forest road treatment, riparian, floodplain, best management practices
- U.S. Forest Service – Forest road treatment and hydrology
- Washington Department of Natural Resources – Forest road treatment and hydrology
- Adopt-A-Stream - Riparian
- Stilly-Snohomish Fisheries Enhancement Task Force – Riparian, floodplain, side channels, LWD, estuarine projects
- Stillaguamish Tribe Banksavers - Riparian
- Ducks Unlimited – Estuarine
- The Nature Conservancy – Estuarine
- City of Arlington – Hydrology, riparian, floodplain
- Department of Ecology – TMDLs, water quality issues
- Private landowners – All project types

