Lower Columbia Salmon Recovery
And
Fish & Wildlife Subbasin Plan

Volume II – Subbasin Plan
Chapter E – Cowlitz, Coweeman and Toutle

Grays-Elochoman and Cowlitz Rivers (WRIAS 25-26)
Watershed Management Plan
Chapter 7 Appendix – Management of Fish Habitat Conditions

Lower Columbia Fish Recovery Board

December 15, 2004

Preface

This is one in a series of volumes that together comprise a Recovery and Subbasin Plan for Washington lower Columbia River salmon and steelhead:

--	Plan Overview	*Overview of the planning process and regional and subbasin elements of the plan.*
Vol. I	Regional Plan	*Regional framework for recovery identifying species, limiting factors and threats, the scientific foundation for recovery, biological objectives, strategies, measures, and implementation.*
Vol. II	Subbasin Plans	*Subbasin vision, assessments, and management plan for each of 12 Washington lower Columbia River subbasins consistent with the Regional Plan. These volumes describe implementation of the regional plan at the subbasin level.*
		II.A. Lower Columbia Mainstem and Estuary *II.B. Estuary Tributaries* *II.C. Grays Subbasin* *II.D. Elochoman Subbasin* *II.E. Cowlitz Subbasin* *II.F. Kalama Subbasin* *II.G. Lewis Subbasin* *II.H. Lower Columbia Tributaries* *II.I. Washougal Subbasin* *II.J. Wind Subbasin* *II.K. Little White Salmon Subbasin* *II.L. Columbia Gorge Tributaries*
Appdx. A	Focal Fish Species	*Species overviews and status assessments for lower Columbia River Chinook salmon, coho salmon, chum salmon, steelhead, and bull trout.*
Appdx. B	Other Species	*Descriptions, status, and limiting factors of other fish and wildlife species of interest to recovery and subbasin planning.*
Appdx. C	Program Directory	*Descriptions of federal, state, local, tribal, and non-governmental programs and projects that affect or are affected by recovery and subbasin planning.*
Appdx. D	Economic Framework	*Potential costs and economic considerations for recovery and subbasin planning.*
Appdx. E	Assessment Methods	*Methods and detailed discussions of assessments completed as part of this planning process.*

This plan was developed by of the Lower Columbia Fish Recovery Board and its consultants under the Guidance of the Lower Columbia Recovery Plan Steering Committee, a cooperative partnership between federal, state and local governments, tribes and concerned citizens.

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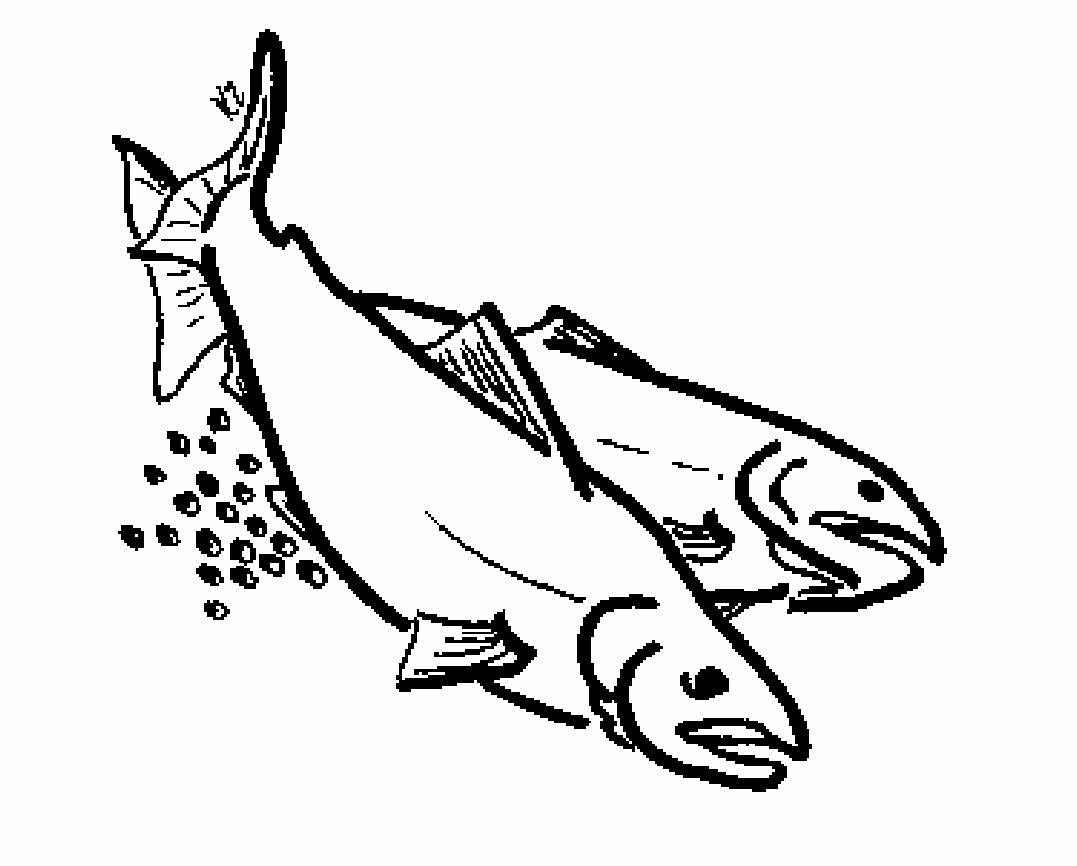

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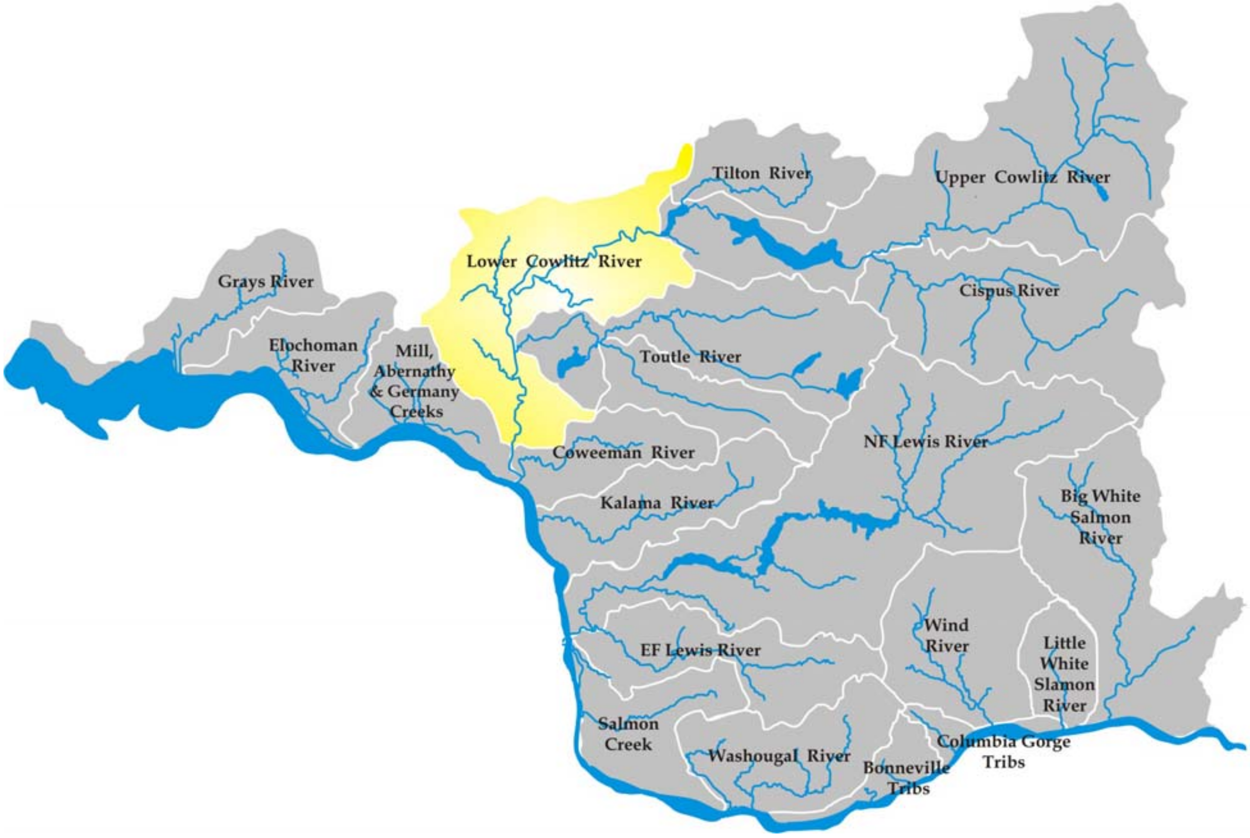

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1.0 Lower Cowlitz River – Executive Summary

This plan describes a vision, strategy, and actions for recovery of listed salmon, steelhead, and trout species to healthy and harvestable levels, and mitigation of the effects of the Columbia River hydropower system in Washington lower Columbia River subbasins. Recovery of listed species and hydropower mitigation is accomplished at a regional scale. This plan for the lower Cowlitz River describes implementation of the regional approach within this subbasin, as well as assessments of local fish populations, limiting factors, and ongoing activities that underlie local recovery or mitigation actions. The plan was developed in a partnership between the Lower Columbia Fish Recovery Board (Board), Northwest Power and Conservation Council, federal agencies, state agencies, tribal nations, local governments, and others.

The Cowlitz River is one of eleven major subbasins in the Washington portion of the Lower Columbia Region. The basin historically supported thousands of fall Chinook, winter steelhead, chum, and coho. Today, numbers of naturally spawning salmon and steelhead have plummeted to levels far below historical numbers. Chinook, chum, and steelhead have been listed as Threatened under the Endangered Species Act and coho is proposed for listing. The decline has occurred over decades and the reasons are many. Freshwater and estuary habitat quality has been reduced by agricultural and forestry practices. Key habitats have been isolated or eliminated by dredging and channel modifications and diking, filling, or draining floodplains and wetlands. Altered habitat conditions have increased predation. Competition and interbreeding with domesticated or nonlocal hatchery fish has reduced productivity. Hydropower construction and operation has altered flows, habitat, and migration conditions. Fish are harvested in fresh and saltwater fisheries.

Lower Cowlitz River coho salmon need to be restored to a high level of viability to meet regional recovery objectives. This means that the population is productive, abundant, exhibits multiple life history strategies, and utilizes significant portions of the subbasin. Steelhead, chum and fall chinook must be restored to medium levels of viability.

In recent years, agencies, local governments, and other entities have actively addressed the various threats to salmon and steelhead, but much remains to be done. One thing is clear: no single threat is responsible for the decline in these populations. All threats and limiting factors must be reduced if recovery is to be achieved. An effective recovery plan must also reflect a realistic balance within physical, technical, social, cultural and economic constraints. The decisions that govern how this balance is attained will shape the region’s future in terms of watershed health, economic vitality, and quality of life.

This plan represents the current best estimation of necessary actions for recovery and mitigation based on thorough research and analysis of the various threats and limiting factors that impact Lower Cowlitz River fish populations. Specific strategies, measures, actions and priorities have been developed to address these threats and limiting factors. The specified strategies identify the best long term and short term avenues for achieving fish restoration and mitigation goals. While it is understood that data, models, and theories have their limitations and growing knowledge will certainly spawn new strategies, the Board is confident that by implementation of the recommended actions in this plan, the population goals in the Lower Cowlitz River Basin can be achieved. Success will depend on implementation of these strategies at the program and project level. It remains uncertain what level of effort will need to be invested in each area of impact to ensure the desired result. The answer to the question of precisely how much is enough is currently beyond our understanding of the species and ecosystems and can only be answered through ongoing monitoring and adaptive management against the backdrop of what is socially possible.

1.1 Key Priorities

Many actions, programs, and projects will make necessary contributions to recovery and mitigation in the Lower Cowlitz Basin. The following list identifies the most immediate priorities.

1. Manage Regulated Stream Flows through the Hydropower System

Hydro-regulation on the Cowlitz River has altered the natural stream flow regime below Mayfield Dam. To support fish and their habitat, hydro-regulation will need to provide adequate flows for habitat formation, fish migration, water quality, floodplain connectivity, habitat capacity, and sediment transport below Mayfield Dam. Due to alterations to the channel and floodplain in the lower river, the ability to restore the natural flow regime is limited and will need to occur in concert with restoration of lower river floodplain function.

2. Restore Floodplain Function, Riparian Function and Stream Habitat Diversity

Most of the Cowlitz mainstem and many of the larger tributaries (e.g. Olequa Creek, Lacamas Creek, Salmon Creek) are in agriculture, rural residential, or urban uses. Many riparian forests have been harvested or developed. Construction of levees, bank stabilization, and riparian vegetation removal have heavily impacted fish habitat. The majority of the mainstem Cowlitz floodplain has been disconnected from the river through channel and floodplain modifications. Removing or modifying channel control and containment structures to reconnect the stream and its floodplain, where this is feasible and can be done without increasing risks of substantial flood damage, will restore normal habitat-forming processes to reestablish habitat complexity, off-channel habitats, and conditions favorable to fish spawning and rearing. These improvements will be particularly beneficial to chum, fall Chinook, and coho. Partially restoring normal floodplain function will also help control downstream catastrophic flooding and will provide wetland and riparian habitats critical to other fish, wildlife, and plant species. Existing floodplain function and riparian habitats will be protected through local land use ordinances, partnerships with landowners, and the acquisition of land, where appropriate. Restoration will be achieved by working with willing landowners, non-governmental organizations, conservation districts, and state and federal agencies.

3. Manage Growth and Development to Protect Watershed Processes and Habitat Conditions

The human population in the basin is relatively low, but it is projected to grow by at least one third in the next twenty years. The local economy is also in transition with reduced reliance on forest products and farming. Population growth will primarily occur within river valleys and along the major stream corridors. This growth will result in the conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions. Land-use changes will provide a variety of risks to terrestrial and aquatic habitats. Careful land-use planning will be necessary to protect and restore natural fish populations and habitats and will also present opportunities to preserve the rural character and local economic base of the basin.

4. Address Immediate Risks with Short-term Habitat Fixes

Restoration of normal watershed processes that allow a basin to restore itself over time has proven to be the most effective strategy for long term habitat improvements. However, restoration of some critical habitats may take decades to occur. In the near term, it is important to initiate short-term fixes to address current critical low numbers of some species. Examples in the Lower Cowlitz Basin include building chum salmon spawning channels and constructing coho overwintering habitat such as alcoves, side channels, and log jams. In the absence of large-scale floodplain and channel migration zone restoration, opportunistic habitat creation and enhancement may be one of the few viable options for providing critical habitat, especially in the lower mainstem. Benefits of structural enhancements are often temporary but will help bridge the period until normal habitat-forming processes are reestablished.

5. Manage Forest Lands to Protect and Restore Watershed Processes

Many of the headwater watersheds of lower Cowlitz tributaries are forested and are managed for commercial timber production. These areas have experienced intensive past forest practices activities and proper forest management is critical to fish recovery. Forest practices have reduced fish habitat quantity and quality by altering stream flow, increasing fine sediment, and degrading riparian zones. In addition, forest road culverts have blocked fish passage in small tributary streams. Effective implementation of new forest practices through the Department of Natural Resources' Habitat Conservation Plan (state lands) and Forest Practices Rules (private lands) are expected to substantially improve conditions by restoring passage, protecting riparian conditions, reducing fine sediment inputs, lowering water temperatures, improving flows, and restoring habitat diversity. Improvements will benefit all species, particularly winter steelhead and coho.

6. Restore Passage at Culverts and Other Artificial Barriers

There are many culvert and other barriers throughout the basin (approximately 25 barriers total). Correcting passage barriers could open up as many as 50 additional miles of habitat. The blocked habitat is believed to be marginal in most cases but cumulatively, passage restoration could have substantial benefits to habitat capacity. Further assessment and prioritization of passage barriers is needed in the basin.

7. Align Hatchery Priorities Consistent with Conservation Objectives

Hatcheries throughout the Columbia basin historically focused on producing fish for fisheries as mitigation for hydropower development and widespread habitat degradation. Emphasis of hatchery production without regard for natural populations can pose risks to natural population viability. Hatchery priorities must be aligned to conserve natural populations, enhance natural fish recovery, and avoid impeding progress toward recovery while continuing to provide some fishery mitigation benefits. The Cowlitz River hatchery programs will produce fall Chinook, spring Chinook, coho, and summer and winter steelhead for use in the lower Cowlitz. Hatchery produced salmon and steelhead will be used to supplement natural production in appropriate areas of the basin and adjacent tributary streams, develop a local broodstock to reestablish historical diversity and life history characteristics, and also to provide fishery mitigation in a manner that does not pose significant risk to natural population rebuilding efforts. The Cowlitz Trout Hatchery also acclimates and releases a temporally-segregated hatchery winter steelhead run for reintroduction and harvest in the Upper Cowlitz and Tilton Basin.

8. Manage Fishery Impacts so they do not Impede Progress Toward Recovery

This near-term strategy involves limiting fishery impacts on natural populations to ameliorate extinction risks until a combination of measures can restore fishable natural populations. There is no directed Columbia River or tributary harvest of ESA-listed lower Cowlitz River salmon and steelhead. This practice will continue until the populations are sufficiently recovered to withstand such pressure and remain self-sustaining. Some lower Cowlitz salmon and steelhead are incidentally taken in mainstem Columbia River and ocean mixed stock fisheries for strong wild and hatchery runs of fall Chinook and coho. These fisheries will be managed with strict limits to ensure this incidental take does not threaten the recovery of wild populations including those from the lower Cowlitz. Steelhead and chum will continue to be protected from significant fishery impacts in the Columbia River and are not subject to ocean fisheries. Selective fisheries for marked hatchery steelhead and coho (and fall Chinook after mass marking occurs) will be a critical tool for limiting wild fish impacts. State and federal legislative bodies will be encouraged to develop funding necessary to implement mass-marking of fall Chinook, thus enabling a selective fishery with lower impacts on wild fish. State and federal fisheries managers will better incorporate Lower Columbia indicator populations into fisheries impact models.

9. Reduce Out-of-Subbasin Impacts so that the Benefits of In-Basin Actions can be Realized

Lower Cowlitz River salmon and steelhead are exposed to a variety of human and natural threats in migrations outside of the subbasin. Human impacts include drastic habitat changes in the Columbia River estuary, effects of Columbia Basin hydropower operation on mainstem, estuary, and nearshore ocean conditions, interactions with introduced animal and plant species, and altered natural predation patterns by northern pikeminnow, birds, seals, and sea lions. A variety of restoration and management actions are needed to reduce these out-of-basin effects so that the benefits in-subbasin actions can be realized. To ensure equivalent sharing of the recovery and mitigation burden, impacts in each area of effect (habitat, hydropower, etc.) should be reduced in proportion to their significance to species of interest.

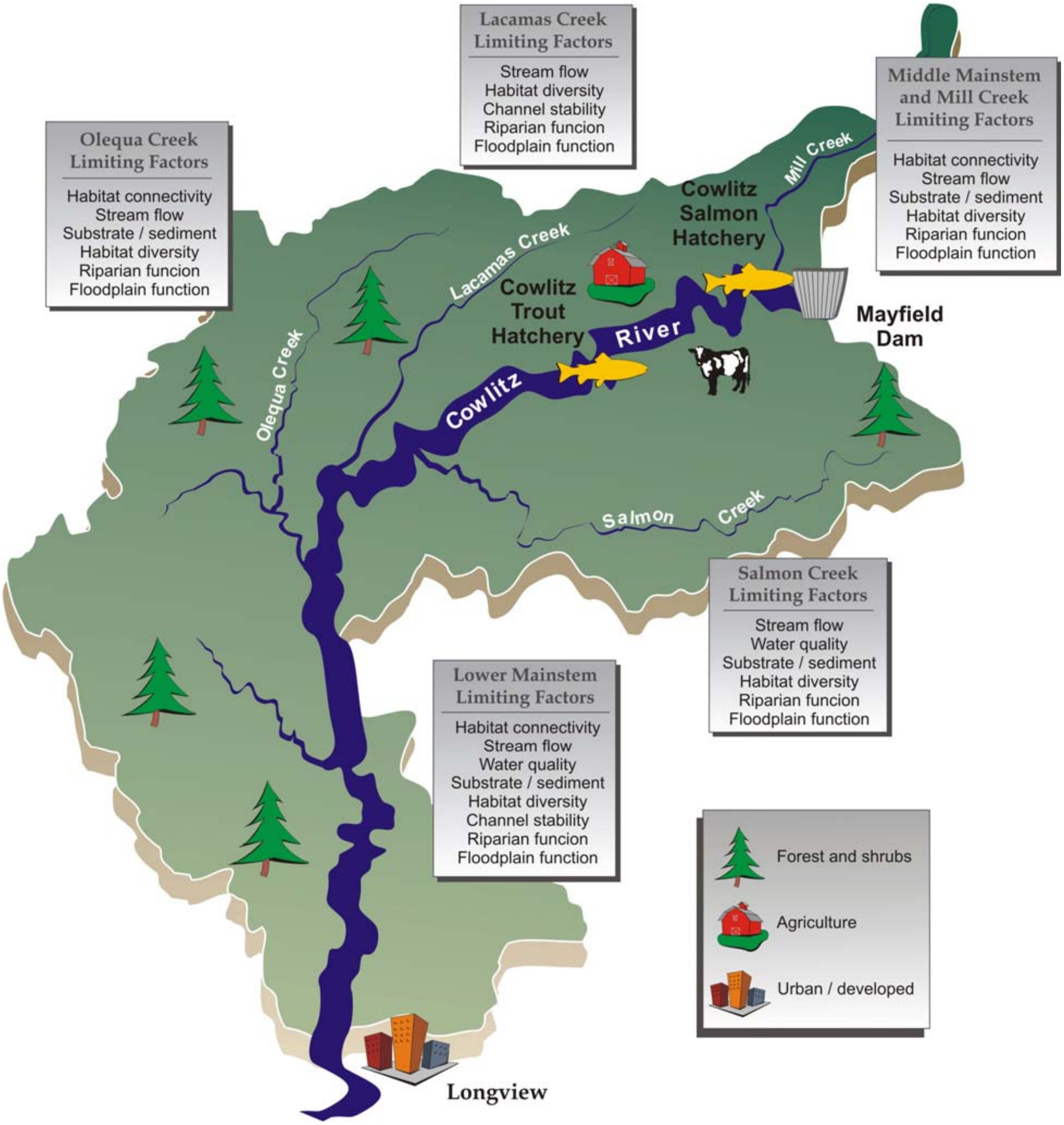


Figure 1. Key features of the Lower Cowlitz River Basin including a summary of limiting fish habitat factors in different areas and the status and relative distribution of focal salmonid species.

2.0 Background

This plan describes a vision and framework for rebuilding salmon and steelhead populations in Washington's lower Cowlitz River Subbasin. The plan addresses subbasin elements of a regional recovery plan for Chinook salmon, chum salmon, coho salmon, steelhead, and bull trout listed or under consideration for listing as Threatened under the federal Endangered Species Act (ESA). The plan also serves as the subbasin plan for the Northwest Power and Conservation Council (NPCC) Fish and Wildlife Program to address effects of construction and operation of the Federal Columbia River Power System.

Development of this plan was led and coordinated by the Washington Lower Columbia River Fish Recovery Board (LCFRB). The Board was established by state statue (RCW 77.85.200) in 1998 to oversee and coordinate salmon and steelhead recovery efforts in the lower Columbia region of Washington. It is comprised of representatives from the state legislature, city and county governments, the Cowlitz Tribe, private property owners, hydro project operators, the environmental community, and concerned citizens. A variety of partners representing federal agencies, Tribal Governments, Washington state agencies, regional organizations, and local governments participated in the process through involvement on the LCFRB, a Recovery Planning Steering Committee, planning working groups, public outreach, and other coordinated efforts.

The planning process integrated four interrelated initiatives to produce a single Recovery/Subbasin Plan for Washington subbasins of the lower Columbia:

- ☐ Endangered Species Act recovery planning for listed salmon and trout.
- ☐ Northwest Power and Conservation Council (NPCC) fish and wildlife subbasin planning for eight full and three partial subbasins.
- ☐ Watershed planning pursuant to the Washington Watershed Management Act, RCW 90-82.
- ☐ Habitat protection and restoration pursuant to the Washington Salmon Recovery Act, RCW 77.85.

This integrated approach ensures consistency and compatibility of goals, objectives, strategies, priorities and actions; eliminates redundancy in the collection and analysis of data; and establishes the framework for a partnership of federal, state, tribal and local governments under which agencies can effectively and efficiently coordinate planning and implement efforts.

The plan includes an assessment of limiting factors and threats to key fish species, an inventory of related projects and programs, and a management plan to guide actions to address specific factors and threats. The assessment includes a description of the subbasin, focal fish species, current conditions, and evaluations of factors affecting focal fish species inside and outside the subbasin. This assessment forms the scientific and technical foundation for developing a subbasin vision, objectives, strategies, and measures. The inventory summarizes current and planned fish and habitat protection, restoration, and artificial production activities and programs. This inventory illustrates current management direction and existing tools for plan implementation. The management plan details biological objectives, strategies, measures, actions, and expected effects consistent with the planning process goals and the corresponding subbasin vision.

3.0 Assessment

3.1 Subbasin Description

3.1.1 *Topography & Geology*

For the purposes of this assessment, the Lower Cowlitz basin is the Cowlitz watershed below Mayfield Dam, not including the Toutle and Coweeman basins. The basin encompasses approximately 440 square miles in portions of Lewis and Cowlitz Counties and lies within WRIA 26 of Washington State. The Cowlitz enters the Columbia at RM 68, approximately 3.5 miles southeast of Longview, WA. The Coweeman and Toutle are the two largest tributaries. These basins are covered in separate chapters. Other significant tributaries include Salmon Creek, Lacamas Creek, Olequa Creek, Delameter Creek, and Ostrander Creek.

Mayfield Dam (RM 52), constructed in 1962, blocks all natural passage of anadromous fish to the upper basin. The Cowlitz Salmon Hatchery Barrier Dam (RM 49.5), located below Mayfield Dam, is a collection facility for trapping and hauling fish into the upper basin, a practice that has been in effect since 1969. Below the Barrier Dam, the river flows south through a broad valley. Much of the lower mainstem Cowlitz suffers from channelization features related to industrial, agricultural, and urban development.

The Toutle River, which enters the Cowlitz at RM 20, is a major lower tributary that drains the north and west sides of Mount St. Helens. The Toutle River was impacted severely by the 1980 eruption of Mount St. Helens and the resulting massive debris torrents and mudflows, which also impacted the Cowlitz mainstem downstream of the Toutle confluence. Following the eruption, the lower mainstem Cowlitz was dredged and dredge spoils were placed in the floodplain.

The lower valley is comprised of Eocene basalt flows and flow breccia. Alpine glaciation and subsequent fluvial working of glacially derived sediments have heavily influenced valley morphology and soils. The most common forest soils are Haplohumults (reddish brown lateritic soils) and the most common grassland soils are Argixerolls (prairie soils) (WDW 1990).

3.1.2 *Climate*

The subbasin has a typical northwest maritime climate. Summers are dry and warm and winters are cool, wet, and cloudy. Mean monthly precipitation ranges from 1.1 inches (July) to 8.8 inches (November) at Mayfield Dam. Annual precipitation averages 46 inches near Kelso, WA (WRCC 2003). Most precipitation occurs between October and March. Snow and freezing temperatures are common in the upper elevations while rain predominates in the middle and lower elevations.

3.1.3 *Land Use, Ownership, and Cover*

Forestry is the dominant land use in the subbasin. Commercial forestland makes up over 80% of the Cowlitz basin below Mayfield Dam. Much of the private land in the lower river valleys is agricultural and residential, with substantial impacts to riparian and floodplain areas in places. Population centers in the subbasin consist primarily of small rural towns, with the larger towns of Castle Rock and Longview/Kelso along the lower river. Projected population change from 2000 to 2020 for unincorporated areas in WRIA 26 is 22%. The following towns in the lower Cowlitz basin are listed with their estimated population change between 2000 and 2020: Longview 21%, Kelso 42%, Castle Rock 2%, Vader 64%, Toledo 64%, and Winlock 49% (LCFRB 2001). The State of Washington owns, and the Washington State Department of Natural

Resources (DNR) manages the beds of all navigable waters within the subbasin. Any proposed use of those lands must be approved in advance by the DNR. A breakdown of land ownership is presented in Figure 2. In most areas, climax species are western hemlock, Douglas fir, and western red cedar. Alder, cottonwood, maple, and willow dominate the larger stream riparian areas (WDW 1990). A breakdown of land cover is presented in Figure 2. Figure 3 displays the pattern of land cover / land-use.

3.1.4 *Human Disturbance Trends*

Projected population change from 2000 to 2020 for unincorporated areas in WRIA 26 is 22%. The following towns in the lower Cowlitz basin are listed with their estimated population change between 2000 and 2020: Longview 21%, Kelso 42%, Castle Rock 2%, Vader 64%, Toledo 64%, and Winlock 49% (LCFRB 2001). Population growth will result in conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions. It is important that growth management policy adequately protect sensitive habitats and the conditions that create and support them.

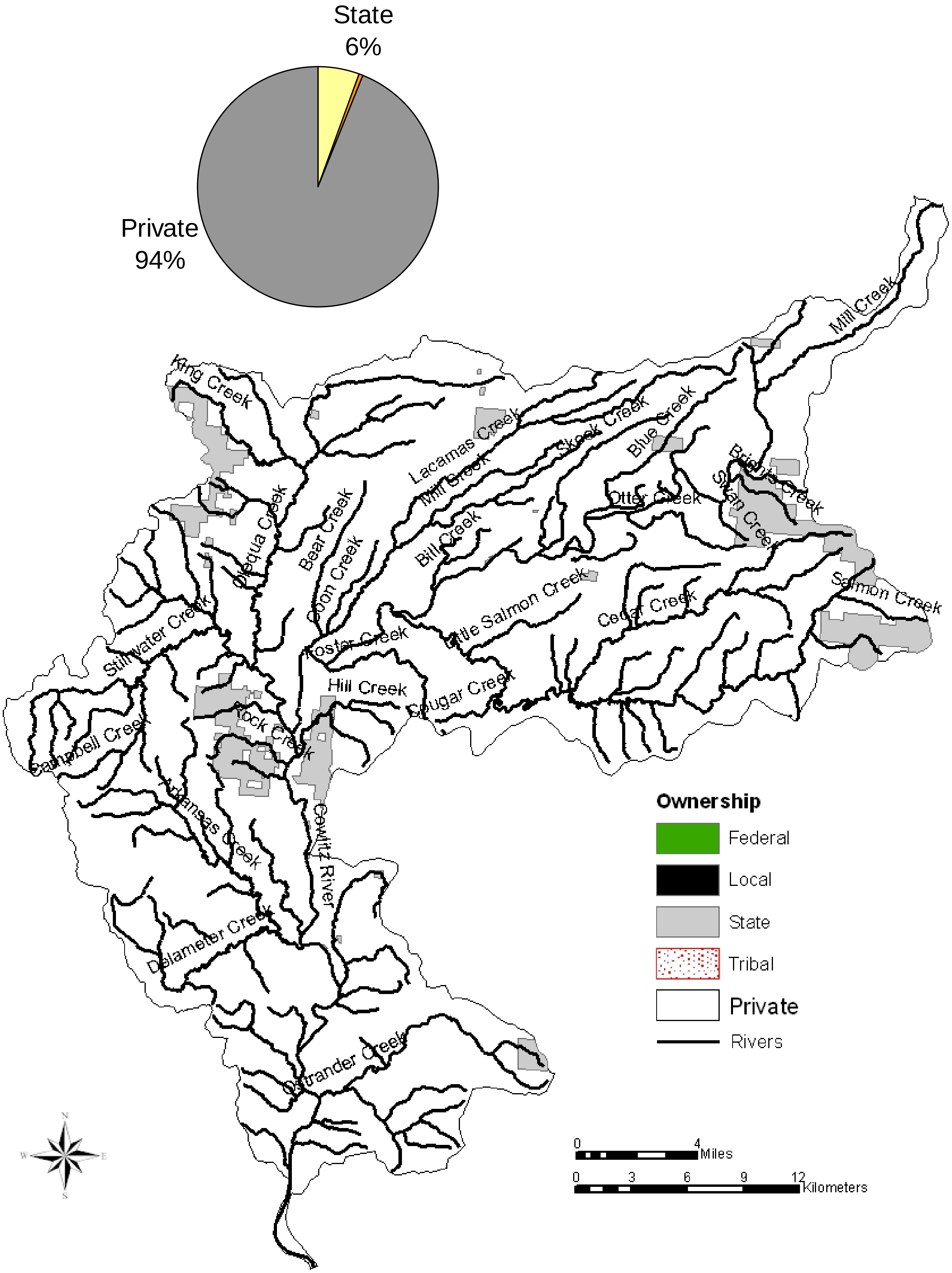


Figure 2. Landownership within the lower Cowlitz basin. Data is WDNR data that was obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

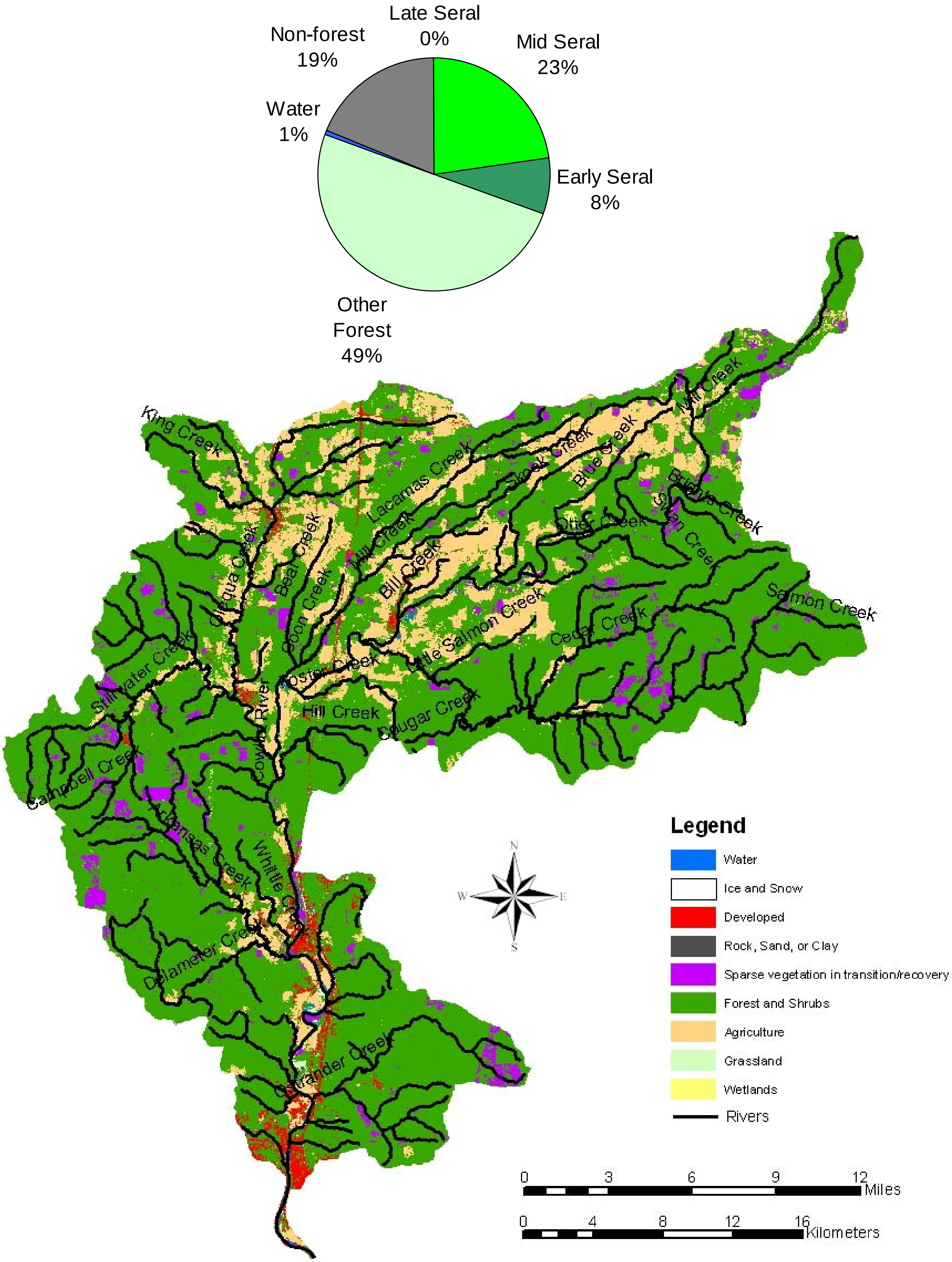


Figure 3. Land cover within the lower Cowlitz basin. Vegetaion cover (pie chart) derived from Landsat data based on methods in Lunetta et al. 1997. Mapped data was obtained from the USGS National Land Cover Dataset (NLCD).

3.2 Focal and Other Species of Interest

Listed salmon, steelhead, and trout species are focal species of this planning effort for the lower Cowlitz basin. Other species of interest were also identified as appropriate. Species were selected because they are listed or under consideration for listing under the U.S. Endangered Species Act or because viability or use is significantly affected by the Federal Columbia Hydropower system. Federal hydropower systems in the Cowlitz River have significantly affected anadromous species in the lower Cowlitz which are also subject to effects in the Columbia River, estuary, and nearshore ocean. The lower Cowlitz ecosystem supports and depends on a wide variety of fish and wildlife in addition to designated species. A comprehensive ecosystem-based approach to salmon and steelhead recovery will provide significant benefits to other native species through restoration of landscape-level processes and habitat conditions. Other fish and wildlife species not directly addressed by this plan are subject to a variety of other Federal, State, and local planning or management activities.

Focal salmonid species in lower Cowlitz River watersheds include fall Chinook, chum, coho, and winter steelhead. Spring Chinook are a focal species in the upper Cowlitz River. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 1). Extinction risks are significant for all focal species – the current health or viability of ranges from very low for chum to low for coho, fall Chinook, and winter steelhead. Returns of fall Chinook, coho, and winter steelhead include both natural and hatchery produced fish. The lower Cowlitz chum population is a subset of a larger population which also includes chum produced in the Toutle and Coweeman rivers.

Table 1. Status of focal salmonid and steelhead populations in the lower Cowlitz basin.

Focal Species	ESA Status	Hatchery Component[1]	Historical numbers[2]	Recent numbers[3]	Current viability[4]	Extinction risk[5]
Fall Chinook	Threatened	Yes	30,000-40,000	1,000-13,000	Low+	40%
Chum (a)	Threatened	No	300,000-500,000	<150	Very Low	70%
Coho	Proposed	Yes	20,000-120,000	unknown	Low	70%
Winter Steelhead	Threatened	Yes	2,000-28,000	unknown	Low	50%

(a) Population includes chum produced from the lower Cowlitz, Toutle, and Coweeman rivers.

[1] Significant numbers of hatchery fish are released in the subbasin.
[2] Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NOAA rough calculations.
[3] Approximate current annual range in number of naturally-produced fish returning to the subbasin.
[4] Propsects for long term persistence based on criteria developed by the NOAA Technical Recovery Team.
[5] Probability of extinction within 100 years corresponding to estimated viability.

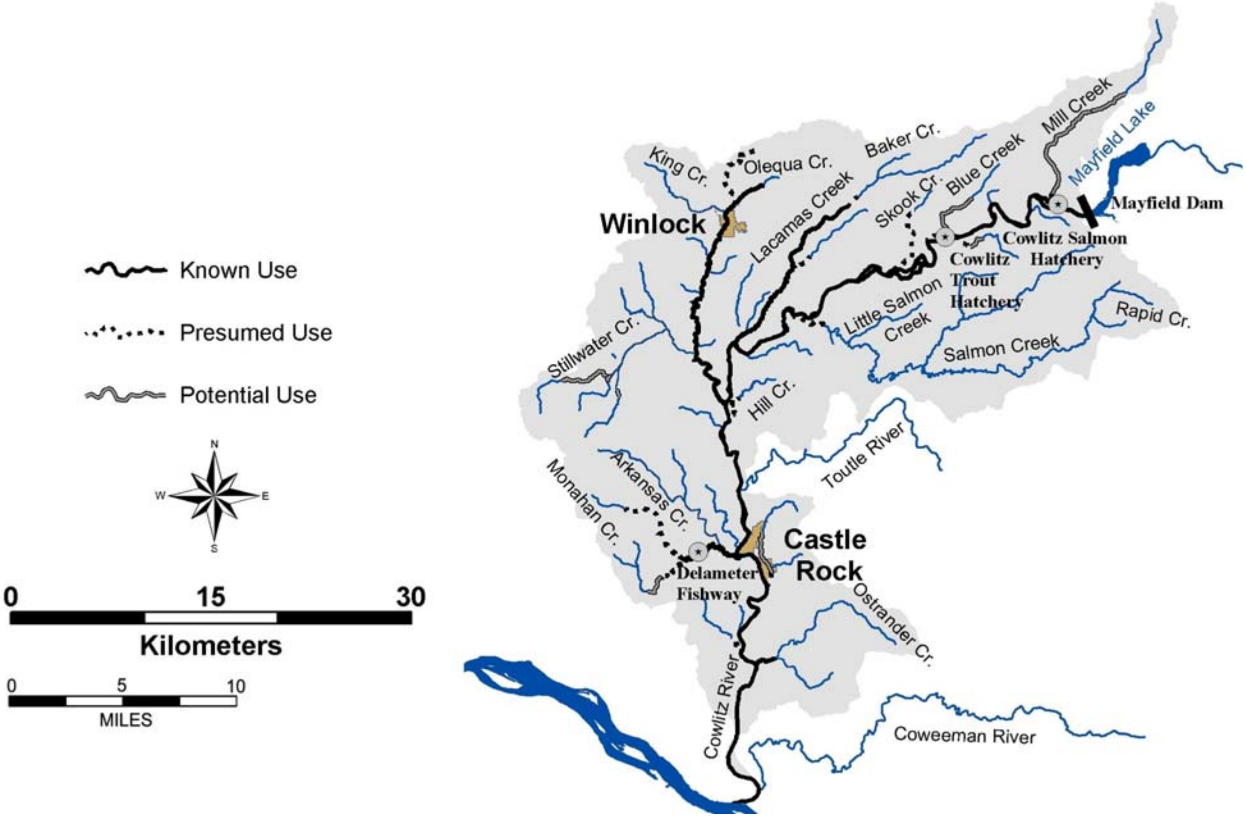
Other species of interest in the Lower Cowlitz Subbasin include coastal cutthroat trout and Pacific lamprey. These species have been affected by many of the same habitat factors that have reduced numbers of anadromous salmonids.

Brief summaries of the population characteristics and status follow. Additional information on life history, population characteristics, and status assessments may be found in Appendix A (focal species) and B (other species).

3.2.1 *Fall Chinook—Cowlitz Subbasin (Lower Cowlitz)*

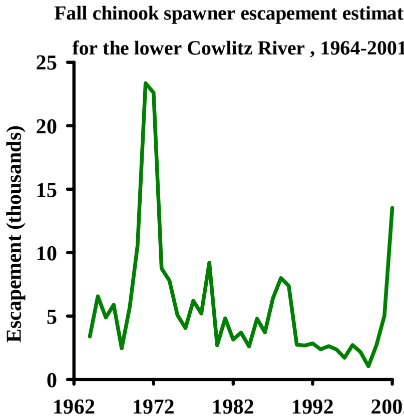
ESA: Threatened 1999 **SASSI: Depressed 2002**

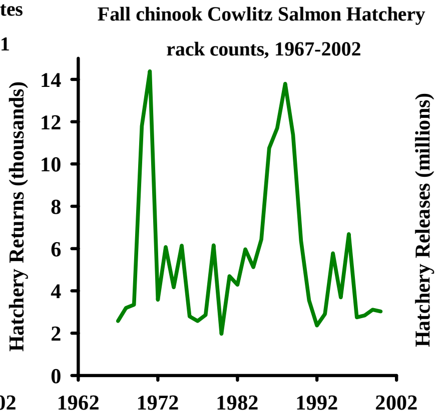
The historical lower Cowlitz adult population is estimated from 30,000-40,000 fish. Current natural spawning returns range from 1,000-13,000 with the majority hatchery origin fish. There is also a number of North Lewis wild fall Chinook which stray into the Lower Cowlitz and spawn. Spawning is primarily concentrated in 11 miles of river from the Cowlitz Salmon Hatchery downstream to the Cowlitz Trout Hatchery. Juvenile rearing occurs near and downstream of the spawning area. Juveniles emerge in early spring and migrate to the Columbia in spring and summer of their first year.

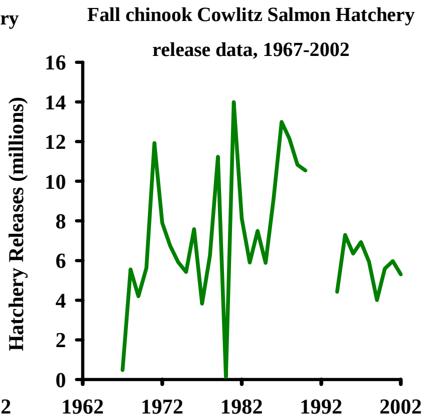


Distribution

- Spawning occurs in the mainstem Cowlitz River between the Cowlitz River Salmon Hatchery and the Kelso Bridge (~45 miles), but is concentrated in the area between the Cowlitz Salmon and Trout Hatcheries (RM 52 and 41.3)
- Historically, Cowlitz River fall chinook were distributed from the mouth to upper tributaries such as the Ohanapecosh and Tilton Rivers and throughout the upper basin
- Completion of Mayfield Dam in 1962 blocked access above the dam (RM 52); all fish were passed over the dam from 1962-66; from 1967-80, small numbers of fall chinook were hauled to the Tilton and upper Cowlitz
- An adult trap and haul program began again in 1994 where fish were collected below Mayfield Dam and released above Cowlitz Falls Dam


Fall chinook spawner escapement estimates for the lower Cowlitz River , 1964-2001


Fall chinook Cowlitz Salmon Hatchery rack counts, 1967-2002


Fall chinook Cowlitz Salmon Hatchery release data, 1967-2002

Life History

- Fall Chinook enter the Cowlitz River from early September to late November
- Natural spawning in the Cowlitz River occurs between October and November, over a broader time period than most lower Columbia fall Chinook; the peak is usually occurs during first week of November
- Age ranges from 2-year-old jacks to 6-year-old adults, with dominant adult age of 3, 4, and 5 (averages are 16.49%, 58.05%, and 19.31%, respectively)
- Fry emerge around March/April, depending on time of egg deposition and water temperature; fall Chinook fry spend the spring in fresh water, and emigrate in the summer as sub-yearlings
- Cowlitz fall Chinook display life history characteristics (spawn timing, migration patterns) that fall between tules and Lewis River late spawning wild fall Chinook

Diversity

- The Cowlitz River fall Chinook stock is designated based on distinct spawning timing and distribution
- Genetic analysis of Cowlitz River Hatchery fall Chinook from 1981, 1982, and 1988 determined they were similar to, but distinct from, Kalama Hatchery fall Chinook and distinct from other Washington Chinook stocks

Abundance

- Historical abundance of natural spawning fall Chinook in the Cowlitz River is estimated to have once been 100,000 adults, declining to about 18,000 adults in the 1950s, 12,000 in the 1960s, and recently to less than 2,000
- In 1948, WDF and WDG estimated that the Cowlitz River produced 63,612 adult fall Chinook; escapement above the Mayfield Dam site was at least 14,000 fish
- Fall Chinook escapement estimates in 1951 were 10,900 in the Cowlitz River and minor tributaries, 8,100 in the Cispus, and 500 in the Tilton
- From 1961-1966, an average of 8,535 fall Chinook were counted annually at Mayfield Dam
- Lower Cowlitz River spawning escapement from 1964-2002 ranged from 1,045 to 23,345 (average 5,522)
- Currently hatchery production accounts for most fall Chinook returning to the Cowlitz River
- WDFW interim natural spawning escapement goal is 3,000 fish; the goal was not met from 1990-2000

Productivity & Persistence

- NMFS Status Assessment for the Cowlitz River indicated a 0.15 risk of 90% decline in 25 years and a 0.33 risk of 90% decline in 50 years; the risk of extinction in 50 years was 0
- Two adult production potential estimates have been reported for the upper Cowlitz: 63,818 and 93,015
- Smolt density model predicted natural production potential for the Cowlitz River below Mayfield Dam of 2,183,000 smolts; above Mayfield Dam the model predicts production potential of 357,000 smolts from the Tilton River and 4,058,000 smolts above Cowlitz Falls
- Current juvenile production from natural spawning is presumed to be low

Hatchery

- Cowlitz River Salmon Hatchery is located about 2 miles downstream of Mayfield Dam; hatchery was completed in 1967; broodstock is primarily derivered from native Cowlitz fall Chinook
- Hatchery releases of fall Chinook in the Cowlitz River began in 1952; hatchery release data are displayed for 1967-2002
- The current hatchery program goal is 5 million fall Chinook juveniles released annually
- Cowlitz hatchery fall Chinook are not currently being reintroduced above Cowlitz Falls Dam

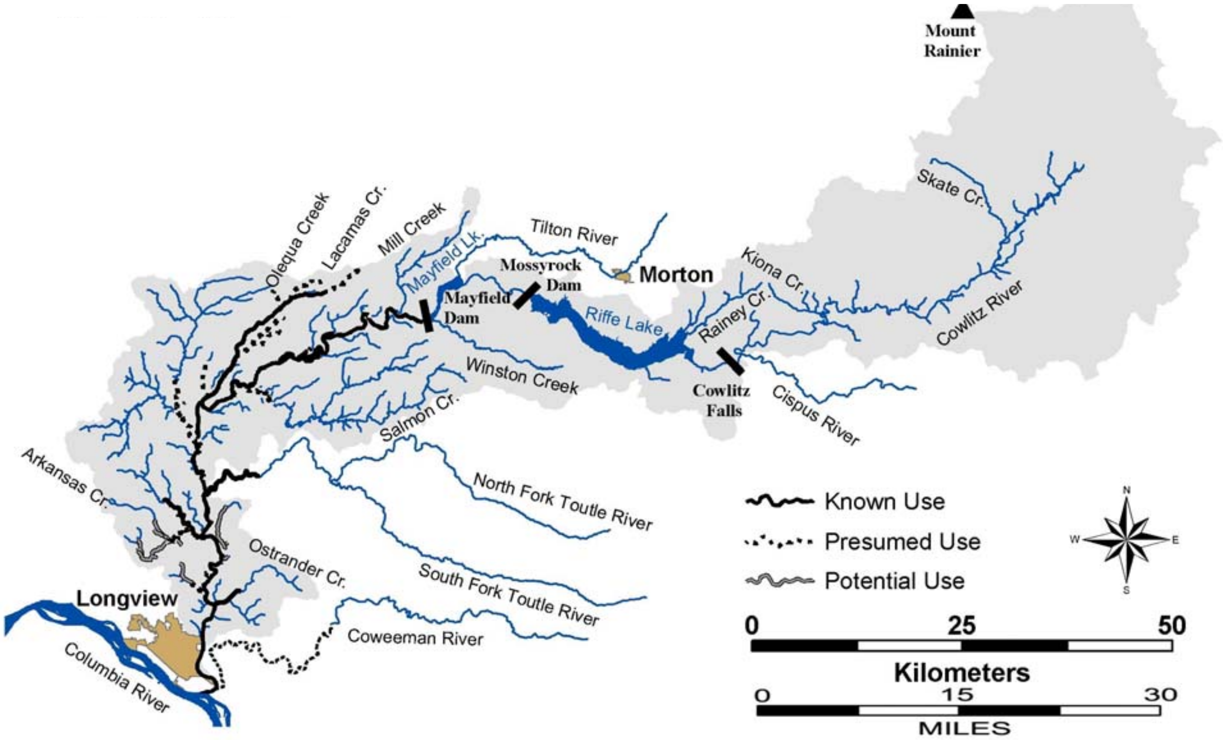
Harvest

- Fall Chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, and in Columbia River commercial and sport fisheries
- Ocean and mainstem Columbia River fisheries are managed for Snake River and Coweeman River wild fall Chinook Endangered Species Act (ESA) harvest rate limits which limits the harvest of Cowlitz fall Chinook
- Cowlitz River fall Chinook are important contributors to Washington ocean sport and troll fisheries and to the Columbia River estuary sport (Buoy 10) fishery
- CWT data analysis of the 1989-94 brood years indicates a total Cowlitz Hatchery fall Chinook harvest rate of 33% with 67% accounted for in escapement
- The majority of fishery CWT recoveries of 1989-94 brood Cowlitz Hatchery fall Chinook were distributed between Washington ocean (30%), British Columbia (21%), Alaska (15%), Cowlitz River (11%), and Columbia River (8%) sampling areas
- Annual harvest is variable depending on management response to annual abundance in Pacific Salmon Commission (PSC)(US/Canada), Pacific Fisheries Management Council (PFMC) (US ocean), and Columbia River Compact Forums
- Sport harvest in the Cowlitz River averaged 2,672 fall Chinook annually from 1977-1986
- Freshwater sport fisheries in the Cowlitz River are managed to achieve adult fall Chinook hatchery escapement goals

3.2.2 *Chum—Cowlitz Subbasin*

ESA: Threatened 1999 **SASSI: NA**

The historical Cowlitz adult population was the largest in the lower Columbia and estimated from 300,000-500,000 fish. This estimate includes production from the mainstem Cowlitz, Toutle, and Coweeman rivers. Current returns are very low, likely less than 150 fish. Typically, less than 20 chum are collected annually in the hatchery trap at the Barrier Dam. Natural spawning primarily occurs in the lower Cowlitz, lower mainstem Toutle, Ostrander Creek, and the lower Coweeman. Peak spawning occurs in late November. Juveniles emerge in the early spring and migrate to the Columbia after a short rearing period.



Distribution

- Chum were reported to historically utilize the lower Cowlitz River and tributaries downstream of the Mayfield Dam site

Life History

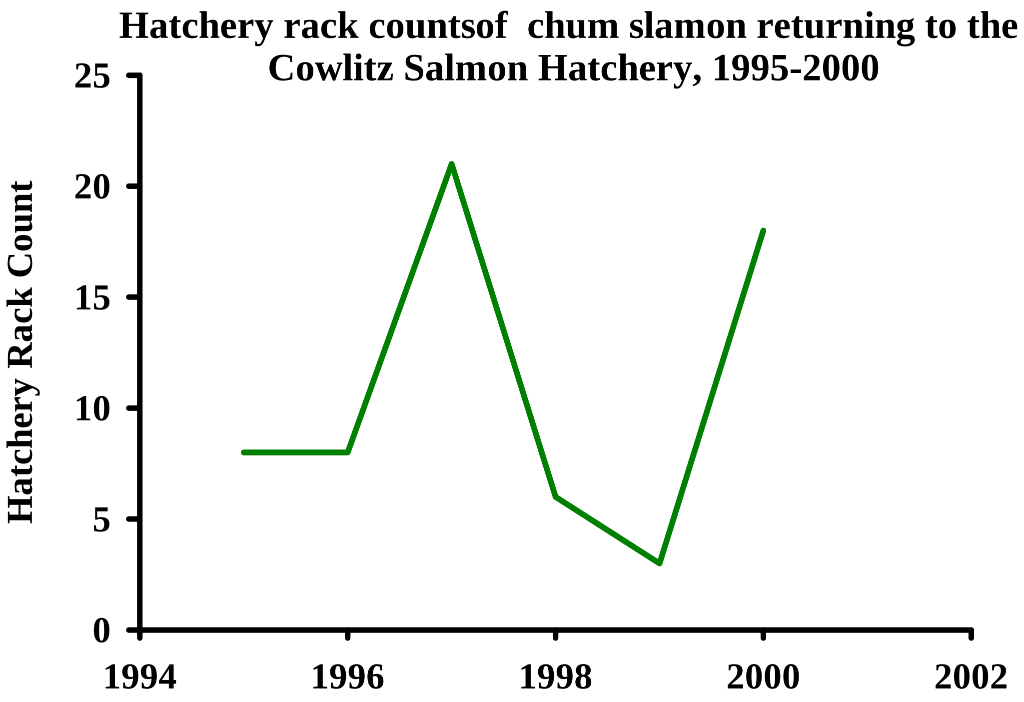
Lower Columbia River chum salmon run from mid-October through November; peak spawner abundance occurs in late November

Dominant age classes of adults are 3 and 4

Fry emerge in early spring; chum emigrate as age-0 smolts generally from March to May

Diversity

- No hatchery releases of chum have occurred in the Cowlitz basin



Abundance

- Estimated escapement of approximately 1,000 chum in early 1950's
- Between 1961 and 1966, the Mayfield Dam fish passage facility counted 58 chum
- Typically less than 20 adults are collected annually at the Cowlitz Salmon Hatchery

Productivity & Persistence

- Anadromous chum production primarily in lower watershed
- Harvest, habitat degradation, and to some degree construction of Mayfield and Mossyrock Dams contributed to decreased productivity

Hatchery

- Cowlitz Salmon Hatchery does not produce/release chum salmon
- Chum salmon are captured annually in the hatchery rack

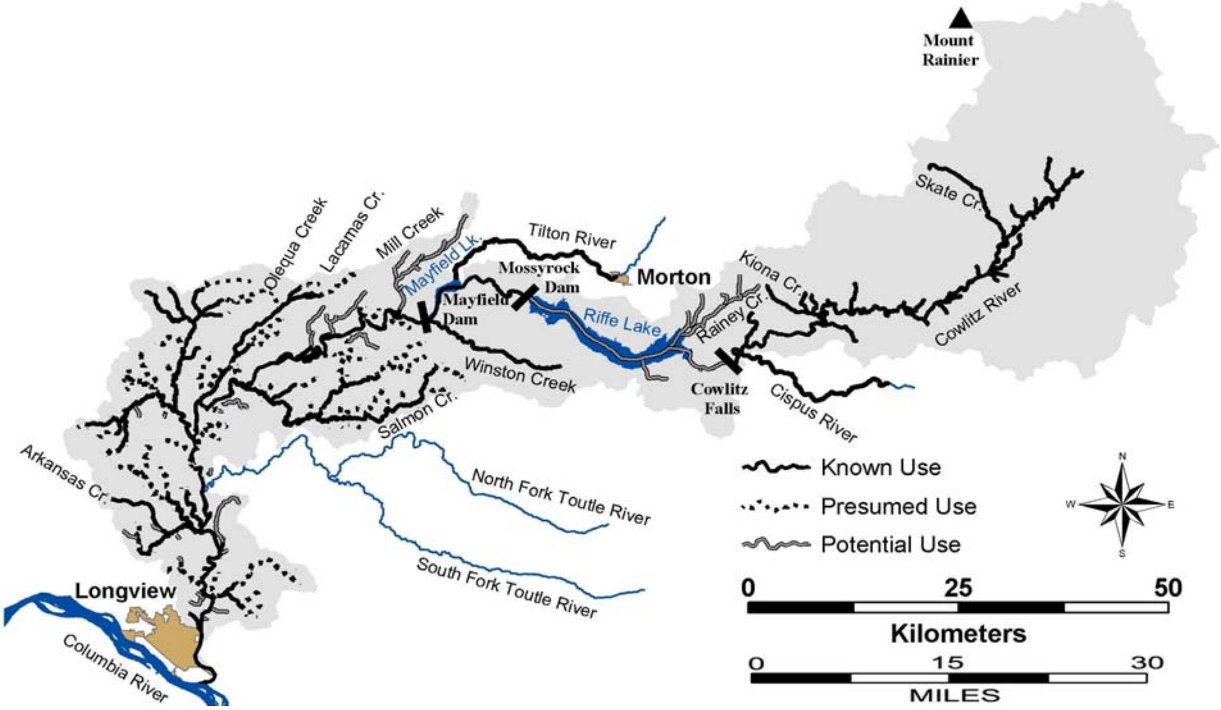
Harvest

- Currently very limited chum harvest occurs in the ocean and Columbia River and is incidental to fisheries directed at other species
- Columbia River commercial fishery historically harvested chum salmon in large numbers (80,000 to 650,000 in years prior to 1943); from 1965-1992 landings averaged less than 2,000 chum, and since 1993 less then 100 chum
- In the 1990s November commercial fisheries were curtailed and retention of chum was prohibited in Columbia River sport fisheries
- The ESA limits incidental harvest of Columbia River chum to less then 5% of the annual return.

3.2.3 *Coho—Cowlitz Subbasin*

ESA: Candidate 1995	**SASSI: Cowlitz—Depressed 2002;**

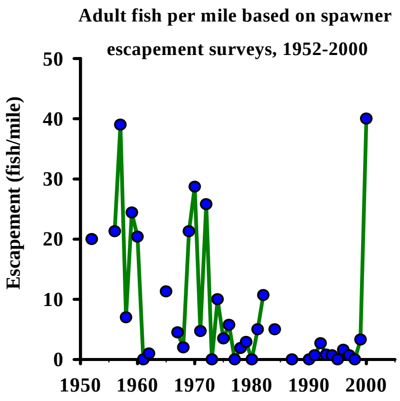
The historical lower Cowlitz adult population is estimated from 20,000-120,000 fish. with the majority of returns being late stock which spawn in November. Current returns are unknown but assumed to be low. A number of hatchery produced fish spawn naturally. Natural spawning occurs primarily in Olequa, Lacamas, Ostrander, Blue, Otter, Mill, Arkansas, Foster, Stillwater, Campbell, and Hill creeks. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the Cowlitz Basin before migrating as yearlings in the spring.

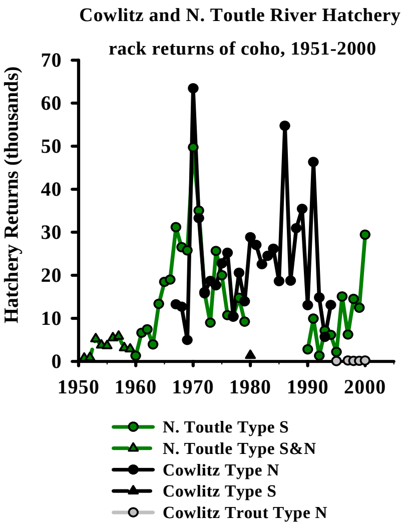


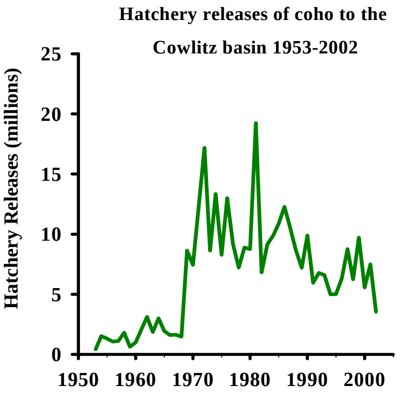
Distribution

- Managers refer to early stock coho as Type S due to their ocean distribution generally south of the Columbia River and late stock coho as Type N due to their ocean distribution generally north of the Columbia River
- Natural spawning is thought to occur in most areas accessible to coho, including the Toutle, SF Toutle, Coweeman, and Green Rivers and all accessible tributaries
- Natural spawning in lower Cowlitz tributaries occurs primarily in Olequa, Lacamas, Brights, Ostrander, Blue, Otter, Mill, Arkansas, Foster, Stillwater, Campbell, and Hill Creeks
- Natural spawning in the Coweeman River basin is primarily in tributaries downstream of the confluence of Mulholland Creek
- The post Mt. St. Helens eruption Toutle River system includes tributaries at various stages of recovery and some tributaries (primarily on the Green and South Toutle) with minor effects of the eruption. Bear, Hoffstadt, Johnson, Alder, Devils, and Herrington Creeks are examples of tributaries important to coho; coho adults are collected and passed to tributaries above the North Toutle Sediment Retention Dam

Completion of Mayfield Dam in 1962 blocked access above the dam; a returning adult trap and haul program began in 1994 where fish were collected below Mayfield Dam and released above Cowlitz Falls Dam, restoring some access to the upper watershed.


Adult fish per mile based on spawner escapement surveys, 1952-2000


Cowlitz and N. Toutle River Hatchery rack returns of coho, 1951-2000


Hatchery releases of coho to the Cowlitz basin 1953-2002

Life History

- Adults enter the Columbia River from August through January (early stock primarily from mid-August through September and late stock primarily from late September to October)
- Peak spawning occurs in late October for early stock and December to early January for late stock
- Adults return as 2-year-old jacks (age 1.1) or 3-year-old adults (age 1.2)
- Fry emerge from January through April on the Cowlitz, depending on water temperature
- Coho spend one year in fresh water, and emigrate as age-1 smolts in the spring

Diversity

- Late stock (or Type-N) coho are informally considered synonymous with Cowlitz River stock
- Early stock(or Type-S) coho are informally considered synonymous with Toutle River stock
- Columbia River early and late stock coho produced from Washington hatcheries are genetically similar

Abundance

- Cowlitz River wild coho run is a fraction of its historical size
- In 1948, WDF estimated coho escapement to the basin was 77,000; in the early 1950s, escapement to the basin was estimated as 32,500 coho
- Escapement surveys on Olequa Creek from 1952-1990 established a range of 0-40 fish/mile
- Average total escapement of natural coho to the Toutle River was estimated as 1,743 for the years 1972-1979, prior to the 1980 eruption of Mt. St. Helens
- In 1985, an estimated 5,229 coho naturally spawned in lower Cowlitz River tributaries (excluding the Coweeman and Toutle systems), but the majority of spawners were fish originating from the Cowlitz Hatchery
- Hatchery production accounts for most coho returning to the Cowlitz River

Productivity & Persistence

- Natural coho production is presumed to be very low in the lower Cowlitz basin with Olequa Creek the most productive

- The Toutle River system likely provided the most productive habitat in the basin in the 1960s and 1970s, but was greatly reduced after the 1980 Mt. St. Helens eruption
- Reintroduction efforts in the upper Cowlitz River basin have demonstrated good production capabilities in tributaries above the dams, but efforts are challenged in passing juvenile production through the system
- Smolt density model natural production potential estimates were made on various sections of the Cowlitz River basin: 123,123 smolts for the lower Cowlitz River, 131,318 smolts for the Tilton River and Winston Creek, 155,018 smolts above Cowlitz Falls, 142,234 smolts for the Toutle River, and 37,797 smolts for the Coweeman River

Hatchery

- The Tilton River Hatchery released coho in the Cowlitz basin from 1915-1921
- A salmon hatchery operated in the upper Cowlitz River near the mouth of the Clear Fork until 1949
- The Cowlitz Salmon Hatchery is located about 2 miles downstream of Mayfield Dam; hatchery was completed in 1967; the hatchery is programmed for an annual release of 4.2 million late coho smolts
- Cowlitz Hatchery coho are important to the reintroduction effort in the upper basin
- The North Toutle Hatchery is located on the Green River less than a mile upstream of the confluence with the North Fork Toutle River; the hatchery is programmed for an annual release of 1 million early coho smolts

Harvest

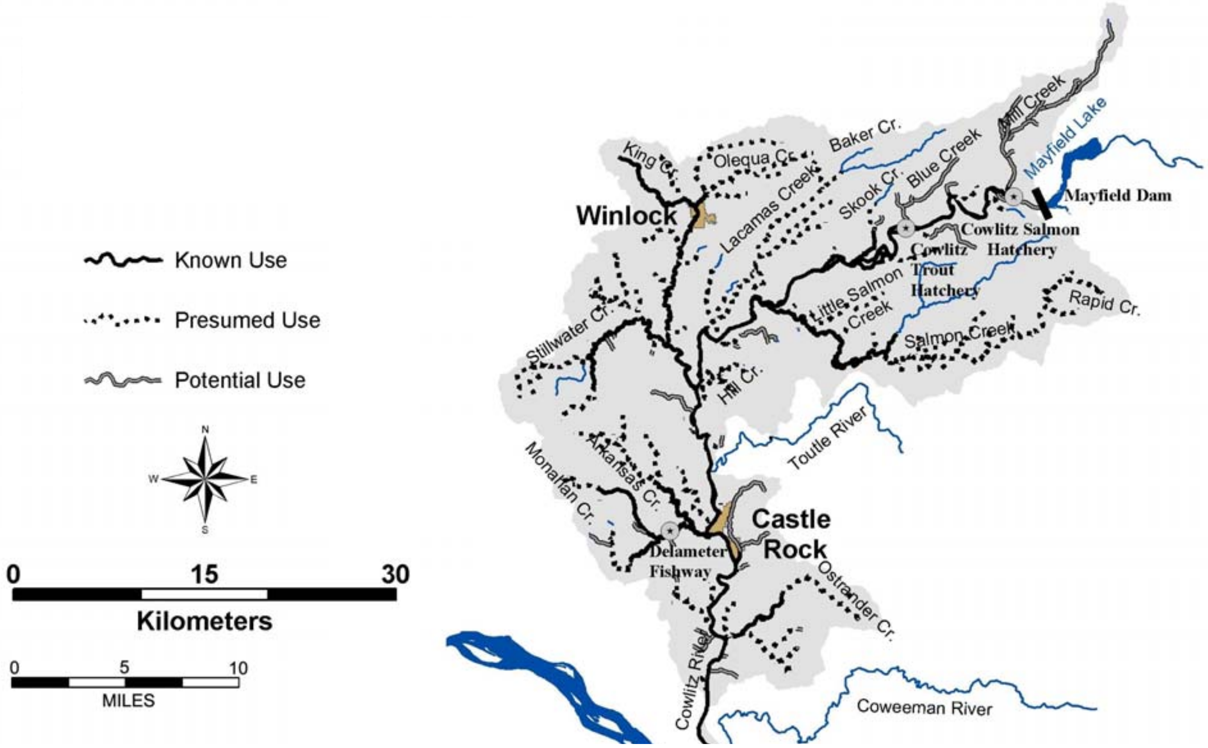
- Until recent years, natural produced coho were managed like hatchery fish and subjected to similar harvest rates; ocean and Columbia River combined harvest of Columbia produced coho ranged from 70% to over 90% from 1970-83
- Ocean fisheries were reduced in the mid 1980s to protect several Puget Sound and Washington coastal wild coho stocks
- Columbia River commercial coho fisheries in November were eliminated in the 1990s to reduce harvest of late Clackamas River wild coho
- Since 1999, Columbia River hatchery fish have been mass marked with an adipose fin clip to enable fisheries to selectively harvest hatchery coho and release wild coho
- Natural produced lower Columbia River coho are beneficiaries of harvest limits aimed at Federal ESA listed Oregon Coastal coho and Oregon State listed Clackamas and Sandy River coho
- During 1999-2002, fisheries harvest of ESA listed coho was less than 15% each year
- Hatchery coho can contribute significantly to the lower Columbia River gill net fishery; commercial harvest of early coho is constrained by fall Chinook and Sandy River coho management; commercial harvest of late coho is focused in October during the peak abundance of hatchery late coho
- A substantial estuary sport fishery exists between Buoy 10 and the Astoria-Megler Bridge; majority of the catch is early hatchery coho, but late coho harvest can also be substantial
- An average of 1,494 coho (1986-1990) were harvested annually in the Cowlitz River sport fishery
- The Toutle River sport fishery was closed in 1982 after the eruption of Mt. St. Helens; the Green River sport fishery was closed from 1981 to 1988 after the eruption of Mt. St. Helens and was reopened in 1989

- CWT data analysis of the 1995-97 North Toutle Hatchery early coho indicates 34% were captured in fisheries and 66% were accounted for in escapement
- CWT data analysis of the 1994 and 1997 brood Cowlitz Hatchery late coho indicates 64% were captured in fisheries and 36% were accounted for in escapement
- Fishery CWT recoveries of 1995-97 Toutle coho were distributed between Columbia River (47%), Washington ocean (37%), and Oregon ocean (15%) sampling areas
- Fishery CWT recoveries of 1994 and 1997 brood Cowlitz coho were distributed between Columbia River (55%), Washington ocean (30%), and Oregon ocean (15%) sampling areas

3.2.4 *Winter Steelhead—Cowlitz Subbasin (Cowlitz)*

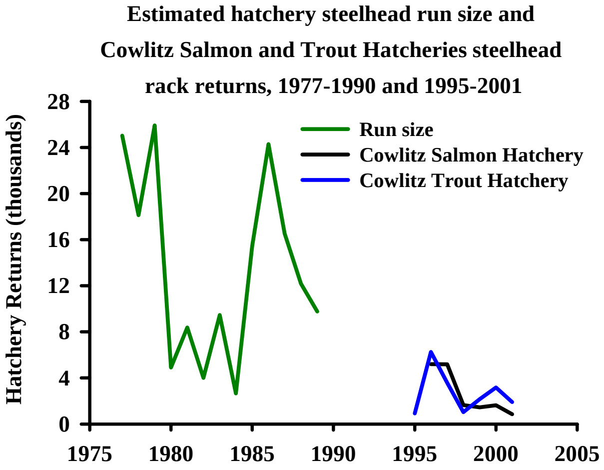
ESA: Threatened 1998 **SASSI: Unknown 2002**

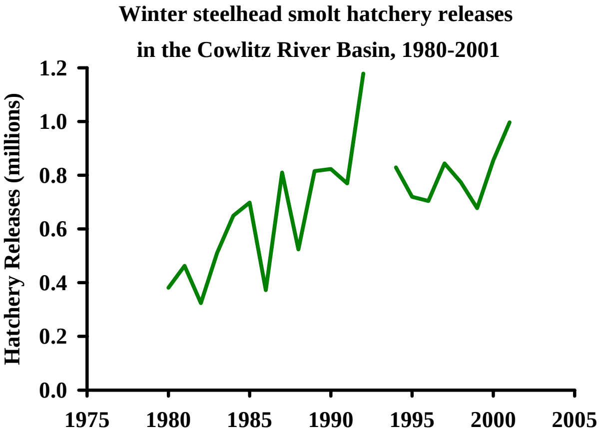
The historical lower Cowlitz adult population is estimated from 2,000-28,000 fish. Current natural spawning returns are unknown. Some interaction may occur between the natural population and Cowlitz origin winter steelhead produced from the hatchery. Interaction with Chambers Creek stock hatchery steelhead is likely low due to different spawn timing. Spawning in the lower Cowlitz primarily occurs in Olequa, Ostrander, Salmon, Arkansas, Delameter, and Stillwater creeks. Spawning time is March to early June. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Cowlitz Basin.



Distribution

- Winter steelhead are distributed throughout the mainstem Cowlitz below Mayfield Dam; natural spawning occurs in Olequa, Ostrander, Salmon, Arkansas, Delameter, Stillwater and Whittle Creeks
- Historically, winter steelhead were distributed throughout the upper Cowlitz, Cispus, and Tilton Rivers; known spawning areas include the mainstem Cowlitz near Riffle and the reach between the Muddy Fork and the Clear Fork and the lower Ohanapecosh River
- Construction of Mayfield Dam in 1963 blocked winter steelhead access to the upper watershed; approximately 80% of the spawning and rearing habitat are not accessible
- In 1994, a trap and haul program began to reintroduce anadromous salmonids to the watershed above Cowlitz Falls Dam; adult winter steelhead are collected at the Cowlitz hatcheries and released in the Upper Cowlitz, Cispus, and Tilton basins; smolts resulting from natural production in the upper watershed are collected at the Cowlitz Falls Fish Collection Facility, acclimated at the Cowlitz Salmon Hatchery, and released in the mainstem Cowlitz





Life History

- Adult migration timing for Cowlitz winter steelhead is from December through April
- Spawning timing on the Cowlitz is generally from early March to early June
- Limited age composition data for Cowlitz River winter steelhead indicate that the dominant age classes are 2.2 and 2.3 (54.2% and 32.2 %, respectively)
- Wild steelhead fry emerge from March through May; juveniles generally rear in fresh water for two years; juvenile emigration occurs from April to May, with peak migration in early May

Diversity

- Cowlitz winter steelhead stock designated based on distinct spawning distribution
- Concern with wild stock interbreeding with hatchery brood stock from Chambers Creek and the Cowlitz River (Cowlitz and late Cowlitz stock)
- Allele frequency analysis of Cowlitz Hatchery late winter steelhead in 1996 was unable to determine the distinctiveness of the stock compared to other lower Columbia steelhead stocks

Abundance

- Historically, annual wild winter steelhead runs to the Cowlitz River were estimated at 20,000 fish; escapement was estimated as 11,000 fish
- In 1936, steelhead were observed in the Cispus River and reported in the Tilton River during escapement surveys
- Between 1961 and 1966, an average of 11,081 adult steelhead were collected annually at the Mayfield Dam Fish Passage Facility
- In the late 1970s and 1980s, wild winter steelhead annual average run size in the Cowlitz River was estimated to be 309 fish
- From 1983-1995, the annual escapement of Cowlitz River (hatchery and wild)winter steelhead ranged from 4,067 to 30,200 (average 16,240)

Productivity & Persistence

- In the late 1970s and 1980s, wild winter steelhead contribution to the annual winter steelhead return was estimated to be 1.7%
- Estimated potential winter steelhead smolt production for the Cowlitz River is 63,399

Hatchery

- The Cowlitz Trout Hatchery, located on the mainstem Cowlitz at RM 42, is the only hatchery in the Cowlitz basin producing winter steelhead
- Hatchery winter steelhead have been planted in the Cowlitz River basin since 1957; broodstock from the Cowlitz River and Chambers Creek have been used; an annual average of 180,000 hatchery winter steelhead smolts were released in the Cowlitz River from 1967-1994; smolt release data are displayed from 1980-2001
- Hatchery fish account for the majority of the winter steelhead run to the Cowlitz River basin

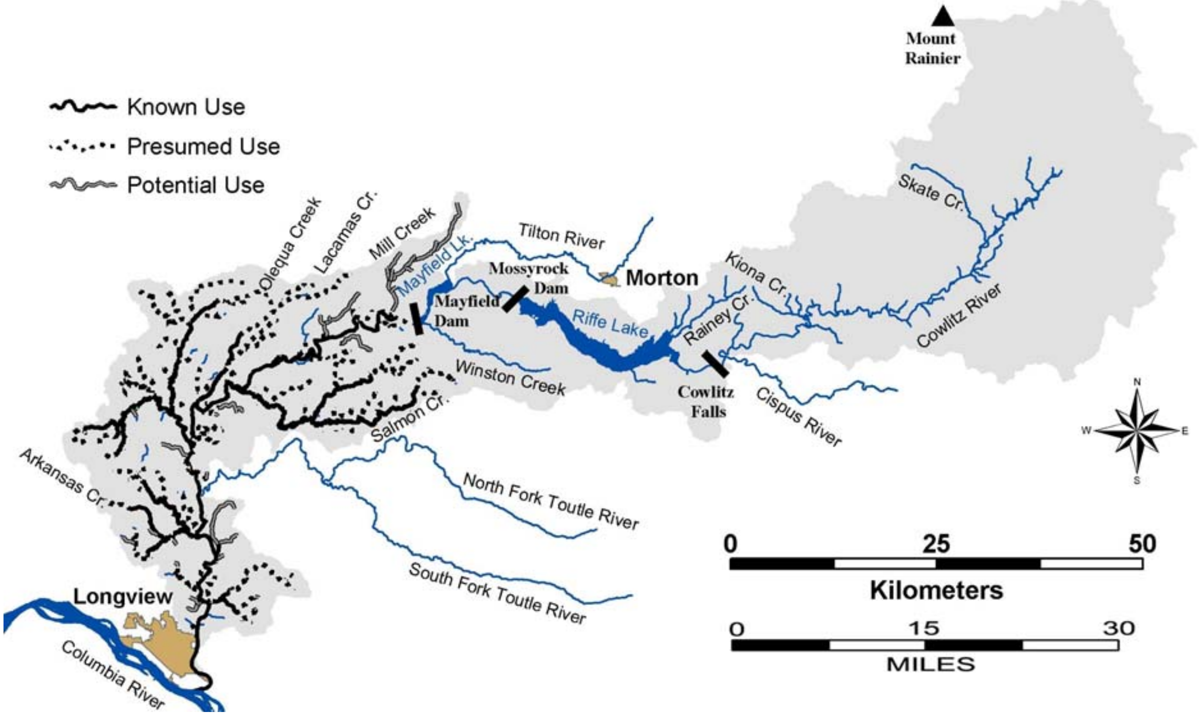
Harvest

- No directed commercial or tribal fisheries target Cowlitz winter steelhead; incidental mortality currently occurs during the lower Columbia River spring Chinook tangle net fisheries
- Steelhead sport fisheries in the Columbia must release wild winter steelhead which are not marked with an adipose fin clip
- ESA limits fishery impact of Cowlitz wild winter steelhead in the mainstem Columbia and in the Cowlitz River
- Approximately 6.2% of returning Cowlitz River steelhead are harvested in the Columbia River sport fishery
- Wild winter steelhead sport harvest in the Cowlitz River from in the late 1970s and early 1980s ranged from 102-336; wild winter steelhead contribution to the total annual sport harvest was less than 2%
- The Cowlitz River may be the most intensely-fished basin in the Washington sport fisheries; the Cowlitz has been the top winter steelhead river in Washington

3.2.5 *Cutthroat Trout—Cowlitz River Subbasin*

ESA: Not Listed	**SASSI: Depressed 2000**

Coastal cutthroat abundance in the lower Cowlitz has not been quantified but the population is considered depressed. Cutthroat trout are present throughout the basin. Both anadromous (fish which have both freshwater and marine life history) and resident forms of cutthroat trout are found in the basin. A Cowlitz Trout Hatchery program produces anadromous cutthroat trout. Anadromous cutthroat enter the Cowlitz from July to October and spawn from January to April. Most juveniles rear 2-3 years before migrating from their natal stream.

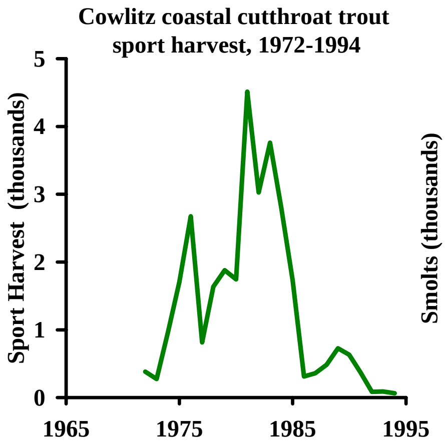


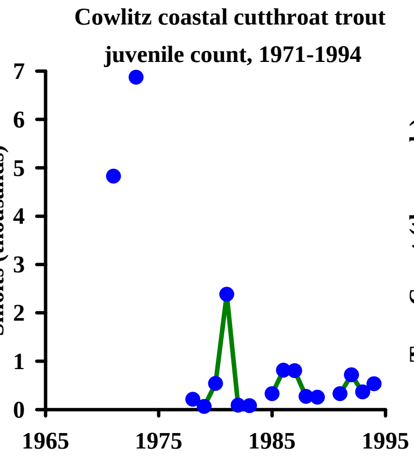
Distribution

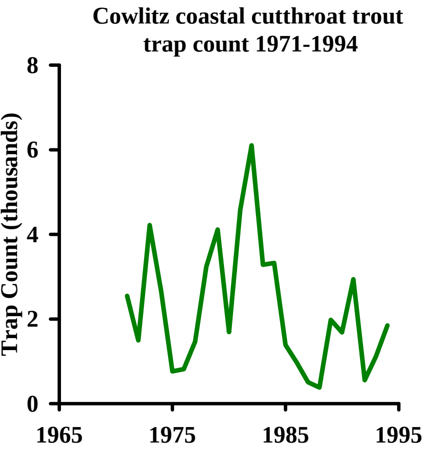
- Anadromous forms were historically present throughout the watershed, but are now limited to the area downstream of Mayfield Dam, which block passage
- Adfluvial forms are present in Mayfield, Riffe, and Scanewa Reservoirs
- Resident forms are documented throughout the system and are the only form present upstream of Mayfield Dam

Life History

- Anadromous, adfluvial, fluvial and resident forms are present
- Anadromous river entry is from July through October, with peak entry in August and September
- Anadromous spawning occurs from January through mid-April
- Fluvial and resident spawn timing is not documented but is believed to be similar to anadromous timing
- Spawn timing at higher elevations is likely later, and may occur as late as June
- Hatchery cutthroat spawn from November to February, due to artificial selection for early spawn timing
- Smolt migration occurs in the spring after juveniles have spend 2 to 3 years in fresh water







Diversity

- Distinct stock based on geographic distribution of spawning areas
- Genetic sampling of ten groups within the Cowlitz system showed little difference among the groups
- Cowlitz collections were significantly different from other lower Columbia samples, except for Elochoman/Skamakowa Creek.

Abundance

- Anadromous counts at Mayfield Dam from 1962 to 1996 ranged from 5458 to 12,324 fish, and averaged 8698
- Outmigrant trapping at Mayfield migrant trap shows a long term declining trend
- Recent years' counts average about 10% of outmigrant counts when sampling began in the early 60s
- Smolt counts have been under 1000 every year since 1978, with the exception of 1982
- No population size data for resident forms

Hatchery

- Cowlitz Trout Hatchery began producing anadromous cutthroat in 1968
- The goal is 115,000 smolts larger than 210 mm to produce a return to the hatchery of 5000 adults

Harvest

- Not harvested in ocean commercial or recreational fisheries
- Angler harvest for adipose fin clipped hatchery fish occurs in mainstem Columbia River summer fisheries downstream of the Cowlitz River
- Cowlitz River sport harvest for hatchery cutthroat can be significant in year of large adult returns.
- Wild cutthroat (unmarked fish) must be released

3.2.6 *Other Species*

Pacific lamprey – Information on lamprey abundance is limited and does not exist for the lower Cowlitz population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have also declined in the lower Cowlitz basin. The adult lamprey return from the ocean to spawn in the spring and summer. Spawning likely occurs in the small to mid-size streams of the basins. Juveniles rear in freshwater up to 6 years before migrating to the ocean.

3.3 Subbasin Habitat Conditions

This section describes the current condition of aquatic and terrestrial habitats within the subbasin. Descriptions are included for habitat features of particular significance to focal salmonid species including watershed hydrology, passage obstructions, water quality, key habitat availability, substrate and sediment, woody debris, channel stability, riparian function, and floodplain function. These descriptions will form the basis for subsequent assessments of the effects of habitat conditions on focal salmonids and opportunities for improvement.

3.3.1 *Watershed Hydrology*

Runoff is predominantly generated by rainfall, with a portion of spring flows coming from snowmelt in the upper elevations and occasional winter peaks from rain-on-snow events. Flow in the mainstem is regulated in large part by the hydropower system. Mayfield Dam (RM 52) is operated by Tacoma Power and has a relatively small (133,764 acre-foot) capacity. Behind Mayfield Dam, Mayfield Lake provides little flood storage capacity and flows from Mayfield Dam are largely in response to the regulation of flows through Mossyrock Dam upstream.

Flood flows in the lower mainstem have been substantially reduced due to flow regulation at the dams. Low summer flows have increased due to flow releases designed to protect the fishery resource in the lower river. In general, average summer, fall, and winter flows have increased and average spring flows have decreased since Mayfield Dam came online in 1956 (Figure 1). This altered streamflow regime is believed to have improved conditions for some anadromous fish that spawn in the lower river but it is also believed to improve conditions for the intermediate host of the salmonid parasite, Ceratomyxa Shasta (Mobrand Biometrics 1999).

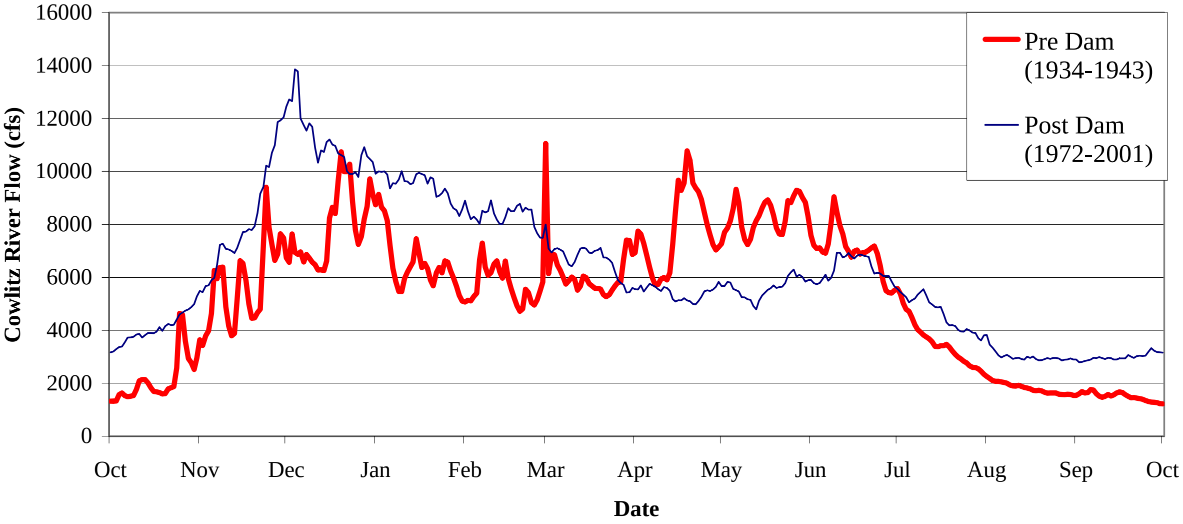


Figure 4. Lower Cowlitz River flow pre and post Mayfield Dam (1956). Values are average daily flows. Hydropower operations have altered the annual streamflow regime. Data are from USGS Stream Gage #14238000; Cowlitz River Below Mayfield Dam, Wash.

The Integrated Watershed Assessment (IWA), which is presented in greater detail later in this chapter, indicates that runoff conditions are 'impaired' throughout the basin, with only a couple of exceptions where conditions are 'moderatly impaired'. These ratings are consistent with a peak flow assessment conducted by Lewis County GIS (2000) that identified the entire lower Cowlitz basin as 'impaired' with regards to an elevated risk of peak flow volumes. Hydrologic impairment is related to a number of factors. Much of the developed land in the lower basin has high watershed imperviousness, which contributes to degraded runoff conditions. Other areas have immature forest stands and high forest road densities, which creates a risk of increased peak flow volumes.

Analysis of low flows in Ostrander Creek and several other smaller tributaries to the Cowlitz using the Toe-Width method indicated that flows were below optimal levels in the fall for spawning and rearing (Caldwell et al. 1999). It is believed that low flows are responsible for low production in these streams (Wade 2000).

Based on the population projections and the estimated total groundwater use in the subbasin, the current and future projected groundwater withdrawal appears to be much less than the groundwater available in the basin; however, local groundwater withdrawals in lower Cowlitz tributaries may have significant impacts on streamflows (LCFRB 2001).

3.3.2 *Passage Obstructions*

The hydropower system blocks upstream passage and has flooded many miles of stream habitat. Now, 100 percent of fall Chinook and 60 percent of steelhead spawning in the Cowlitz River mainstem occurs in the lower basin (Mobrand Biometrics 1999). The Cowlitz River Barrier Dam (RM 49.5) blocks most anadromous fish and the Mayfield Dam presents a complete barrier. Some stocks are collected at the Barrier Dam and passed into upper basin streams. A notable passage barrier is a hydroelectric dam on Mill Creek (confluence near the Barrier Dam) that blocks approximately 5.2 miles of anadromous habitat. Culverts, floodgates, inadequate fish ladders, and dams present passage barriers to anadromous fish in many of the smaller tributaries to the lower mainstem Cowlitz. A full description can be found in the limiting factors analysis (Wade 2000).

3.3.3 *Water Quality*

The lower Cowlitz (RM 4.9) was placed on Washington State's 303(d) list for impaired water bodies in 1996 for exceedances of pH, water temperature, and fecal coliform standards. The 1998 list only included this reach as having an exceedance of arsenic levels (WDOE 1998). Elevated dissolved gas levels in the mainstem below the dams have been measured during high flow events (Harza 1999a as cited in Wade 2000). The lead standard was exceeded in one sample collected at Cowlitz River at Toledo (USEPA, STORET database). Several exceedances of temperature and fecal coliform have occurred on Cowlitz tributaries. Pesticide and herbicide chemicals have been detected on Olequa Creek (Wade 2000). A TMDL study was initiated on Salmon Creek in 1999 for fecal coliform, temperature, and turbitity.

3.3.4 *Key Habitat Availability*

Most of the lower mainstem Cowlitz (up to RM 17) and the lower 4 miles of the Coweeman are tidally influenced and contain pool habitat of low quality due to channelization. Diking, placement of dredge spoils, and transportation corridors have eliminated the bulk of the side-channel habitat on the lower Cowlitz and the lower reaches of tributaries (Wade 2000). Gravel mining has eliminated historical side channel habitat at various sites along the mainstem from RM 20 – 50. Exposed gravel bars along the channel have decreased since 1939. Measures of pool habitat in the mainstem below the Barrier Dam ranged from 3% (10,000 cfs) to 17% (2,140 cfs) (Harza 2000). Stream surveys conducted by the Cowlitz Conservation District in the 1990s identified low pool frequencies in 7 tributaries between RM 20 and 50 (Wade 2000).

3.3.5 *Substrate & Sediment*

The eruption of Mount St. Helens added an enormous amount of fine sediments to the lower mainstem Cowlitz channel and floodplain. Spawning size gravel is limited in the mainstem from Mayfield Dam to the Cowlitz Trout Hatchery due to transport capacity exceeding input. The opposite occurs between the I-5 Bridge and the Trout Hatchery, resulting in large accumulations of gravels and transport to downstream reaches (Harza 1999). There are excessive quantities of substrate fines below the Barrier Dam due to land-use activities in the lower basin (Mobrand Biometrics 1999). The limiting factors TAG identified numerous problems with substrate fines in tributary streams. A detailed description can be found in the WRIA 26 Limiting Factors Analysis (Wade 2000).

Sediment supply conditions were evaluated as part of the IWA watershed process modeling, which is presented in greater detail later in this chapter. IWA model results estimate 'moderately impaired' sediment supply conditions throughout the basin. Exceptions include the lowermost subwatersheds, which are 'impaired', and the Little Salmon Creek, Skook Creek, and portions of the upper Lacamas Creek drainage, which rate as 'functional'. Sediment supply impairments are related to road and vegetative cover conditions. Road densities in the lower Cowlitz basin are consistently greater than 4 mi/mi^2 and are greater than 7 mi/mi^2 in some areas. Approximately 31% of anadromous stream channels have stream-adjacent roads (Lewis County GIS 2000).

Sediment production from private forest roads is expected to decline over the next 15 years as roads are updated to meet the new forest practices standards, which include ditchline disconnect from streams and culvert upgrades. The frequency of mass wasting events should also decline due to the new regulations, which require geotechnical review and mitigation measures to minimize the impact of forest practices activities on unstable slopes.

3.3.6 *Woody Debris*

The lower 20 miles of the Cowlitz mainstem and most of the smaller tributaries have low quantities of stable LWD due to scour from past splash damming and/or active removal. Given its large size, this reach may never have been able to retain LWD (Wade 2000). However, the lower mainstem above the Toutle and Coweeman Rivers historically contained large log jams (Mobrand Biometrics 1999). An analysis of historical aerial photographs revealed many accumulations of logs along channel margins in 1939, attributed to upstream harvest practices and subsequent flood deposition. A lack of wood observed in 1960s photos was attributed to removal for fish habitat improvement and a lack of recruitment potential due to harvest. A slight increase in in-stream wood observed on 1996 photos is assumed to be the result of discontinued stream cleaning practices and increased recruitment due to the re-growth of riparian forests (Harza 2000). Stream surveys and observations in the Cowlitz tributaries between RM 20 and 52 have identified a general lack of in-stream LWD

3.3.7 *Channel Stability*

Bank stability is generally good along the lower Cowlitz mainstem though erosion of dredge spoils may be a concern in some areas. Bank stability problems have been observed from RM 20 – 25, however, overall stability may have been enhanced along the lower mainstem due to hydropower regulation (Mobrand Biometrics 1999). Bank stability problems in the small lower Cowlitz tributaries are identified in the limiting factors analysis. Many of these are related to cattle impacts (Wade 2000).

3.3.8 *Riparian Function*

Riparian forests along the lower 20 miles of the Cowlitz River and within the lower reaches of the smaller tributaries have been severely degraded through industrial and commercial development. Agriculture and forestry activities have also impacted riparian areas. Riparian forests on the Cowlitz River from RM 20 – 52 lack mature forests and adequate buffer widths (Wade 2000). An aerial photo analysis on this reach revealed that coniferous cover types currently make up less of the riparian forest than they did historically. Gravel bars currently have more vegetative cover compared to conditions in 1939, possibly due to reduction of flood flows by upstream dams. Another change since 1939 is a decrease in the meadow/grasslands cover type, likely related to current agriculture, shrub encroachment, and residential uses (Harza 2000).

According to IWA watershed process modeling, which is presented in greater detail later in this chapter, about half of the subwatersheds in the lower Cowlitz basin are ‘impaired’ and half are ‘moderately impaired’. One subwatershed, located in the headwaters of Cedar Creek (Salmon Creek tributary), was rated as ‘functional’. The greatest impairment occurs in the lower basin that has experienced widespread development. Impaired areas are also located along Olequa and Lacamas Creeks, which have received impacts related to agriculture, grazing, residential development, and forestry activities.

Riparian function is expected to improve over time on private forestlands. This is due to the requirements under the Washington State Forest Practices Rules (Washington Administrative Code Chapter 222). Riparian protection has increased dramatically today compared to past regulations and practices.

3.3.9 *Floodplain Function*

The lower 20 miles of the Cowlitz has experienced severe loss of floodplain connectivity due to dikes, riprap, and/or deposited dredge spoils originating from the Mount St. Helens eruption. Only the Sandy River Bend area near Castle Rock retains connected floodplain habitat. Floodplain loss in the lower reaches of many of the smaller tributaries is a result of I-5, the railroad corridor, and the placement of dredge spoils (Wade 2000).

The mainstem Cowlitz between RM 20 and RM 52 (Mayfield Dam) has scattered areas with bank revetments, though floodplain connection is generally in good shape. However, there has been a decrease in total square feet of habitat per mile from 1936 to 1996 (Mobrand Biometrics 1999). Channel incision, diking, dredging, bank hardening, and various types of development have disconnected floodplains from channels in several tributaries to this reach. A detailed description is given in the limiting factors analysis (Wade 2000).

3.4 Stream Habitat Limitations

A systematic link between habitat conditions and salmonid population performance is needed to identify the net effect of habitat changes, specific stream sections where problems occur, and specific habitat conditions that account for the problems in each stream reach. In order to help identify the links between fish and habitat conditions, the Ecosystem Diagnosis and Treatment (EDT) model was applied to lower Cowlitz River fall Chinook, chum, coho, and winter steelhead. A thorough description of the EDT model, and its application to lower Columbia salmonid populations, can be found in Appendix E.

Three general categories of EDT output are discussed in this section: population analysis, reach analysis, and habitat factor analysis. Population analysis has the broadest scope of all model outputs. It is useful for evaluating the reasonableness of results, assessing broad trends in population performance, comparing among populations, and for comparing past, present, and desired conditions against recovery planning objectives. Reach analysis provides a greater level of detail. Reach analysis rates specific reaches according to how degradation or restoration within the reach affects overall population performance. This level of output is useful for identifying general categories of management (i.e. preservation and/or restoration), and for focusing recovery strategies in appropriate portions of a subbasin. The habitat factor analysis section provides the greatest level of detail. Reach specific habitat attributes are rated according to their relative degree of impact on population performance. This level of output is most useful for practitioners who will be developing and implementing specific recovery actions.

3.4.1 *Population Analysis*

Population assessments under different habitat conditions are useful for comparing fish trends and establishing recovery goals. Fish population levels under current and potential habitat conditions were inferred using the EDT model based on habitat characteristics of each stream reach and a synthesis of habitat effects on fish life cycle processes.

Habitat-based assessments were completed in the Lower Cowlitz Basin for fall Chinook, chum, coho and winter steelhead. Model results indicate the largest proportional decrease in adult productivity has occurred with winter steelhead, though results are similar for both chum and coho (Table 2). The estimated proportional changes in adult abundance vary depending on the species, with chum experiencing a dramatic 96% decline from historical numbers (Figure 5). This can be attributed to severe degradation of the historically available chum habitat in the lower river. Winter steelhead, coho, and fall Chinook declines have also been severe, with respective declines in abundance of 89%, 76%, and 64% (Figure 5). Diversity (as measured by the diversity index) has declined for all species (Table 2), with winter steelhead and chum diversity declining by 77% and 56%, respectively.

Smolt productivity has also declined from historical levels for each species in the lower Cowlitz basin (Table 2). For fall Chinook and chum, smolt productivity has decreased by 57% and 44% respectively. For both coho and winter steelhead the decrease was estimated as approximately 75% and 83%, respectively. Smolt abundance in the lower Cowlitz has declined most dramatically for chum, with an estimated 94% decrease from historical levels (Table 2). Current fall Chinook, coho, and winter steelhead smolt abundance levels are modeled at approximately 20-40 % of historical numbers (Table 2).

In all cases, model results indicate that restoration of PFC conditions would produce substantial benefits. Chum and winter steelhead would see the greatest proportional benefit in adult returns. Current winter steelhead returns would increase by an estimated 582%, and current chum return would increase by an estimated 639% (Table 2). Changes in smolt abundance due to restoration of PFC are similar to the adult trends, with all species greatly benefiting from the restoration (Table 2).

Table 2. Population productivity, abundance, and diversity (of both smolts and adults) based on EDT analysis of current (P or patient), historical (T or template)[1], and properly functioning (PFC) habitat conditions.

Species	Adult Abundance			Adult Productivity			Diversity Index			Smolt Abundance			Smolt Productivity		
	P	PFC	T[1]	P	PFC	T[1]	P	PFC	T[1]	P	PFC	T[1]	P	PFC	T[1]
Fall Chinook	8,873	20,865	24,356	5.9	11.0	14.5	0.65	1.00	1.00	1,484,327	3,049,618	3,809,863	551	998	1,295
Chum	6,239	46,130	166,140	1.9	6.7	9.8	0.44	1.00	1.00	3,080,762	21,871,960	48,310,830	582	883	1,042
Coho	4,144	15,655	17,626	4.2	12.4	17.1	0.81	0.96	1.00	83,989	338,523	381,605	91	264	359
Winter Steelhead	198	1,352	1,727	2.3	10.0	26.1	0.23	0.39	1.00	3,913	25,618	17,101	45	193	271

[1] Estimate represents historical conditions in the subbasin and current conditions in the mainstem and estuary.

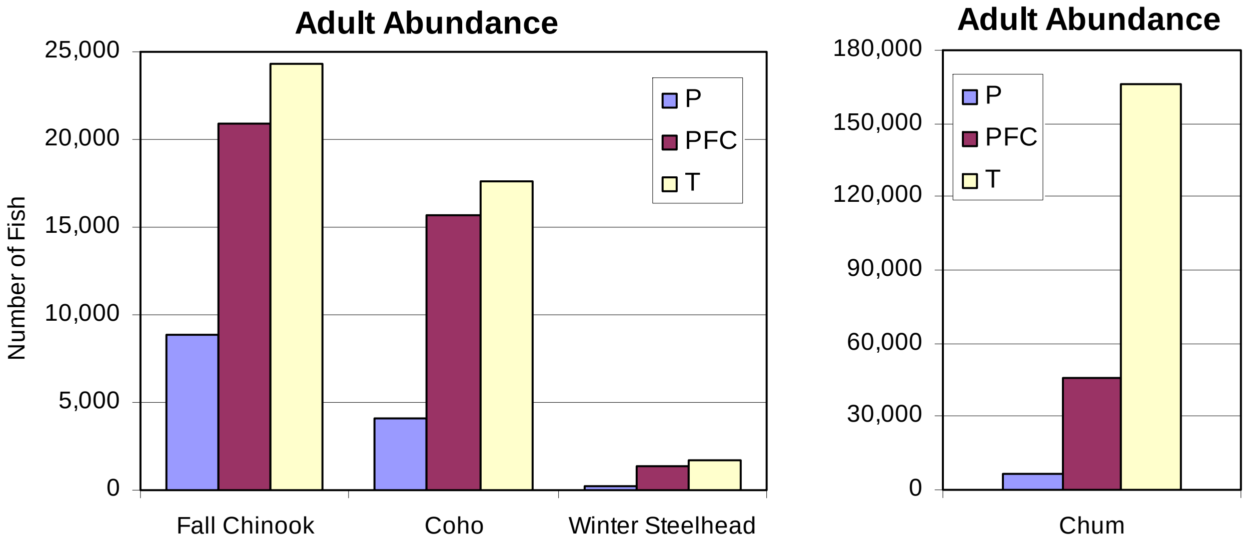


Figure 5. Adult abundance of Lower Cowlitz River fall chinook, coho, winter steelhead and chum based on EDT analysis of current (P or patient), historical (T or template), and properly functioning (PFC) habitat conditions.

3.4.2 *Stream Reach Analysis*

Habitat conditions and suitability for fish are better in some portions of a subbasin than in others. The reach analysis of the EDT model uses estimates of the difference in projected population performance between current/patient and historical/template habitat conditions to identify core and degraded fish production areas. Core production areas, where habitat degradation would have a large negative impact on the population, are assigned a high value for preservation. Likewise, currently degraded areas that provide significant potential for restoration are assigned a high value for restoration. Collectively, these values are used to prioritize the reaches within a given subbasin. Reach locations are displayed in Figure 6.

High priority reaches for fall Chinook include the two middle Cowlitz reaches, Mid Cowlitz 3 and Mid Cowlitz 4 (Figure 7). These reaches, along with most other important fall Chinook reaches, show a strong preservation emphasis. Important reaches for chum include mainstem reaches (Lower Cowlitz 1, and Mid Cowlitz 6 and 7), as well as tributary reaches (Lacamas Cr 1, Olequa Cr 1, and Salmon Cr 1 and 2) (Figure 8). These high priority reaches show mixed recovery emphases, with reach Lower Cowlitz 1 having the largest restoration potential of any reach modeled for chum.

For coho, high priority reaches are spread throughout the basin (Figure 9). The majority of these important reaches are located in tributaries, such as Olequa Creek, Lacamas Creek, Salmon Creek, and Stillwater Creek. The vast majority of reaches modeled for coho show a restoration recovery emphasis, with reaches Olequa Cr 7 and Arkansas Cr 1 having the largest restoration potential of any reach modeled for coho.

Winter steelhead make extensive use of the available lower Cowlitz habitats, reaching well into Olequa, Lacamas, Salmon, Arkansas, Delameter, and Monahan Creeks. In contrast, fall Chinook use primarily only mainstem habitats from the mouth to the barrier dam. Chum and coho also use mostly mainstem habitats but will make some use of the lower reaches of tributary habitats.

High priority reaches for winter steelhead are located in mainstem areas (Mid Cowlitz 6 and 7) and tributaries (Olequa Cr 2-4, Stillwater Cr 5 and Salmon Cr 2) (Figure 10). The importance of these reaches is primarily for juvenile rearing though some limited spawning occurs here. As with coho, the vast majority of reaches modeled for winter steelhead show a restoration recovery emphasis, with Olequa Cr 2 and 3 having the largest restoration potential of any reach modeled for steelhead.

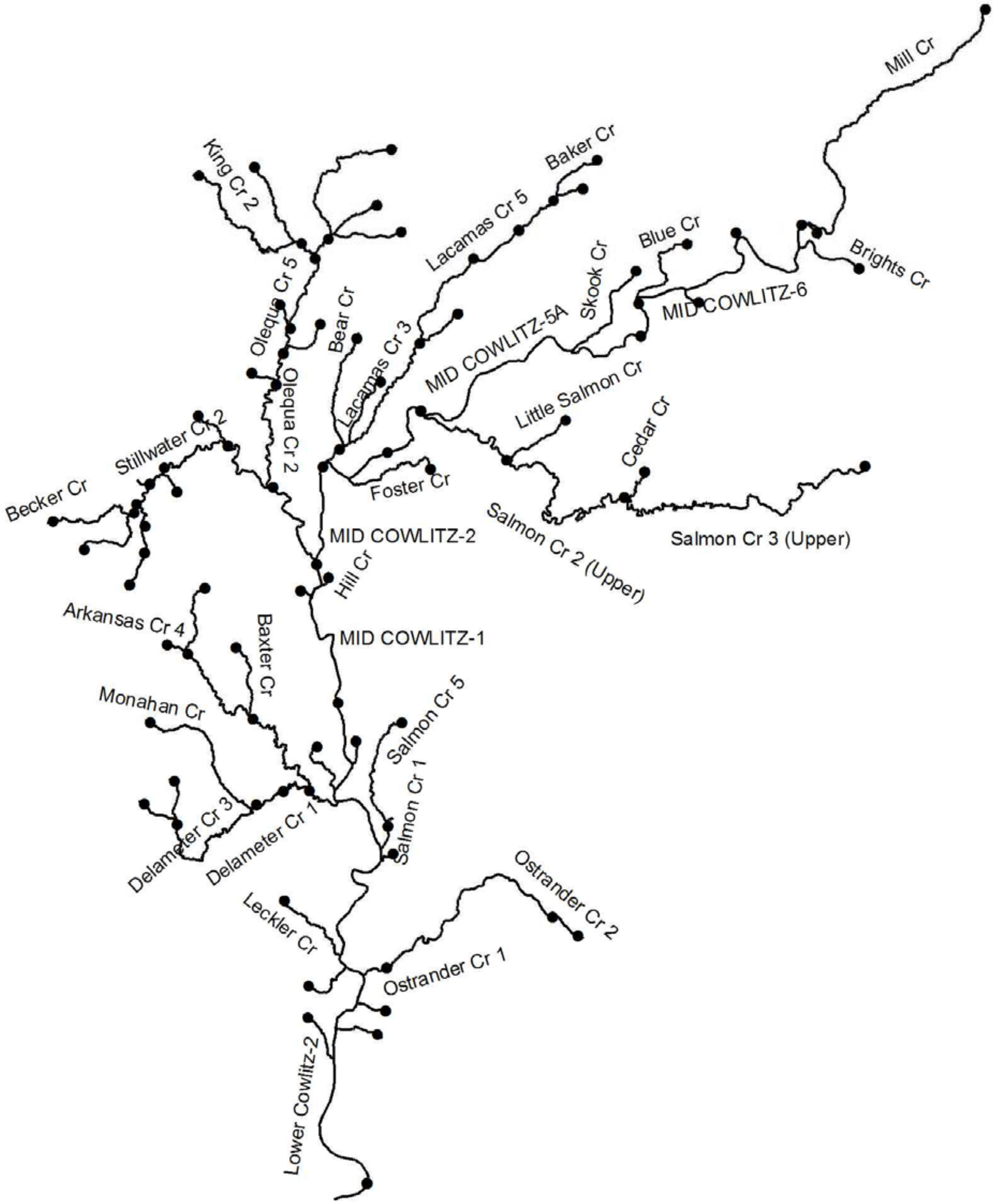


Figure 6. Lower Cowlitz subbasin with EDT reaches identified. For readability, not all reaches are labeled.

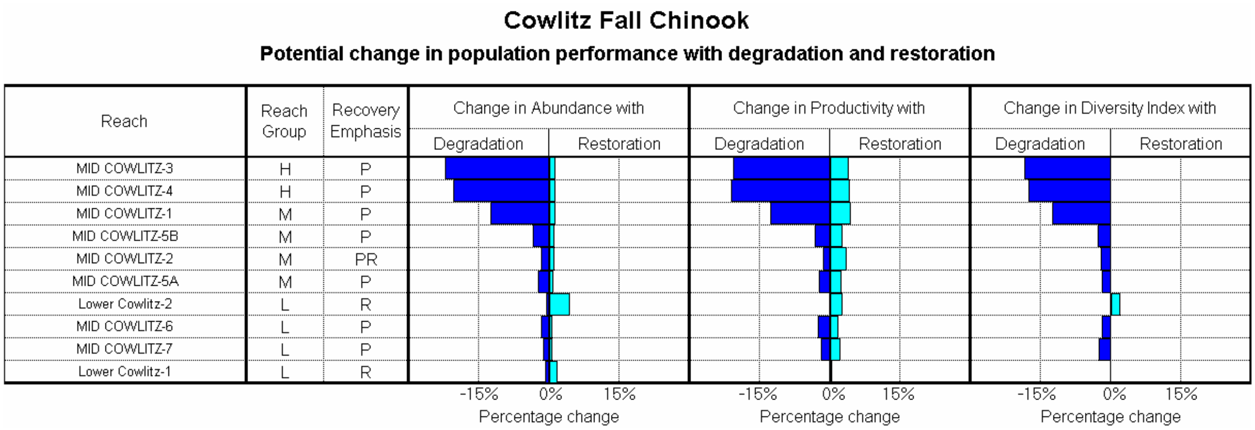


Figure 7. Lower Cowlitz River subbasin fall Chinook ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphasis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams. Some low priority reaches are not included for display purposes.

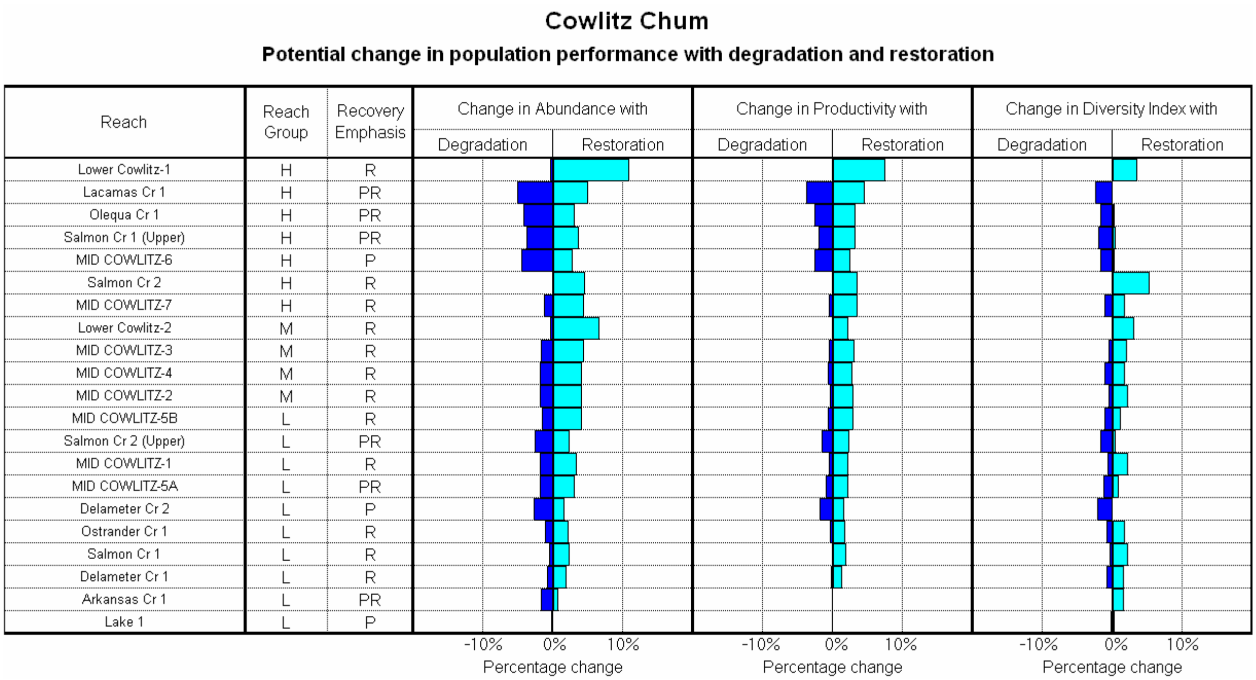
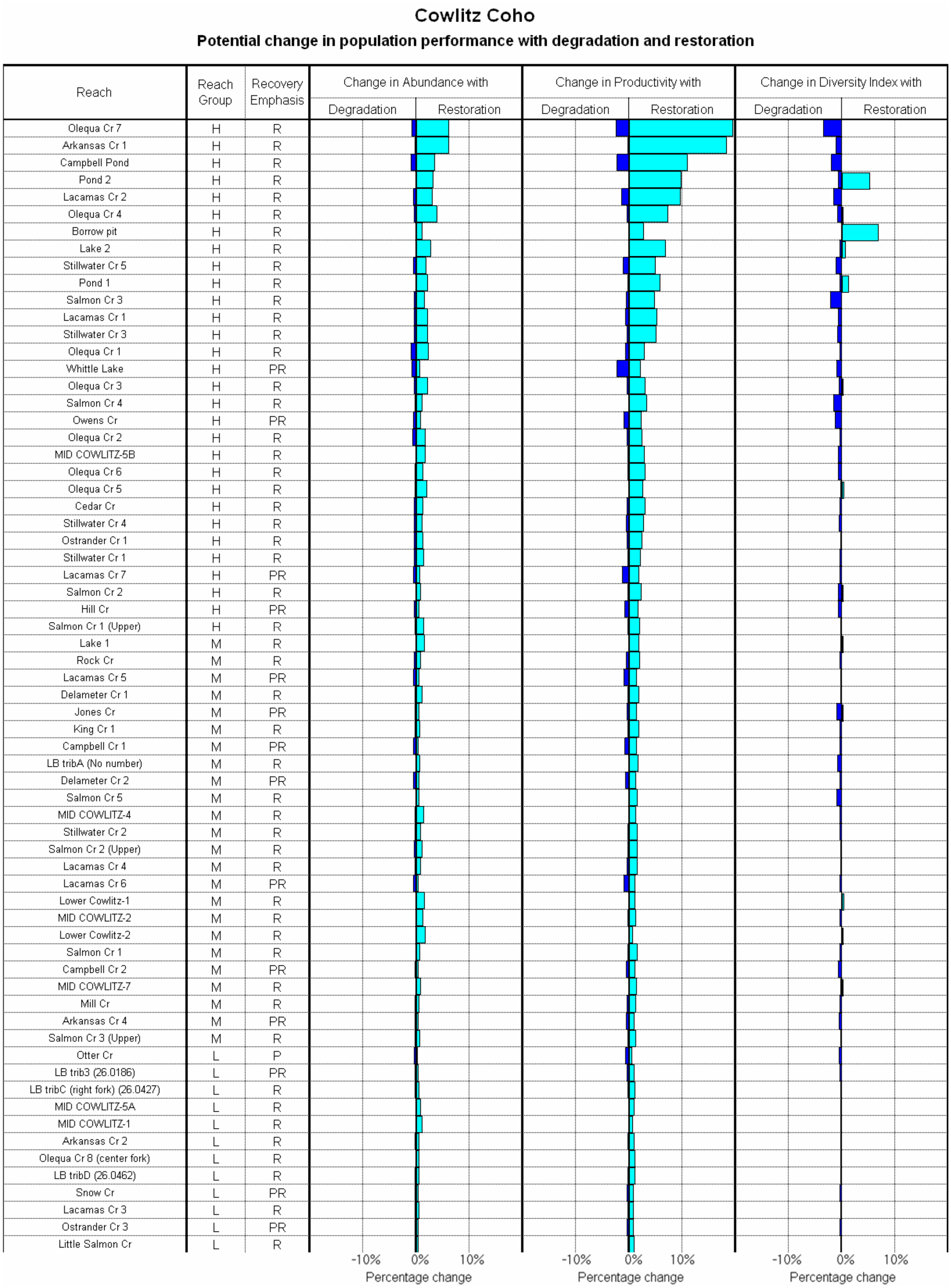
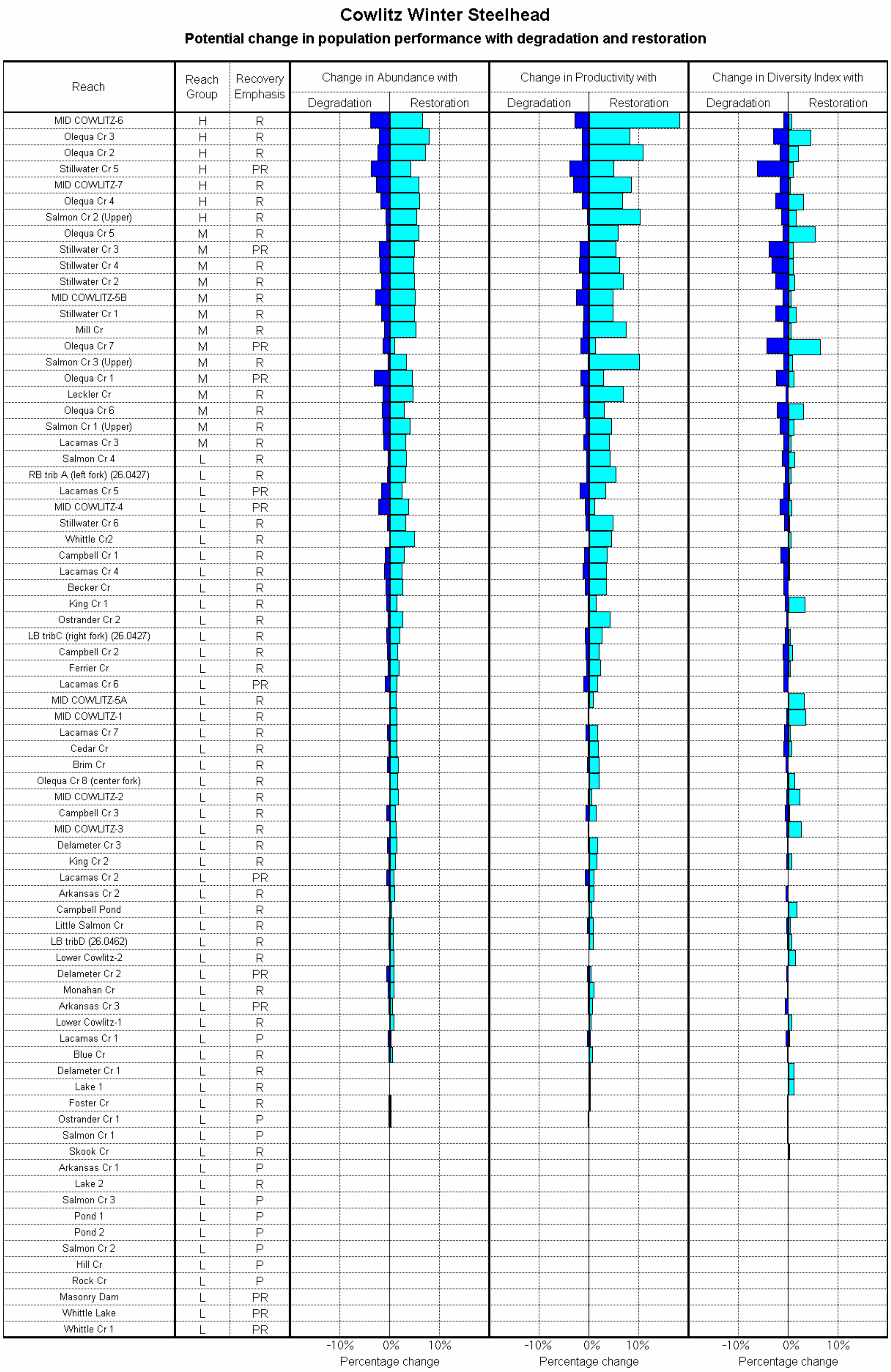


Figure 8. Lower Cowlitz subbasin chum ladder diagram.



Reach	Reach Group	Recovery Emphasis
Olequa Cr 7	H	R
Arkansas Cr 1	H	R
Campbell Pond	H	R
Pond 2	H	R
Lacamas Cr 2	H	R
Olequa Cr 4	H	R
Borrow pit	H	R
Lake 2	H	R
Stillwater Cr 5	H	R
Pond 1	H	R
Salmon Cr 3	H	R
Lacamas Cr 1	H	R
Stillwater Cr 3	H	R
Olequa Cr 1	H	R
Whittle Lake	H	PR
Olequa Cr 3	H	R
Salmon Cr 4	H	R
Owens Cr	H	PR
Olequa Cr 2	H	R
MID COWLITZ-5B	H	R
Olequa Cr 6	H	R
Olequa Cr 5	H	R
Cedar Cr	H	R
Stillwater Cr 4	H	R
Ostrander Cr 1	H	R
Stillwater Cr 1	H	R
Lacamas Cr 7	H	PR
Salmon Cr 2	H	R
Hill Cr	H	PR
Salmon Cr 1 (Upper)	H	R
Lake 1	M	R
Rock Cr	M	R
Lacamas Cr 5	M	PR
Delameter Cr 1	M	R
Jones Cr	M	PR
King Cr 1	M	R
Campbell Cr 1	M	PR
LB tribA (No number)	M	R
Delameter Cr 2	M	PR
Salmon Cr 5	M	R
MID COWLITZ-4	M	R
Stillwater Cr 2	M	R
Salmon Cr 2 (Upper)	M	R
Lacamas Cr 4	M	R
Lacamas Cr 6	M	PR
Lower Cowlitz-1	M	R
MID COWLITZ-2	M	R
Lower Cowlitz-2	M	R
Salmon Cr 1	M	R
Campbell Cr 2	M	PR
MID COWLITZ-7	M	R
Mill Cr	M	R
Arkansas Cr 4	M	PR
Salmon Cr 3 (Upper)	M	R
Otter Cr	L	P
LB trib3 (26.0186)	L	PR
LB tribC (right fork) (26.0427)	L	R
MID COWLITZ-5A	L	R
MID COWLITZ-1	L	R
Arkansas Cr 2	L	R
Olequa Cr 8 (center fork)	L	R
LB tribD (26.0462)	L	R
Snow Cr	L	PR
Lacamas Cr 3	L	R
Ostrander Cr 3	L	PR
Little Salmon Cr	L	R

Figure 9. Cowlitz River subbasin coho ladder diagram. Some low priority reaches are not included for display purposes.



Reach	Reach Group	Recovery Emphasis
MID COWLITZ-6	H	R
Olequa Cr 3	H	R
Olequa Cr 2	H	R
Stillwater Cr 5	H	PR
MID COWLITZ-7	H	R
Olequa Cr 4	H	R
Salmon Cr 2 (Upper)	H	R
Olequa Cr 5	M	R
Stillwater Cr 3	M	PR
Stillwater Cr 4	M	R
Stillwater Cr 2	M	R
MID COWLITZ-5B	M	R
Stillwater Cr 1	M	R
Mill Cr	M	R
Olequa Cr 7	M	PR
Salmon Cr 3 (Upper)	M	R
Olequa Cr 1	M	PR
Leckler Cr	M	R
Olequa Cr 6	M	R
Salmon Cr 1 (Upper)	M	R
Lacamas Cr 3	M	R
Salmon Cr 4	L	R
RB trib A (left fork) (26.0427)	L	R
Lacamas Cr 5	L	PR
MID COWLITZ-4	L	PR
Stillwater Cr 6	L	R
Whittle Cr2	L	R
Campbell Cr 1	L	R
Lacamas Cr 4	L	R
Becker Cr	L	R
King Cr 1	L	R
Ostrander Cr 2	L	R
LB tribC (right fork) (26.0427)	L	R
Campbell Cr 2	L	R
Ferrier Cr	L	R
Lacamas Cr 6	L	PR
MID COWLITZ-5A	L	R
MID COWLITZ-1	L	R
Lacamas Cr 7	L	R
Cedar Cr	L	R
Brim Cr	L	R
Olequa Cr 8 (center fork)	L	R
MID COWLITZ-2	L	R
Campbell Cr 3	L	R
MID COWLITZ-3	L	R
Delameter Cr 3	L	R
King Cr 2	L	R
Lacamas Cr 2	L	PR
Arkansas Cr 2	L	R
Campbell Pond	L	R
Little Salmon Cr	L	R
LB tribD (26.0462)	L	R
Lower Cowlitz-2	L	R
Delameter Cr 2	L	PR
Monahan Cr	L	R
Arkansas Cr 3	L	PR
Lower Cowlitz-1	L	R
Lacamas Cr 1	L	P
Blue Cr	L	R
Delameter Cr 1	L	R
Lake 1	L	R
Foster Cr	L	R
Ostrander Cr 1	L	P
Salmon Cr 1	L	P
Skook Cr	L	R
Arkansas Cr 1	L	P
Lake 2	L	R
Salmon Cr 3	L	P
Pond 1	L	P
Pond 2	L	P
Salmon Cr 2	L	P
Hill Cr	L	P
Rock Cr	L	P
Masonry Dam	L	PR
Whittle Lake	L	PR
Whittle Cr 1	L	PR

Figure 10. Cowlitz River subbasin winter steelhead ladder diagram.

3.4.3 *Habitat Factor Analysis*

The Habitat Factor Analysis of EDT identifies the most important habitat factors affecting fish in each reach. Whereas the EDT reach analysis identifies reaches where changes are likely to significantly affect the fish, the Habitat Factor Analysis identifies specific stream reach conditions that may be modified to produce an effect. Like all EDT analyses, the habitat factor analysis compares current/patient and historical/template habitat conditions. For each reach, EDT generates what is referred to as a “consumer reports diagram”, which identifies the degree to which individual habitat factors are acting to suppress population performance. The effect of each habitat factor is identified for each life stage that occurs in the reach and the relative importance of each life stage is indicated. For additional information and examples of this analysis, see Appendix E. Inclusion of the consumer report diagram for each reach is beyond the scope of this document. A summary of the most critical life stages and the habitat factors affecting them are displayed for each species in Table 3.

Table 3. Summary of the primary limiting factors affecting life stages of focal salmonid species. Results are summarized from EDT Analysis.

Species and Lifestage		***Primary factors***	***Secondary factors***	***Tertiary factors***
Lower Cowlitz Fall Chinook				
most critical	Egg incubation	channel stability, sediment	pathogens	
second	Fry colonization	channel stability, flow, food, habitat diversity, pathogens, predation		
third	Prespawning holding	habitat diversity		
Lower Cowlitz Chum				
most critical	Egg incubation	channel stability, sediment	key habitat	flow, pathogens
second	Prespawning holding	habitat diversity	harassment, pathogens	key habitat, flow
third	Spawning	habitat diversity	flow, pathogens, harassment	key habitat
Lower Cowlitz Coho				
most critical	Egg incubation	channel stability, sediment	key habitat	
second	0-age summer rearing	habitat diversity, temperature	flow, food	channel stability, competition (hatchery), predation, key habitat,
third	0-age winter rearing	habitat diversity	flow	food, channel stability
Lower Cowlitz Winter Steelhead				
most critical	0-age summer rearing	habitat diversity	competition (hatchery), food, pathogens, predation	channel stability
second	Egg incubation	sediment, temperature	channel stability	
third	1-age summer rearing	habitat diversity	competition (hatchery), food, pathogens, predation	channel stability

The consumer reports diagrams have also been summarized to show the relative importance of habitat factors by reach. The summary figures are referred to as habitat factor analysis diagrams and are displayed for each species below. The reaches are ordered according to their combined restoration and preservation rank. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to historical conditions.

For the fall Chinook population, primary habitat impacts are due to sediment, channel stability, and habitat diversity (Figure 11). The channel is severely channelized by dikes, which have served to simplify and limit available habitat. Riparian areas are in poor condition and LWD levels are low. Historically, large log jams may have been present in the lower mainstem. Stream cleanouts in the 1960s, reduced recruitment due to riparian harvest, and intercepted transport from upstream due to the dams has significantly reduced LWD levels.

High priority reaches for chum have also been negatively impacted by habitat degradation. In these reaches, habitat diversity, key habitat and sediment have had the greatest impact (Figure 12). Loss of habitat diversity is related to increased bed scour as a result of confinement, degraded riparian areas, and a lack of LWD. Key habitat has been reduced due to the dramatic reduction in historically available side-channels. Sediment input is a major factor and primarily stems from sediments originating from the 1980 Mount St. Helens eruption that are delivered via the Toutle River. These same conditions also serve to increase the risk of elevated peak flows. Furthermore, silvaculture, agriculture, and residential development have impacted riparian zones and LWD recruitment rates.

Coho habitat in the lower Cowlitz subbasin has been affected by a variety of factors. These impacts include loss of habitat diversity, increased sediment, loss of key habitat, reduced channel stability and an altered temperature regime (Figure 13). The causes of these impacts are the same as those mentioned above.

The habitat factor analysis for winter steelhead identified numerous impacts to current population performance. High impact attributes in steelhead stream reaches include habitat diversity, temperature, sediment, flow, and channel stability (Figure 14). Habitat diversity is low due to degraded riparian areas, low LWD levels, and incised channels. There is a risk of increased peak flow due to upper basin timber harvest, roads, and an increase in impervious surfaces due to residential and agricultural development. Low flows have been identified as a problem for summer rearing (Caldwell et al. 1999). Sediment contributions stem from high road densities and agriculture/grazing practices. Degraded riparian areas affect temperature, food, and channel stability.

Lower Cowlitz Fall Chinook

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
MID COWLITZ-3	●	●		•		•			•	⬤	•			•	•	✛
MID COWLITZ-4	●	●		•		•			•	●	•			•	•	✛
MID COWLITZ-1	●	●		•		•			•	⬤	•			•	•	✚
MID COWLITZ-5B	●	●	+	•					•	•	•			•	•	•
MID COWLITZ-2	●	●		•		•			•	⬤	•			•	•	✛
MID COWLITZ-5A	●	●		•					•	•	•			•	•	✛
Lower Cowlitz-2	⬤	⬤	•	•	•	•			●	⬤	•			•	•	✚
MID COWLITZ-6	●	•		•					•		•			•		✛
MID COWLITZ-7	●	●							•	●	•			•		+
Lower Cowlitz-1	●	●	•	•	•	•			•	•	•			•	•	✛

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

Figure 11. **Lower Cowlitz fall chinook habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to template conditions. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams. Some low priority reaches are not included for display purposes.**

Lower Cowlitz Chum

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Lower Cowlitz-1	●	⬤		•	•				●	●	•			•	●	⬤
Lacamas Cr 1	●	⬤		•	•				●	●	●					●
Olequa Cr 1	•	●		•					•	●	•					●
Salmon Cr 1 (Upper)	•	●			•				•	●	•					●
MID COWLITZ-6	•	●		•					•		•			•	•	
Salmon Cr 2	•	⬤							•	•	•				•	●
MID COWLITZ-7	•	⬤		•					●	•	•			•	•	●
Lower Cowlitz-2	●	⬤		•	•				●	●	•			•	•	⬤
MID COWLITZ-3	•	●		•					•	●	•			•	•	●
MID COWLITZ-4	•	●		•					•	•	•			•	•	●
MID COWLITZ-2	•	⬤		•					•	●	•			•	•	●
MID COWLITZ-5B	•	●		•					•	•	•			•	•	●
Salmon Cr 2 (Upper)	•	●							•	●	•					•
MID COWLITZ-1	•	●		•					•	●	•			•	•	●
MID COWLITZ-5A	•	●		•					•	•	•			•	•	●
Delameter Cr 2	•	●							•	●	•					•
Ostrander Cr 1	•	●							•	●	•					●
Salmon Cr 1	•	●							•	•	•					●
Delameter Cr 1	•	●							•	•	•				•	●
Arkansas Cr 1	•	•							•		•					•
Lake 1																

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

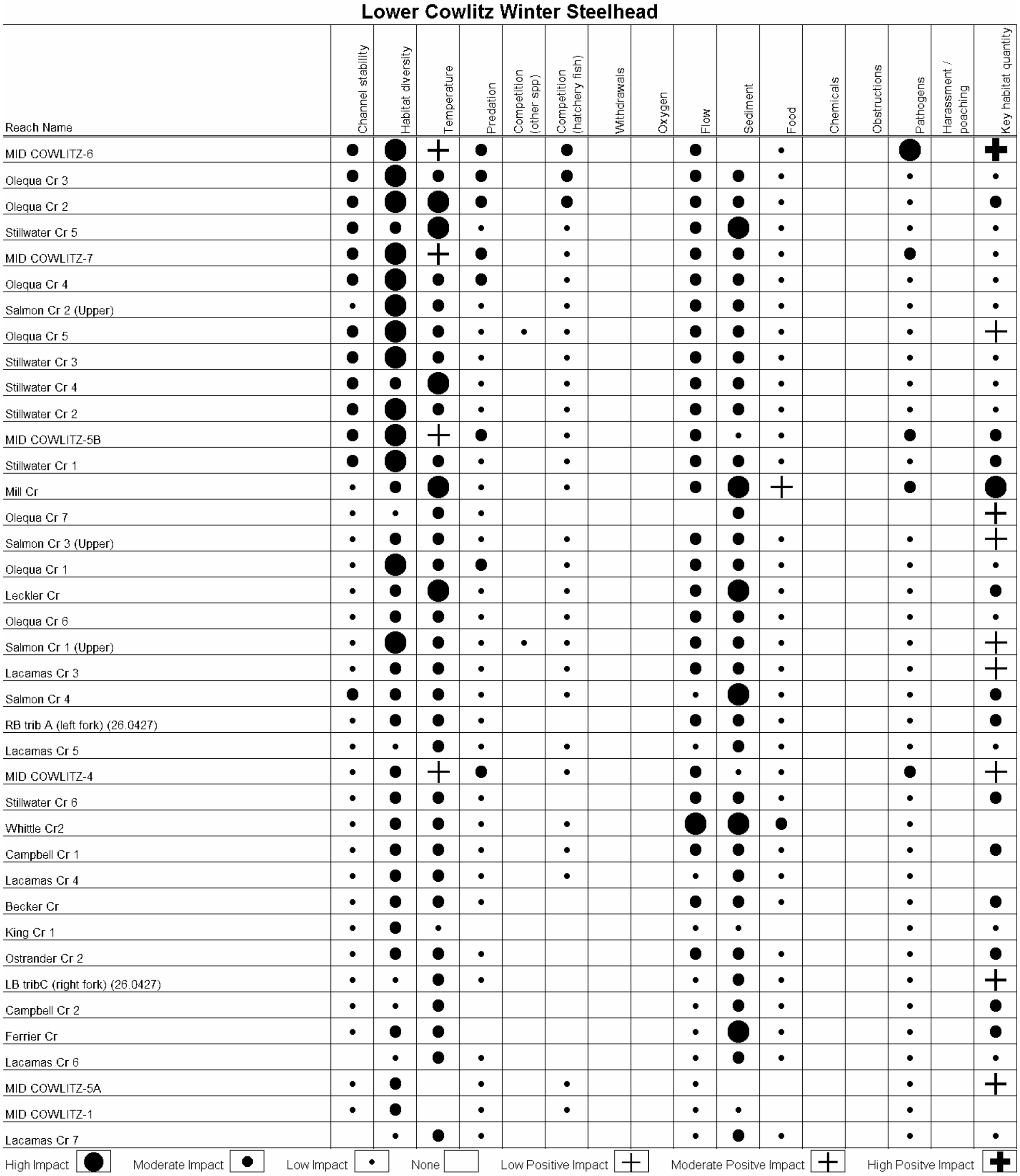
Figure 12. **Lower Cowlitz chum habitat factor analysis diagram.**

Lower Cowlitz Coho

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Olequa Cr 7	⬤	⬤	⬤	●		●			●	⬤	●					⬤
Arkansas Cr 1	⬤	⬤	⬤	•	•	•		•	●	⬤	●					⬤
Campbell Pond	⬤	⬤	⬤	•		•			●	⬤	●					⬤
Pond 2	●	⬤	⬤	•	•	•			●	⬤	●					●
Lacamas Cr 2	⬤	⬤	●	•		●			●	⬤	•			•		●
Olequa Cr 4	●	⬤	●	●		●			●	●	●			•		⬤
Borrow pit	●	●	●			•			●	⬤	•					╋
Lake 2	⬤	⬤	●		•	•			●	●	●					⬤
Stillwater Cr 5	●	●	●			•			●	●	•					●
Pond 1	•	⬤	●		•	•			●	⬤	●					✚
Salmon Cr 3	●	●	●	•		•			●	●	●			•		+
Lacamas Cr 1	●	●	●	•	•	●			●	●	●			•		●
Stillwater Cr 3	●	⬤	●			•			●	●	•					•
Olequa Cr 1	●	⬤	●	●		•			●	●	•			•		•
Whittle Lake		●	•						•	●	•					
Olequa Cr 3	●	⬤	●	•		•			●	●	●			•		●
Salmon Cr 4	●	●	●	•		•			●	●	•					+
Owens Cr	●	●	•						•	⬤	•					●
Olequa Cr 2	●	⬤	●	•		•			●	●	•			•		●
MID COWLITZ-5B	●	⬤	+	•		•			•	•	•			●		⬤
Olequa Cr 6	●	●	●	•		•			•	●	•					●
Olequa Cr 5	●	⬤	●	•	•	•			●	•	•					⬤
Cedar Cr	●	●	●						•	●	•					●
Stillwater Cr 4	●	●	●						•	●	•					•
Ostrander Cr 1	●	●	●			•			●	⬤	●					●
Stillwater Cr 1	●	⬤	●						●	•	•					•
Lacamas Cr 7	●	•	●						•	●	•			•		●
Salmon Cr 2	●	●	•						•	●	•					+
Hill Cr	●	•	•						•	●	•					•
Salmon Cr 1 (Upper)	●	⬤	●		•	•			●	●	●			•		●
Lake 1	●	⬤	●		•	•			●	●	•					●
Rock Cr	●	●	•						•	⬤	•					⬤
Lacamas Cr 5	•	•	●	•		•			•	●	•			•		•
Delameter Cr 1	●	●	●		•	•			•	●	•					•
Jones Cr	●	●	•						•	●	•					●
King Cr 1	●	●	•						•	●	•					●
Campbell Cr 1	•	•	•						•	●	•					✚
LB tribA (No number)	●	●	•						•	●	•					●
Delameter Cr 2	•	•	•						•	●	•					+
Salmon Cr 5	●	●	•			•			•	●	•					╋
MID COWLITZ-4	●	⬤		•		•			•	•	•			●		●
Stillwater Cr 2	•	●	•						•	•	•					•
Salmon Cr 2 (Upper)	●	●	●	•		•			•	●	•					+
Lacamas Cr 4	•	●	•	•		•			•	•	•					●
Lacamas Cr 6	•	•	●						•	●	•					•
Lower Cowlitz-1	•	⬤	•	•		•			•	•	•			•		●
MID COWLITZ-2	•	⬤		•		•			•	•	•			●		●

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ╋ High Positve Impact ✚

Figure 13. Lower Cowlitz coho habitat factor analysis diagram. Some low priority reaches are not included for display purposes.



Lower Cowlitz Winter Steelhead

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
MID COWLITZ-6	●	⬤	✛	●		●			●		•			⬤		✚
Olequa Cr 3	●	⬤	●	●		●			●	●	•			•		•
Olequa Cr 2	●	⬤	⬤	●		●			●	●	•			•		●
Stillwater Cr 5	●	●	⬤	•		•			●	⬤	•			•		•
MID COWLITZ-7	●	⬤	✛	●		•			●	●	•			●		•
Olequa Cr 4	●	⬤	●	●		•			●	●	•			•		•
Salmon Cr 2 (Upper)	•	⬤	●	•		•			●	●	•			•		•
Olequa Cr 5	●	⬤	●	•	•	•			●	●	•			•		+
Stillwater Cr 3	●	⬤	●	•		•			●	●	•			•		•
Stillwater Cr 4	●	●	⬤	•		•			●	●	•			•		•
Stillwater Cr 2	●	⬤	●	•		•			●	●	•			•		•
MID COWLITZ-5B	●	⬤	+	●		•			●	•	•			●		●
Stillwater Cr 1	●	⬤	●	•		•			●	●	•			•		●
Mill Cr	•	●	⬤	•		•			●	⬤	+			●		⬤
Olequa Cr 7	•	•	●	•						●						✛
Salmon Cr 3 (Upper)	•	●	●	•		•			●	●	•			•		+
Olequa Cr 1	•	⬤	●	●		•			●	●	•			•		•
Leckler Cr	•	●	⬤	•		•			●	⬤	•			•		●
Olequa Cr 6	•	●	●	•		•			●	●	•			•		•
Salmon Cr 1 (Upper)	•	⬤	●	•	•	•			●	●	•			•		+
Lacamas Cr 3	•	●	●	•		•			●	●	•			•		+
Salmon Cr 4	●	●	●	•		•			•	⬤	•			•		●
RB trib A (left fork) (26.0427)	•	●	●	•					●	●	•			•		●
Lacamas Cr 5	•	•	●	•		•			•	●	•			•		•
MID COWLITZ-4	•	●	+	●		•			●	•	•			●		+
Stillwater Cr 6	•	●	●	•					●	●	•			•		●
Whittle Cr2	•	●	●	•		•			⬤	⬤	●			•		
Campbell Cr 1	•	●	●	•		•			●	●	•			•		●
Lacamas Cr 4	•	●	●	•		•			•	●	•			•		
Becker Cr	•	●	●	•					●	●	•			•		●
King Cr 1	•	●	•						•	•				•		•
Ostrander Cr 2	•	●	●	•					●	●	•			•		●
LB tribC (right fork) (26.0427)	•	•	●	•					•	●	•			•		✛
Campbell Cr 2	•	•	●						•	●	•			•		●
Ferrier Cr	•	●	●						•	⬤	•			•		●
Lacamas Cr 6		•	●	•					•	●	•			•		•
MID COWLITZ-5A	•	●		•		•			•					•		✛
MID COWLITZ-1	•	●		•		•			•	•				•		
Lacamas Cr 7		•	●	•					•	●	•			•		•

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

Figure 14. Lower Cowlitz River subbasin winter steelhead habitat factor analysis diagram.

3.5 Watershed Process Limitations

This section describes watershed process limitations that contribute to stream habitat conditions significant to focal fish species. Reach level stream habitat conditions are influenced by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input, and large woody debris recruitment are often affected by upstream conditions and by contributing landscape factors. Accordingly, restoration of degraded channel habitat may require action outside the targeted reach, often extending into riparian and hillslope (upland) areas that are believed to influence the condition of aquatic habitats.

Watershed process impairments that affect stream habitat conditions were evaluated using a watershed process screening tool termed the Integrated Watershed Assessment (IWA). The IWA is a GIS-based assessment that evaluates watershed impairments at the subwatershed scale (3,000 to 12,000 acres). The tool uses landscape conditions (i.e. road density, impervious surfaces, vegetation, soil erodability, and topography) to identify the level of impairment of 1) riparian function, 2) sediment supply conditions, and 3) hydrology (runoff) conditions. For sediment and hydrology, the level of impairment is determined for local conditions (i.e. within subwatersheds, not including upstream drainage area) and at the watershed level (i.e. integrating the entire drainage area upstream of each subwatershed). See Appendix E for additional information on the IWA.

The lower Cowlitz watershed, which encompasses a total of 483 square miles, is divided into 40 subwatersheds for the IWA. The upstream end of the lower Cowlitz watershed terminates at Mayfield Dam. Upstream of the dam are the Mayfield-Tilton, Riffe Lake, Cispus River, and Upper Cowlitz watersheds. These seven watersheds comprise the Cowlitz River subbasin. IWA results for the Lower Cowlitz watershed are shown in Table 4. A reference map showing the location of each subwatershed in the basin is presented in Figure 15. Maps of the distribution of local and watershed level IWA results are displayed in Figure 1.

3.5.1 *Hydrology*

Current Conditions.— Local level hydrologic conditions in the lower Cowlitz watershed are impaired in virtually all subwatersheds, with only two moderately impaired subwatersheds located off the upper mainstem. The lower mainstem of the Cowlitz River has undergone extensive agricultural and residential development. Population centers in the subbasin consist primarily of small rural towns, with the larger towns of Castle Rock, Kelso, and Longview situated along the lower river. The hydrologic impacts of development include increased magnitude, frequency, and intensity of storm runoff, reduced ground water recharge, and lower stream flows during summer baseflow periods. These effects stem from vegetation removal, an increase in the quantity of impervious surfaces, and an increase in the channel network. Thirty-nine of 40 subwatersheds have less than 50% of total area in hydrologically mature forest cover. It should be noted, however, that much of this area is in what was once lowland prairie, and sparse tree cover is a natural condition in some areas. In the mainstem Cowlitz, impacts to streamflow may be overshadowed by the effects of hydro-regulation.

Watershed level results for hydrologic condition are generally similar, with the exception that hydrologic conditions rated as impaired at the local level in three subwatersheds become moderately impaired at the watershed level, due to the influence of upstream contributing subwatersheds. When considering these results it is important to note that the IWA does not explicitly consider the effects of the dams on streamflows within mainstem Lower Cowlitz subwatersheds. The three subwatersheds with improved hydrology ratings at the watershed level are in the Cowlitz mainstem below Mayfield Dam. Given the expected influence of dam operations on mainstem hydrology, the IWA watershed level rating does not accurately represent the effects of upstream influences. For the purpose of the IWA analysis, watershed level effects are calculated as though the watershed terminates at the dam.

Predicted Future Trends.— Due to the low forest cover within the forested subwatersheds and the low percentage of forested subwatersheds, hydrologic conditions in the lower Cowlitz watershed are predicted to remain unchanged (i.e., impaired) over the next 20 years unless specific actions are taken to ameliorate the problem. Conditions in the mainstem are generally driven by hydropower operations, and are determined to a lesser extent by tributary conditions. Hydropower operations may be modified in the future to benefit salmon recovery, but for the purpose of this analysis these operations are predicted to remain constant over this period.

Table 4. IWA results for the Lower Cowlitz Watershed

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
80407						TOUTLE
80201	I	M	I	I	M	none, east Willapa
80203	I	I	I	I	M	east Willapa
70606, 80201, 80202, 80203	I	I	I	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407, 60408, 70101, 70102, 70103, 70104, 70105, 70201, 70202, 70203, 70204, 70205, 70501, 70502, 70503, 70504, 70505, 70601, 70605, 80202
80201						60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407, 60408, 70101, 70102, 70103, 70104, 70105, 70201, 70202, 70203, 70204, 70205, 70501, 70502, 70503, 70504, 70505, 70601, 70605, 70606
80202	I	M	I	I	M	none
80203	I	I	I	I	M	none
70504	I	M	I	I	M	70501, 70502, 70503, 70505
70501	I	M	M	I	M	none
70501--70502	I	M	I	I	M	70501
70502	I	M	I	I	M	70501
70503	I	I	M	I	I	none
70504						
70505	I	M	M	I	M	70503
70601	I	M	M	I	M	none
70605	I	M	M	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407, 60408, 70101, 70102, 70103, 70104,70105, 70201, 70202, 70203, 70204, 70205, 70501, 70502, 70503, 70504, 70505, 70601
70606	I	I	I	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407, 60408, 70101, 70102, 70103, 70104, 70105, 70201, 70202, 70203, 70204, 70205, 70501, 70502, 70503, 70504, 70505, 70601, 70605
70605, 70606	I	I	I	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407, 60408, 70101, 70102, 70103,

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
						70104, 70105, 70201, 70202, 70203, 70204, 70205, 70501, 70502, 70503, 70504, 70505, 70601, 70605
70104	I	M	M	I	M	70105
70104, 70105	I	M	M	I	M	70105
70103	I	M	M	I	M	70101, 70102, 70104, 70105, 70201, 70202, 70203, 70204, 70205
70102	I	M	I	I	M	70101
70101	I	M	M	I	M	none
70201	I	M	I	I	M	none
70202	I	M	I	I	M	none
70203	I	M	I	I	M	none
70204	I	M	I	I	M	70201, 70202, 70203
70205	I	M	I	I	M	70201, 70202, 70203, 70204
60408	I	M	I	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407
60401	I	F	I	I	F	none
60402	I	M	M	I	M	none
60403	I	F	M	M	M	60101, 60102, 60103, 60104, 60402
60404	M	F	I	M	F	none
60405	I	M	M	I	F	60401
60406	I	M	M	I	F	60401, 60405, 60404
60202	I	M	M	I	M	60201
60103	I	M	M	I	M	60104
60303	I	F	M	I	M	none
60302	I	M	M	I	M	60201, 60202, 60304, 60305
60301, 60304	I	M	M	I	M	60305
60304	I	M	M	I	M	60305
60305	I	M	M	I	M	none
60403, 60407	I	M	I	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60402, 60403
60102	I	M	M	M	M	60103, 60104, 60402

Subwatershed[a]	**Local Process Conditions**[b]			**Watershed Level Process Conditions**[c]		**Upstream Subwatersheds**[d]
	Hydrology	**Sediment**	**Riparian**	**Hydrology**	**Sediment**	
60101, 60102	I	M	M	M	M	60103, 60104, 60402
60101	I	M	M	M	M	60103, 60104
60201	M	M	F	M	M	none
60104	I	M	M	I	M	none
80101	I	M	M	I	M	none
80102	I	M	M	I	M	80101

Notes:

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170800010#####.

[b] IWA results for watershed processes at the subwatershed level (i.e., not considering upstream effects). This information is used to identify areas that are potential sources of degraded conditions for watershed processes, abbreviated as follows:

F: Functional
M: Moderately impaired
I: Impaired

[c] IWA results for watershed processes at the watershed level (i.e., considering upstream effects). These results integrate the contribution from all upstream subwatersheds to watershed processes and are used to identify the probable condition of these processes in subwatersheds where key reaches are present.

[d] Subwatersheds upstream from this subwatershed.

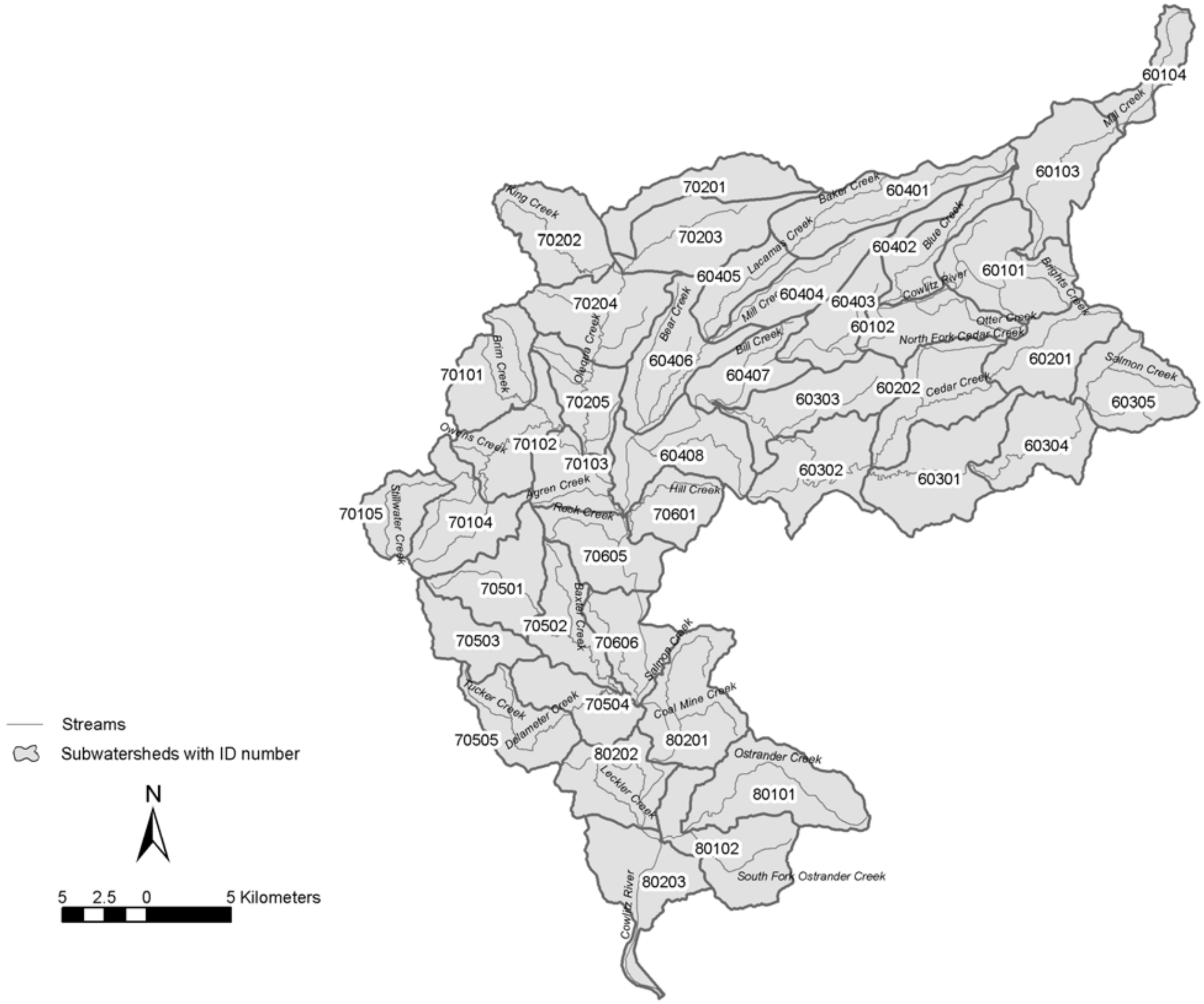


Figure 15. Map of the Lower Cowltiz basin showing the location of the IWA subwatersheds.

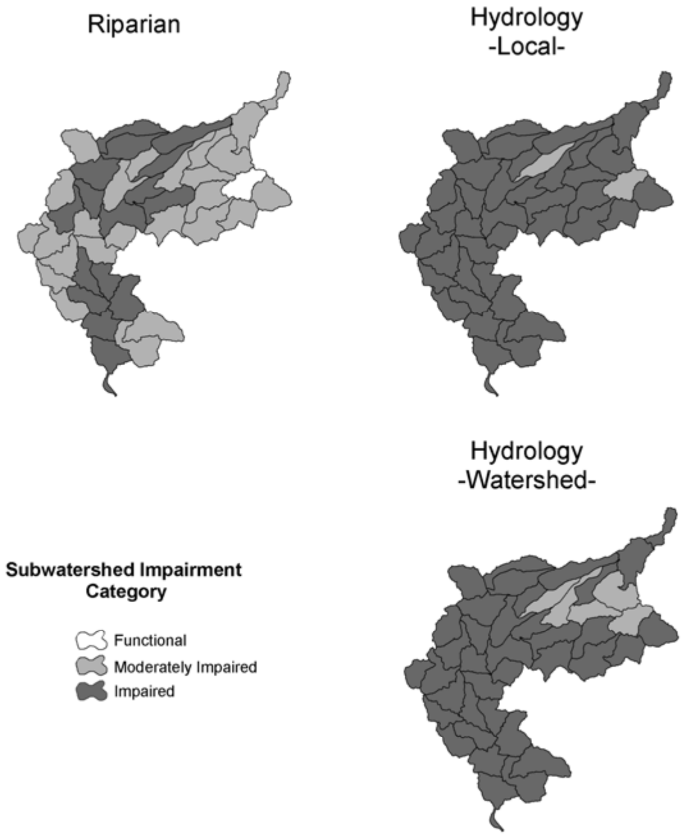


Figure 16. IWA subwatershed impairment ratings by category for the Lower Cowlitz basin

3.5.2 *Sediment Supply*

Current Conditions.— Most subwatersheds are rated as moderately impaired for local sediment supply conditions. Four adjacent subwatersheds (60303, 60403, 60404, and 60401) are rated as locally functional for sediment. A few subwatersheds in the lower portion of the basin, including the mouth subwatershed, are rated impaired. The remainder are moderately impaired. Based on geology type and slope class, subwatersheds rated as functional for sediment were found to have natural erodability ratings in the low-to-intermediate range, ranging from 37 to 43 on a scale of 0 to 126. Road densities are generally moderate to high and streamside road densities are mostly moderate in these subwatersheds.

Locally functional and impaired sediment ratings in two subwatersheds, respectively, become moderately impaired at the watershed level. This implies that hydrologic and sediment conditions in these subwatersheds are potentially affected by upstream as well as local conditions. However, when considering these results it is important to note that the IWA does not explicitly consider the effects of the dams on streamflows within mainstem Lower Cowlitz subwatersheds. Two subwatersheds with changing sediment ratings are located along the lower Cowlitz mainstem, which is affected both by the effect of dams (which capture sediment from the upper subbasin) and the influence of undammed tributaries within the Coweeman and Toutle River watersheds.

Predicted Future Trends.— Sediment conditions are generally rated as moderately impaired to impaired throughout the lower Cowlitz basin, with the exception of the Mill Creek tributary to Lacamas Creek (functional). The watershed is characterized by a broad array of land uses, ranging from agriculture and timber to urban and industrial development, and also contains the developing I-5 corridor.

Land uses in tributary watersheds are generally predicted to continue, and may in some cases shift towards residential and urban development along the I-5 corridor. Based on the trajectory of predominant land uses, sediment conditions in tributary drainages are predicted to trend towards increasing degradation. These impacts may be mitigated to some degree by improved forestry and road management practices on public and private timberlands, and improved stormwater controls. Nevertheless, the predicted overall trend is toward increasing degradation in tributary drainages.

Sediment conditions in the mainstem Cowlitz are determined by the presence of major dams, sediment delivery from tributary drainages, and significantly, from tributary watersheds such as the Toutle and Coweeman Rivers. Of particular note, the Toutle River watershed was heavily impacted with sediment from the Mt. St. Helens eruption in 1980. Sediment delivery from the Toutle River watershed is a consistent management challenge in the lower Cowlitz mainstem. The trend in sediment conditions in the mainstem is expected to remain constant in subwatersheds above the confluence with the Toutle, and to degrade over the next 20 years in mainstem reaches downstream of the Toutle.

3.5.3 *Riparian Condition*

Current Conditions.— Riparian conditions are rated as moderately impaired or impaired, with only one subwatershed, Cedar Creek (60201), rated as functional. Moderately impaired conditions are present in 23 subwatersheds and the remaining 16 subwatersheds are rated as impaired. Generally, riparian conditions in the Puget Trough subwatersheds in the more northern and eastern portion of the watershed are better than the Willapa Hills subwatersheds to the west and south.

Riparian forests along the lower 20 miles of the Cowlitz and within the lower reaches of the smaller tributaries have been severely degraded through industrial and commercial development. Agriculture and forestry activities have also impacted riparian areas (Wade 2000).

Predicted Future Trends.— Riparian forests along the lower 20 miles of the Cowlitz and within the lower reaches of the smaller tributaries have been severely degraded through industrial and commercial development. Riparian conditions are rated functional in Cedar Creek (60201), moderately impaired in 23 subwatersheds, and impaired in the remaining 14 subwatersheds. Conditions in middle and upper tributary subwatersheds are generally predicted to remain stable over the next 20 years, trending towards gradual improvement as regrowth in degraded watersheds proceed.

Riparian conditions along the lower mainstem and in lower tributary drainages are expected to trend downward over the next 20 years, as development pressure around the towns of Castle Rock, Longview, and Kelso increase. Channelization and bank modifications along the mainstem further limit the potential for riparian recovery in many areas.

3.6 Other Factors and Limitations

3.6.1 *Hatcheries*

Hatcheries currently release over 50 million salmon and steelhead per year in Washington lower Columbia River subbasins. Many of these fish are released to mitigate for loss of habitat. Hatcheries can provide valuable mitigation and conservation benefits but may also cause significant adverse impacts if not prudently and properly employed. Risks to wild fish include genetic deterioration, reduced fitness and survival, ecological effects such as competition or predation, facility effects on passage and water quality, mixed stock fishery effects, and confounding the accuracy of wild population status estimates. This section describes hatchery programs in the Lower Cowlitz Basin and discusses their potential effects.

Hatcheries have operated in the Cowlitz River Basin since the early 1900s. For example, the Tilton River Hatchery released coho salmon in the Cowlitz River from 1915–21 and a salmon hatchery operated in the upper Cowlitz near the mouth of the Clear Fork until 1949. Three hatcheries currently operate in the basin: the Cowlitz Salmon Hatchery, the Cowlitz Trout Hatchery, and the North Toutle Hatchery (formerly the Green River Hatchery). The three hatcheries coordinate annual production efforts and are collectively referred to as the Cowlitz River Hatchery Complex.

Cowlitz Salmon Hatchery

The Cowlitz Salmon Hatchery, completed in 1967, is approximately two miles downstream of Mayfield Dam. Current production goals are 5 million fall Chinook juveniles released in the Cowlitz River, approximately 1.2 million spring Chinook smolts (967,000 into the lower Cowlitz, and 100,000 to the Deep River net pens), 300,000 spring Chinook fry for release into the upper Cowlitz above Cowlitz Falls Dam, and 3.2 million late-stock coho smolts (Figure 17).

Cowlitz Trout Hatchery

The Cowlitz Trout Hatchery is located on the mainstem Cowlitz at RM 42. Current production goals include 300,000 early run winter steelhead smolts released to the lower Cowlitz River; 352,500 late-run winter steelhead smolts to the lower Cowlitz River; 250,000 fingerlings and 37,500 late-run winter steelhead smolts to the upper Cowlitz and Cispus rivers, and 100,000 late-run winter steelhead fingerlings to the Tilton River; 500,000 summer steelhead smolts in the lower Cowlitz River; 100,000 sea run cutthroat trout fingerlings in the Tilton River; and 160,000 sea-run cutthroat trout fingerlings in the Cowlitz River and Blue Creek (Figure 17).

The North Toutle Hatchery

The North Toutle Hatchery, on the Green River less than a mile upstream of the confluence with the NF Toutle River, began operations in 1956 and was destroyed in the 1980 Mt. St. Helens eruption. Rearing ponds near the hatchery site were developed after the eruption and operations were restored in 1985. The rebuilt hatchery resumed collecting broodstock in 1990. Current hatchery release goals are 2.5 million sub-yearling fall Chinook, 800,000 early-stock coho smolts, and 50,000 summer steelhead (from Skamania Hatchery) smolts (Figure 18). Rearing ponds located at RM 8 on the Coweeman River are used to acclimate winter steelhead for release in the basin. Annual production goals are 14,000 smolts; an additional 6,000 smolts are released directly to the Coweeman River without acclimation at the ponds (Figure 18).

Table 5. Cowlitz Basin hatchery production.

Hatchery	Release Location	Fall Chinook	Spring Chinook	Late Coho	Sea-run Cutthroat	Winter Steelhead	Summer Steelhead
Cowlitz Salmon	Lower Cowlitz	5,000,000	967,000	3,200,000			
	Upper Cowlitz		300,000				
Cowlitz Trout	Lower Cowlitz				150,000	652,500	500,000
	Upper Cowlitz					287,500	
	Tilton					100,000	

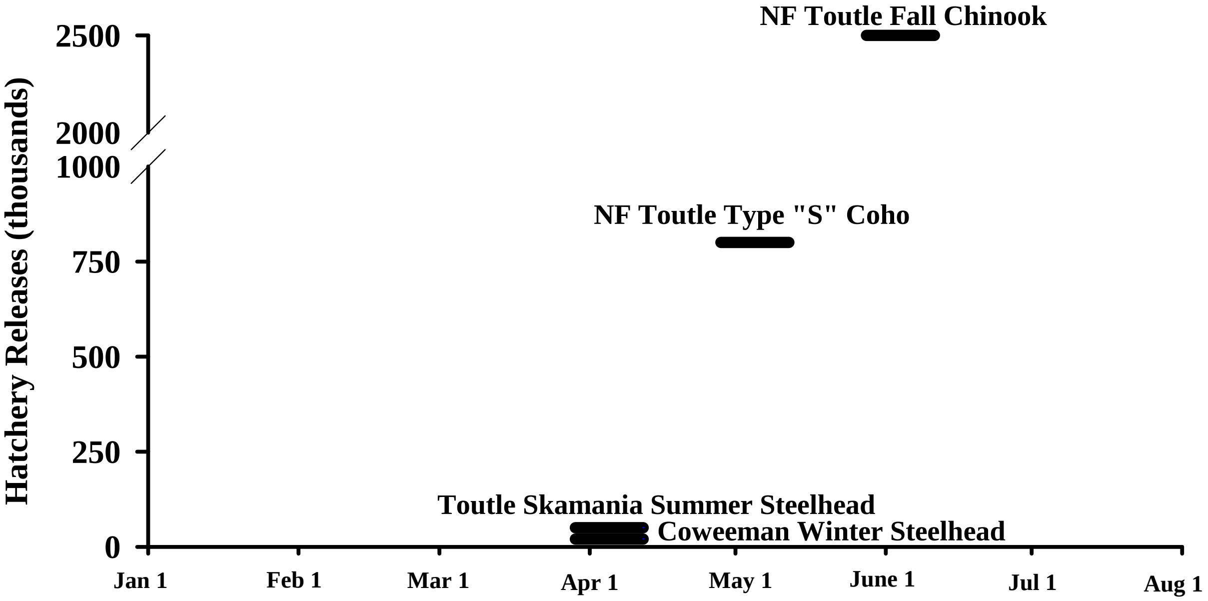


Figure 17. Magnitude and timing of hatchery releases in the Toutle and Coweeman River basins by species, based on 2003 brood production goals.

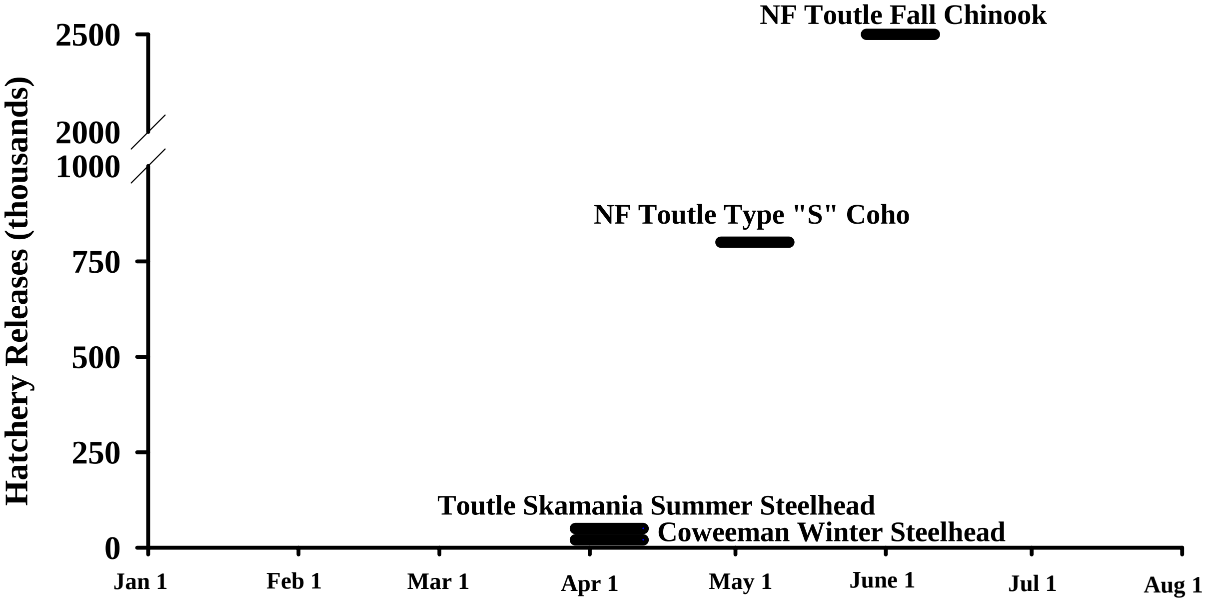


Figure 18. Magnitude and timing of hatchery releases in the Toutle and Coweeman River basins by species, based on 2003 brood production goals

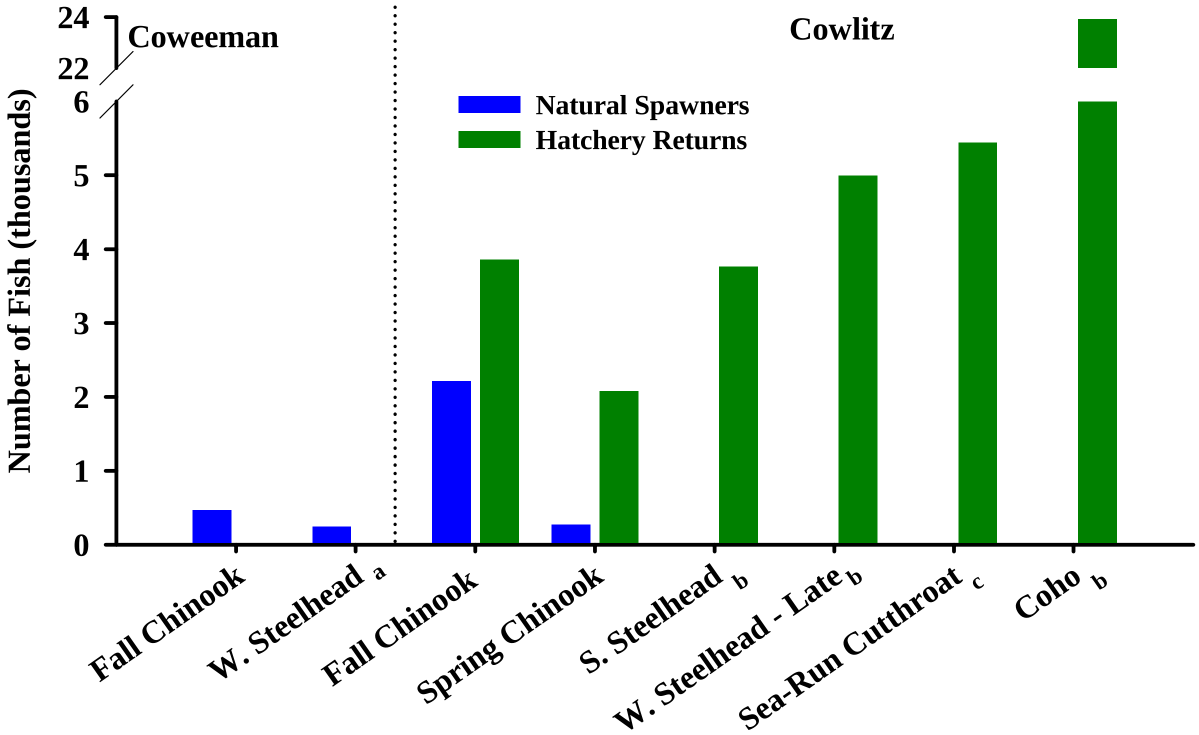


Figure 19. Recent average hatchery returns and estimates of natural spawning escapement in the Cowlitz River basin by species. The years used to calculate averages varied by species, based on available data. The data used to calculate average hatchery returns and natural escapement for a particular species and basin were derived from the same years in all cases. All data were from 1992 to the present. Calculation of each average utilized a minimum of 5 years of data.

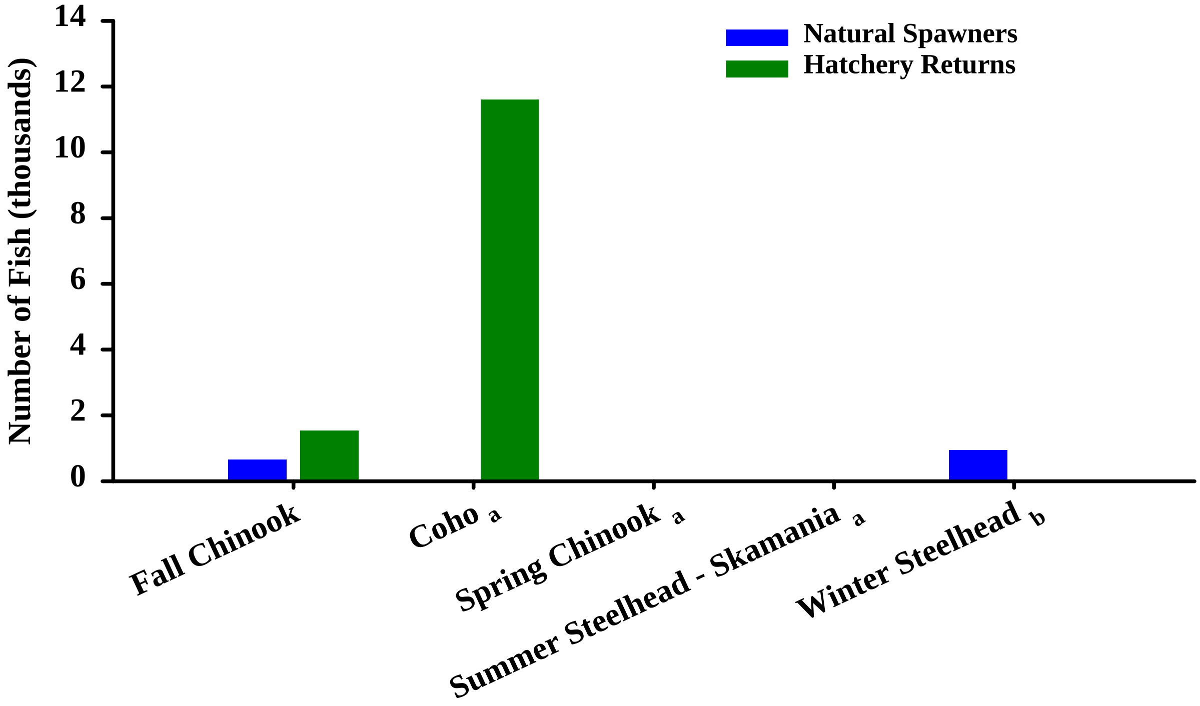


Figure 20. Recent average hatchery returns and estimates of natural spawning escapement in the Toutle River basin by species.

Hatchery Effects

Genetics—Broodstock for fall Chinook at the Cowlitz Salmon Hatchery have come almost entirely from native Cowlitz fall Chinook, with hatchery fall Chinook transfers into the Cowlitz in a few years. There have been no transfers of fall Chinook into the Cowlitz since 1990, and past transfers have all come from hatcheries within the Lower Columbia ESU. Genetic analysis from the 1980s indicated that Cowlitz Salmon Hatchery fall Chinook were similar to, but distinct from, Kalama Hatchery fall Chinook and distinct from other Washington fall Chinook stocks in the lower Columbia River.

Fall Chinook broodstock at the North Toutle Hatchery have been primarily collected from the Toutle River although there have been been significant transfers made from lower Columbia ESU hatchery stocks, most significantly Spring Creek Hatchery and Kalama Hatchery fall Chinook. Specific genetic data is not available for Toutle Fall Chinook.

Fall Chinook in the Coweeman River basin are considered wild fish with little hatchery influence. Hatchery fall Chinook from the Spring Creek, Washougal, and Toutle Hatcheries were released periodically in the Coweeman during 1951–1979, but releases were discontinued in 1980. Since the early 1980s, hatchery-tagged fall Chinook have not been recovered in the Coweeman basin during spawning surveys, indicating the population is not influenced by stray hatchery fish.

Spring Chinook broodstock for the Cowlitz Salmon Hatchery has been almost exclusively collected from Cowlitz River native spring Chinook (In the late 1960s there were fewer then a million Willamette spring Chinook released into the Cowlitz). Genetic analysis in the 1980s indicated that Cowlitz Salmon Hatchery spring Chinook were genetically similar to, but distinct from, Kalama Hatchery and Lewis River wild spring Chinook and significantly different from other lower Columbia River spring Chinook stocks.

Broodstock for the coho salmon hatchery programs has come from native Cowlitz River (Cowlitz Salmon Hatchery) and Toutle River (North Toutle Hatchery) stocks. These stocks also have been used as broodstock for other lower Columbia River coho hatchery programs. Late stock coho salmon (Type N) and early coho salmon (Type S) are informally considered synonymous with Cowlitz River and Toutle River coho stocks, respectively. Columbia River early and late stock coho salmon produced from Washington hatcheries have not been found to be genetically different.

Both early and late winter steelhead hatchery programs exist at the Cowlitz Trout Hatchery. Broodstock for the early winter steelhead has come from a combination of Chambers Creek, Elochoman River, and Cowlitz River winter steelhead. Broodstock for the late-run winter steelhead program has come only from the Cowlitz River late winter steelhead stock. Genetic analysis in the mid-1990s was unable to determine the distinctiveness of Cowlitz basin winter steelhead from other lower Columbia winter steelhead stocks. Broodstock for the summer steelhead hatchery program at the Cowlitz Trout Hatchery and the North Toutle Hatchery originated from Skamania stock. The North Toutle Hatchery continues to receive broodstock from the Skamania Hatchery, while summer steelhead broodstock for the Cowlitz program is collected at the Cowlitz Trout and Salmon hatcheries. Winter steelhead broodstock for smolts acclimated and released from the Coweeman rearing ponds comes from hatchery returns to the Elochoman River Hatchery.

Broodstock for the cutthroat trout program at the Cowlitz Trout Hatchery originated from native Cowlitz River sea-run cutthroat trout with some limited influence from Beaver Creek stocks. Current broodstock collection comes from adults returning to the hatchery.

Interactions—Hatchery fall Chinook account for most adults returning to the Cowlitz, Toutle, and Green rivers. Hatchery returns are approximately double the natural escapement in the Cowlitz basin (Figure 19 and Figure 20). Many natural spawners are expected to be first generation hatchery fish; wild fish abundance is likely low. The Toutle and Green River fall Chinook populations are being re-established after the 1980 Mt. St. Helens eruption. Depending on the rebuilding success of these populations, the potential for wild/hatchery fish interactions may increase. The lower Cowlitz River downstream of the Cowlitz Salmon Hatchery barrier dam is an important rearing area for naturally produced fall Chinook. Hatchery-origin fall Chinook released in the lower Cowlitz may compete with natural-origin fall Chinook for food and space; research to study this potential interaction is in progress. Hatchery-origin fall Chinook fingerlings released in the lower Cowlitz also may be preyed upon by wild steelhead and cutthroat trout smolts.

Hatchery spring Chinook account for most adults returning to the Cowlitz River (Figure 19) Hatchery spring Chinook are released downstream of the Hatchery Barrier Dam as smolts for the harvest mitigation program and into the upper Cowlitz (upstream of Cowlitz Falls Dam) as subyearlings to supplement the natural reintroduction program. Some predation by hatchery-origin smolts may occur on naturally produced fall Chinook, coho, or chum fry. However, the potential for these interactions is minimized by timing the release of hatchery smolts (March) to when the fish are smolted and prepared to quickly emigrate from the river to the Columbia estuary.

Hatchery coho salmon, account for most adults returning to the Cowlitz and Toutle rivers (Figure 19 and Figure 20). Significant coho production can occur in the upper Cowlitz basin from adults transplanted from the lower river; these fish are usually first generation hatchery fish. The smolt-to-adult survival of naturally produced coho juveniles in the upper Cowlitz has been low in the initial years of the program, so few naturally produced coho adults have been available for transplanting to the upper Cowlitz. Hatchery smolts released in the lower Cowlitz River potentially compete with wild fall Chinook, steelhead, and chum salmon for food and space, but competition is limited to smolt migration time through the basin. Migration time is minimized by releasing smolts (in May) when they are prepared to move towards the Columbia estuary.

Hatchery fish account for most winter steelhead adults returning to the Cowlitz and Coweeman rivers (Figure 19). In the Toutle River system, the winter steelhead annual return is thought to be primarily comprised of naturally produced fish (Figure 20). Potential for interaction between wild and hatchery adults is expected to be low because of relative numbers of natural and hatchery fish and temporal and spatial segregation. Summer steelhead are not expected to reproduce naturally in the Cowlitz River (Figure 19) because they are introduced to the basin and there is no intention for a naturally reproducing population. Hatchery summer and winter steelhead smolts are released from the Cowlitz Trout Hatchery and Coweeman rearing ponds in May at a size and stage of smoltification intended to minimize travel time during emigration. In addition, hatchery summer steelhead are released from net pens in the Lower Cowlitz river and from a small acclimation pond in the lower S. Fk. Toutle River. Preliminary data suggests that steelhead smolts move downstream rapidly at approximately 20 miles per day so competition with native and non-native species in the lower Cowlitz is considered low.

However, steelhead smolts that residualize may actively prey upon spring and fall Chinook, coho, and chum fry that are present in the lower Cowlitz River basin. Large releases of hatchery smolts may attract additional predators causing increased predation on wild fish, but conversely, wild fish may benefit from the presence of large numbers of hatchery fish because wild fish usually have better predator avoidance capabilities.

Hatchery sea-run cutthroat trout account for most adults returning to the Cowlitz River (Figure 19). A natural population (anadromous and resident below the dams and resident above the dams) exists but is assumed to be relatively small. Hatchery sea run cutthroat trout smolts are released from the Cowlitz Trout Hatchery in April at a target size of 8.3 in (210 mm) FL; trout at this size generally exhibit smolt characteristics and rapidly emigrate. Hatchery cutthroat smolts have the potential to compete for food and space or to prey on juvenile fish in the system, however, competition with native and non-native species in the lower Cowlitz is considered low. Competition with, and predation on, other salmonids is likely greater when cutthroat trout smolts residualize.

Water Quality/Disease — Water for the Cowlitz Salmon Hatchery comes from three sources. The majority of water is supplied from the Cowlitz River, with an average 75,000 gpm available to the rearing ponds and 15,000 gpm available for the fish separator and ladder. Two separate well systems provide 1,000 and 700 gpm, respectively, between August and April and generally are used for egg incubation and early fry rearing. During incubation, salmon *Saprolegniasis* (fungus) is the primary concern and requires daily formalin treatments at 1:600 for 15 minutes. Excessive gas in the incubation effluent is variable and may be associated with periodic increases in yolk coagulation in eggs and fry. Water flow to fry is kept below 6 gpm to reduce or eliminate Bacterial Cold Water Disease (BCWD). A fish pathologist routinely checks for Infectious Hematopoeitic Necrosis Virus (IHNV) and Bacterial Kidney Disease (BKD). All equipment in the rearing ponds is sanitized with an iodine solution after each use.

Water for the Cowlitz Trout Hatchery also comes from three sources. Nine shallow wells on either side of the river provide up to 5 cfs. The well water is generally used for initial rearing and for water temperature regulation throughout the facility. The north well has had some bacteria and gas problems, is not used, and may be abandoned. An ozone plant operates from May to December to disinfect up to 20 cfs of Cowlitz River water; the ozone plant removes pathogens (primarily *Ceratomyxa shasta*) present in the river water. Untreated river water up to 50 cfs is available when the ozone plant is not in operation. All water entering the facility is stored in basins, where it flows to the fish rearing ponds via gravity. Because of a limited water supply, all water is reused in the lower rearing ponds and some may be used three times without treating. Hatchery staff follows protocols in the Fish Health Manual to reduce the occurrence of disease. During incubation, diseases that occur include BCWD and *Trichodina*. Rearing fish are routinely examined by hatchery staff and a fish health specialist; treatments are prescribed accordingly.

Water for the North Toutle Hatchery comes from the Green River; the hatchery has a water right totaling 26,031 gpm. A rearing site associated on the South Fork Toutle River utilizes 3-4 cfs directly from the river. Rearing ponds at the facility are sanitized with chlorine at 20 parts per million before being stocked with fry. Equipment used at the rearing ponds is routinely disinfected with an iodine solution. Fish are monitored throughout the rearing phase by WDFW pathologists.

Water for the Coweeman rearing ponds comes directly from tributary creeks of the Coweeman River. Operations of the acclimation ponds are not subject to NPDES requirements, thus discharge water quality parameters are not monitored. Fish health is monitored daily and the area fish health specialist conducts monthly visits and advises disease treatment. Sanitizing rearing pond equipment is done according to the Fish Health Manual.

Mixed Harvest—The purpose of the fall Chinook hatchery program at the Cowlitz Salmon Hatchery is to mitigate for losses resulting from hydroelectric development in the basin. Historically, exploitation rates of hatchery and wild fall Chinook likely were similar. Fall Chinook are an important target species in ocean and Columbia River commercial and recreational fisheries, as well as in Cowlitz River recreational fisheries. CWT data analysis of the fall Chinook 1989–1994 brood years from the Cowlitz Salmon and North Toutle hatcheries indicate a 33% and 41% exploitation rate, respectively, leaving 67% and 59% of the respective adult return for escapement. Exploitation of wild fish during the same period likely was similar. Hatchery and wild fall Chinook harvest rates remain similar and are now constrained by ESA harvest limitations.

At the Cowlitz Salmon Hatchery, the spring Chinook program mitigates for salmon lost as a result of hydroelectric development in the basin. The program provides fish for harvest while minimizing adverse effects on ESA-listed fish. Historically, exploitation rates of hatchery and wild spring Chinook were likely similar. Spring Chinook are an important target species in Columbia River commercial and recreational fisheries, as well as tributary recreational fisheries. CWT data analysis of the 1989–1994 brood years from the Cowlitz Salmon Hatchery indicate a 40% exploitation rate on spring Chinook; 60% of the adult return was accounted for in escapement. Most of the harvest occurred in the Cowlitz River sport fishery. Exploitation of wild fish during the same period likely was similar. Selective fisheries targeting hatchery spring Chinook have been implemented in recent years in the mainstem Columbia sport and commercial fisheries and in the Cowlitz River sport fishery. Regulations allowing retention of hatchery fish and requiring release of wild fish increase opportunity to catch hatchery fish and significantly decrease impacts to wild fish. The selective fishery program enables the spring Chinook reintroduced into the upper Cowlitz to pass through the fisheries.

Mitigating for late run coho salmon lost as a result of hydroelectric development is a goal of the Cowlitz Salmon Hatchery coho salmon program. The program provides fish for harvest while minimizing adverse effects on ESA-listed fish. All hatchery smolts are adipose fin-clipped to allow for selective harvest. Ocean and Columbia River sport and commercial fisheries and Cowlitz River sport fisheries benefit from this program. Historically, naturally produced coho from the Columbia River were managed like hatchery fish and subjected to similar exploitation rates. Ocean and Columbia River combined harvest of Columbia River-produced coho ranged from 70% to over 90% during 1970–1983. To protect several wild coho stocks, ocean fisheries were limited beginning in the mid-1980s and Columbia River commercial fisheries were temporally adjusted in the early 1990s. With the advent of selective fisheries for marked hatchery fish, exploitation of wild coho has been reduced, while hatchery fish can be harvested at higher rates. Currently, Cowlitz wild coho benefit from ESA harvest restrictions placed on Oregon Coastal natural coho (federal listing) in ocean fisheries and Oregon Lower Columbia natural coho (state listing) in Columbia River fisheries.

At the Cowlitz Trout Hatchery, the early and late winter steelhead hatchery programs mitigate for winter steelhead lost as a result of hydroelectric development in the basin; the program provides fish for harvest while minimizing adverse effects on ESA-listed fish. Fisheries that benefit include lower Columbia and Cowlitz River sport fisheries; approximately 6.2% of the returning Cowlitz Trout Hatchery steelhead are harvested in the lower Columbia River sport fishery and about 70% are harvested in the Cowlitz River sport fishery. Prior to selective fishery regulations, exploitation rates of wild and hatchery winter steelhead likely were similar. Mainstem Columbia River sport fisheries became selective for hatchery steelhead in 1984 and Washington tributaries became selective during 1986–1992 (except the Toutle in 1994). Current selective harvest regulations in the lower Columbia and tributary sport fisheries have targeted hatchery steelhead and limited harvest of wild winter steelhead to less than 10% (estimated at 6% for the Cowlitz tributary sport fishery). In the Cowlitz River, winter steelhead originating from the upper Cowlitz are marked with a right ventral fin clip and are protected from harvest in the lower Cowlitz fishery. Ventral fin-clipped fish that return to either of the Cowlitz River hatcheries are transported to the upper Cowlitz River to provide harvest opportunity for anglers and spawners for the reintroduction program.

The Coweeman rearing ponds provide winter steelhead for tributary sport harvest opportunity. Sport fisheries in the Coweeman, lower Cowlitz, and lower Columbia rivers benefit from this program. Selective fishery regulations allow for protection of wild winter steelhead while maximizing harvest rates on Coweeman hatchery winter steelhead. The Coweeman tributary fishery harvest rate for hatchery winter steelhead is estimated to be 30% with a 4% mortality impact estimated for wild winter steelhead.

At the Cowlitz Trout Hatchery and the North Toutle Hatchery, the summer steelhead hatchery programs mitigate for steelhead lost as a result of hydroelectric development in the basin and provide harvest opportunity. Summer steelhead are introduced to the basin; there is no intention of trying to develop a self-sustaining population of summer steelhead. Fisheries that benefit include tributary and lower Columbia River recreational fisheries. Selective fishing regulations and the differences in the timing of runs focus harvest on hatchery summer steelhead and minimize effects to wild steelhead.

The Cowlitz Trout Hatchery's sea-run cutthroat trout program mitigates for losses resulting from hydroelectric development in the basin and provides harvest opportunity. These fish contribute to the tributary sport fishery; harvest effects on wild fish should be minimal because of the differences in the timing of runs of cutthroat trout and regulations about minimum size, bag limit, and wild cutthroat trout release.

Passage—At the Cowlitz Salmon Hatchery, the adult collection facility is a barrier dam across the entire width of the river that prevents upstream migration of all returning salmonids. Returning adults enter through a fish ladder into a sorting, transfer, and holding facility. Fish to be retained for broodstock are directed to the holding facilities, while fish to be transported and released in the upper watershed are directed toward transfer facilities. If fish are able to bypass collection, Mayfield Dam—with no fish passage facilities—is approximately two miles upstream.

At the Cowlitz Trout Hatchery, the adult collection facility consists of a weir and fish ladder in Blue Creek and upstream migration in the mainstem Cowlitz River is unimpeded. Fish are hand-sorted and retained in adult holding ponds if they are needed for broodstock. Fish exceeding broodstock needs are transferred back to the river, or to the Cowlitz Salmon Hatchery, via specialized fish tanker trucks.

At the North Toutle Hatchery, the adult collection facility is a temporary weir for collecting coho salmon and fall Chinook. The weir is installed and removed annually and only effects fish passage during the time of adult coho and fall Chinook collection.

There are no adult collection facilities at the Coweeman rearing ponds. Hatchery programs at this facility obtain broodstock from other hatchery facilities.

Supplementation—The Cowlitz Salmon Hatchery spring Chinook program is partly intended to restore natural spawning populations of spring Chinook in the upper Cowlitz River basin. Current production goals are 300,000 fingerling spring Chinook for annual release. As well, hatchery-origin adult returns in excess of annual broodstock needs are transported above Cowlitz Falls Dam as part of the reintroduction program. Reintroduction efforts have been challenged by low success in collecting emigrating juveniles to pass through the hydro system.

This hatchery's late stock coho salmon (Type-N) program also provides for restocking of the upper Cowlitz basin. Annual production goals depend on the availability of adults for natural spawning in the upper basin. If insufficient adults are available, the release goal is 1 million fry annually in the upper Cowlitz. Reintroduction efforts indicate good production capabilities in tributaries above the dams. Although coho smolt collection at the hydroelectric facility has been more successful then Chinook, reintroduction efforts are also challenged in passing juveniles through the system.

The Cowlitz Trout Hatchery has an annual goal of restoring natural spawning late-run winter steelhead populations in the upper Cowlitz and Tilton River basins. Current annual release goals are 350,000 fingerlings and 37,500 smolts in the upper watershed. Juvenile downstream migrant passage is better at the hydro-facility than for Chinook, and similar to coho.

Biological Risk Assessment

The evaluation of hatchery programs and implementation of hatchery reform in the Lower Columbia is occurring through several processes. These include: 1) the LCFRB recovery planning process; 2) Hatchery Genetic Management Plan (HGMP) preparation for ESA permitting; 3) FERC related plans on the Cowlitz River and Lewis River; and 4) the federally mandated Artificial Production Review and Evaluation (APRE) process. Through each of these processes, WDFW is applying a consistent framework to identify the hatchery program enhancements that will maximize fishing-related economic benefits and promote attainment of regional recovery goals. Developing hatcheries into an integrated, productive, stock recovery tool requires a policy framework for considering the acceptable risks of artificial propagation, and a scientific assessment of the benefits and risks of each proposed hatchery program. WDFW developed the Benefit-Risk Assessment Procedure (BRAP) to provide that framework. The BRAP evaluates hatchery programs in the ecological context of the watershed, with integrated assessment and decisions for hatcheries, harvest, and habitat. The risk assessment procedure consists of five basic steps, grouped into two blocks:

Policy Framework

- Assess population status of wild populations
- Develop risk tolerance profiles for all stock conditions
- Assign risk tolerance profiles to all stocks

Risk Assessment

- Conduct risk assessments for all hatchery programs

- Identify appropriate management actions to reduce risk

Following the identification of risks through the assessment process, a strategy is developed to describe a general approach for addressing those risks. Building upon those strategies, program-specific actions and an adaptive management plan are developed as the final steps in the WDFW framework for hatchery reform.

Table 6 identifies hazards levels associated with risks involved with hatchery programs in the Lower Cowlitz River Basin. Table 7 identifies preliminary strategies proposed to address risks identified in the BRAP for the same populations.

The BRAP risk assessments and strategies to reduce risk have been key in providing the biological context to develop the hatchery recovery measures for lower Columbia River sub-basins.

Table 6. Preliminary BRAP for hatchery programs affecting populations in the Lower Cowlitz River Basin

Symbol	Description
○	Risk of hazard consistent with current risk tolerance profile.
?	Magnitude of risk associated with hazard unknown.
●	Risk of hazard exceeds current risk tolerance profile.
▨	Hazard not relevant to population

	Hatchery Program		Risk Assessment of Hazards											
			Genetic			Ecological			Demographic		Facility			
Lower Cowlitz Population	Name	Release (millions)	Effective Population Size	Domestication	Diversity	Predation	Competition	Disease	Survival Rate	Reproductive Success	Catastrophic Loss	Passage	Screening	Water Quality
Fall Chinook	Cowlitz Fall Chinook	5.000	○	●	○	○	?	○	○	?	○	○	●	○
	Cowlitz Coho 1+	3.200	▨	▨	▨	?	?	○	▨	▨	▨	○	●	○
	Cowlitz Coho Eggs	0.181	▨	▨	▨	?	?	○	▨	▨	▨	○	●	○
	Cowlitz Sp. Chinook 1+	0.912	▨	▨	▨	?	?	○	▨	▨	▨	○	●	○
	Cowlitz Sp. Chinook 0+	0.300	▨	▨	▨	○	?	○	▨	▨	▨	○	●	○
	Friends of the Cowlitz Sp. Chinook 1+	0.055	▨	▨	▨	?	?	○	▨	▨	▨	○	●	○
	Cowlitz Early W. Steelhead 1+	0.300	▨	▨	▨	?	?	○	▨	▨	▨	○	●	○
	Cowlitz Late W. Steelhead 1+	0.390	▨	▨	▨	?	?	○	▨	▨	▨	○	●	○
	Colwitz Late W. Steelhead 0+	0.200	▨	▨	▨	?	?	○	▨	▨	▨	○	●	○
	Cowlitz S. Steelhead	0.450	▨	▨	▨	?	?	○	▨	▨	▨	○	●	○
	Friends of the Cowlitz S. Steelhead 1+	0.100	▨	▨	▨	?	?	○	▨	▨	▨	○	●	○
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.010	▨	▨	▨	?	?	○	▨	▨	▨	○	●	○
	Cowlitz Sea-run Cutthroat 1+	0.150	▨	▨	▨	?	?	○	▨	▨	▨	○	●	○
Chum	Cowlitz Fall Chinook	5.000	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Coho 1+	3.200	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Coho Eggs	0.181	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sp. Chinook 1+	0.912	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sp. Chinook 0+	0.300	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Friends of the Cowlitz Sp. Chinook 1+	0.055	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Early W. Steelhead 1+	0.300	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Late W. Steelhead 1+	0.390	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Colwitz Late W. Steelhead 0+	0.200	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz S. Steelhead	0.450	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Friends of the Cowlitz S. Steelhead 1+	0.100	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.010	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sea-run Cutthroat 1+	0.150	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
Winter Steelhead	Cowlitz Fall Chinook	5.000	▨	▨	▨	○	?	○	▨	▨	▨	○	○	○
	Cowlitz Coho 1+	3.200	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Coho Eggs	0.181	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sp. Chinook 1+	0.912	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sp. Chinook 0+	0.300	▨	▨	▨	○	?	○	▨	▨	▨	○	○	○
	Friends of the Cowlitz Sp. Chinook 1+	0.055	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Early W. Steelhead 1+	0.300	○	○	?	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Late W. Steelhead 1+	0.390	○	?	?	?	?	○	○	?	○	○	○	○
	Colwitz Late W. Steelhead 0+	0.200	○	?	?	?	?	○	○	?	○	○	○	○
	Cowlitz S. Steelhead	0.450	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Friends of the Cowlitz S. Steelhead 1+	0.100	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.010	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sea-run Cutthroat 1+	0.150	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○

Table 7. Preliminary strategies proposed to address risks identified in the BRAP for Lower Cowlitz River Basin populations

	Hatchery Program		Risk Assessment of Hazards																
			Address Genetic Risks					Address Ecological Risks				Address Demographic Risks		Address Facility Risks			
Lower Cowlitz Population	**Name**	**Release (millions)**	**Mating Procedure**	**Integrated Program**	**Segregated Program**	**Research/ Monitoring**	**Broodstock Source**	**Number Released**	**Release Procedure**	**Disease Containment**	**Research/ Monitoring**	**Culture Procedure**	**Research/ Monitoring**	**Reliability**	**Improve Passage**	**Improve Screening**	**Pollution Abateme**
Fall Chinook	Cowlitz Fall Chinook	5.000		●		●							●				
	Cowlitz Coho 1+	3.200						●	●		●						
	Cowlitz Coho Eggs	0.181						●	●		●						
	Cowlitz Sp. Chinook 1+	0.912						●	●		●						
	Cowlitz Sp. Chinook 0+	0.300															
	Friends of the Cowlitz Sp. Ch. 1+	0.055						●	●		●						
	Cowlitz Early W. Steelhead 1+	0.300						●	●		●						
	Cowlitz Late W. Steelhead 1+	0.390						●	●		●						
	Cowlitz Late W. Steelhead 0+	0.200						●	●		●						
	Cowlitz S. Steelhead 1+	0.450						●	●		●						
	Friends of the Cowlitz S. Steelhead 1+	0.100						●	●		●						
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.010						●	●		●						
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.150						●	●		●						

Impact Assessment

The potential significance of negative hatchery impacts within the subbasin on natural populations was estimated with a simple index based on: 1) intra-specific effects resulting from depression in wild population productivity that can result from interbreeding with less fit hatchery fish and 2) inter-specific effects resulting from predation of juvenile salmonids of other species. The index reflects only a portion of net hatchery effects but can provide some sense of the magnitude of key hatchery risks relative to other limiting factors. Fitness effects are among the most significant intra-specific hatchery risks and can also be realistically quantified based on hatchery fraction in the natural spawning population and assumed fitness of the hatchery fish relative to the native wild population. Predation is among the most significant inter-specific effects and can be estimated from hatchery release numbers by species. This index assumed that equilibrium conditions have been reached for the hatchery fraction in the wild and for relative fitness of hatchery and wild fish. This simplifying assumption was necessary because more detailed information is lacking on how far the current situation is from equilibrium. The index does not consider the numerical benefits of hatchery spawners to natural population numbers, ecological interactions between hatchery and wild fish other than predation, or out-of-basin interactions, all of which are difficult to quantify. Appendix E contains a detailed description of the method and rationale behind this index.

The indexed potential for negative impacts of hatchery spawners on wild population fitness in the Lower Cowlitz Basin is high (ranging from 20% - 27%) for all species expect chum, for which there is no hatchery production. All hatchery produced species in the Cowlitz hatchery system are of domestic native local origin. The high incidence of fall Chinook and coho hatchery spawners suggests that the fitness of natural and hatchery fish is now probably quite similar and natural populations might decline substantially without continued hatchery subsidy under current habitat conditions. Interspecific impacts from predation are highest for fall Chinook (27%) and chum (10%). Interspecific impacts are 7% for coho and negligible for spring Chinook and winter steelhead.

Table 8. Presumed reductions in wild population fitness as a result of natural hatchery spawners and survival as a result of interactions with other hatchery species for lower Cowlitz salmon and steelhead populations.

Population	Annual releases[a]	Hatchery fraction[b]	Fitness category[c]	Assumed fitness[d]	Fitness impact[e]	Interacting releases[f]	Interspecies impact[g]
Fall Chinook	5,000,000	0.67	2	0.7	0.20	5,319,500	0.27
Spring Chinook	1,267,000[h]	0.90	2	0.7	0.27	--	--
Chum	0[i]	0	--	--	0	2,189,500	0.109
Coho	3,200,000[j]	0.85	2	0.7	0.26	5,319,500	0.07
Winter steelhead	652,500[k]	0.92	2	0.7	0.276	0	0

[a] Annual release goals.

[b] Proportion of natural spawners that are first generation hatchery fish.

[c] Broodstock category: 1 = derived from native local stock, 2 = domesticated stock of native local origin, 3 = originates from same ESU but substantial divergence may have occurred, 4 = out-of-ESU origin or origin uncertain

[d] Productivity of naturally-spawning hatchery fish relative to native wild fish prior to significant hatchery influence. Because population-specific fitness estimates are not available for most lower Columbia River populations, we applied hypothetical rates comparable to those reported in the literature and the nature of local hatchery program practices.

[e] Index based on hatchery fraction and assumed fitness.

[f] Number of other hatchery releases with a potential to prey on the species of interest. Includes steelhead and coho for fall Chinook and coho. Includes steelhead for chum.

[g] Predation impact based on interacting releases and assumed species-specific predation rates.

[h] 300,000 fingerling spring chinook from Cowlitz Trout Hatchery are released annually in an attempt to restore the upper Cowlitz population. An additional 967,000 yearlings are released in the lower Cowlitz from Cowlitz Salmon Hatchery.

[i] There are no records of hatchery chum releases in the basin.

[j] The Lower Cowlitz coho hatchery program is composed of late coho (type N). One goal of the late stock coho salmon hatchery program is to provide restocking of the upper Cowlitz basin. Reintroduction efforts have been challenged in passing juvenile production through the system.

[k] Includes 300,000 hatchery stock and 352,500 late winter stock. An additional 500,000 summer steelhead are released per year.

3.6.2 *Harvest*

Fishing generally affects salmon populations through directed and incidental harvest, catch and release mortality, and size, age, and run timing alterations because of uneven fishing on different run components. From a population biology perspective, this can result in fewer spawners and can alter age, size, run timing, fecundity, and genetic characteristics. Fewer spawners result in fewer eggs for future generations and diminish marine-derived nutrients delivered via dying adults, now known to be significant to the growth and survival of juvenile salmon in aquatic ecosystems. The degree to which harvest-related limiting factors influence productivity varies by species and location.

Most harvest of wild Columbia River salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. Fish are caught in the Canada/Alaska ocean, U.S. West Coast ocean, lower Columbia River commercial and recreational, tributary recreational, and in-river treaty Indian (including commercial, ceremonial, and subsistence) fisheries. Total exploitation rates have decreased for lower Columbia salmon and steelhead, especially since the 1970s as increasingly stringent protection measures were adopted for declining natural populations.

Current fishing impact rates on lower Columbia River naturally-spawning salmon populations ranges from 2.5% for chum salmon to 45% for tule fall Chinook (Table 1). These rates include estimates of direct harvest mortality as well as estimates of incidental mortality in catch and release fisheries. Fishery impact rates for hatchery produced coho and steelhead are higher than for naturally-spawning fish of the same species because of selective fishing regulations. These rates generally reflect recent year (2001-2003) fishery regulations and quotas controlled by weak stock impact limits and annual abundance of healthy targeted fish. Actual harvest rates will vary for each year dependent on annual stock status of multiple west coast salmon populations, however, these rates generally reflect expected impacts of harvest on lower Columbia naturally-spawning and hatchery salmon and steelhead under current harvest management plans.

Table 9. Approximate annual exploitation rates (% harvested) for naturally-spawning lower Columbia salmon and steelhead under current management controls (represents 2001-2003 fishing period).

	AK./Can. Ocean	West Coast Ocean	Col. R. Comm.	Col. R. Sport	Trib. Sport	**Wild Total**	Hatchery Total	Historic Highs
Fall Chinook (Tule)	15	15	5	5	5	**45**	45	80
Fall Chinook (Bright)	19	3	6	2	10	**40**	Na	65
Chum	0	0	1.5	0	1	**2.5**	2.5	60
Coho	<1	9	6	2	1	**18**	51	85
Steelhead	0	<1	3	0.5	5	**8.5**	70	75

Columbia River fall Chinook are subject to freshwater and ocean fisheries from Alaska to their rivers of origin in fisheries targeting abundant Chinook stocks originating from Alaska, Canada, Washington, Oregon, and California. Columbia tule fall Chinook harvest is constrained by a Recovery Exploitation Rate (RER) developed by NOAA Fisheries for management of Coweeman naturally-spawning fall Chinook. Some in-basin sport fisheries are closed to the retention of Chinook to protect naturally spawning populations. Harvest of lower Columbia bright fall Chinook is managed to achieve an escapement goal of 5,700 natural spawners in the North Fork Lewis.

Rates are very low for chum salmon, which are not encountered by ocean fisheries and return to freshwater in late fall when significant Columbia River commercial fisheries no longer occur. Chum are no longer targeted in Columbia commercial seasons and retention of chum is prohibited in Columbia River and lower Cowlitz River sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead.

Harvest of lower Cowlitz coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River as well as recreational fisheries in the Lower Cowlitz Basin. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish.

Steelhead, like chum, are not encountered by ocean fisheries and non-Indian commercial steelhead fisheries are prohibited in the Columbia River. Incidental mortality of steelhead occurs in freshwater commercial fisheries directed at Chinook and coho and freshwater sport fisheries directed at hatchery steelhead and salmon. All recreational fisheries are managed to selectively harvest fin-marked hatchery steelhead and commercial fisheries cannot retain hatchery or wild steelhead.

Access to harvestable surpluses of strong stocks in the Columbia River and ocean is regulated by impact limits on weak populations mixed with the strong. Weak stock management of Columbia River fisheries became increasingly prevalent in the 1960s and 1970s in response to continuing declines of upriver runs affected by mainstem dam construction. In the 1980s coordinated ocean and freshwater weak stock management commenced. More fishery restrictions followed ESA listings in the 1990s. Each fishery is controlled by a series of regulating factors. Many of the regulating factors that affect harvest impacts on Columbia River stocks are associated with treaties, laws, policies, or guidelines established for the management of other stocks or combined stocks, but indirectly control impacts of Columbia River fish as well. Listed fish generally comprise a small percentage of the total fish caught by any fishery. Every listed fish may correspond to tens, hundreds, or thousands of other stocks in the total catch. As a result of weak stock constraints, surpluses of hatchery and strong naturally-spawning runs often go unharvested. Small reductions in fishing rates on listed populations can translate to large reductions in catch of other stocks and recreational trips to communities which provide access to fishing, with significant economic consequences.

Selective fisheries for adipose fin-clipped hatchery coho (since 1999), and steelhead (since 1984) have substantially reduced fishing mortality rates for naturally-spawning populations and allowed concentration of fisheries on abundant hatchery fish. Selective fisheries occur in the Columbia River and tributaries for steelhead; and in the ocean, Columbia River, and tributaries for coho. Columbia River hatchery fall Chinook are not marked for selective fisheries, but likely will be in the future because of recent legislation enacted by Congress.

3.6.3 *Mainstem and Estuary Habitat*

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. Juvenile and adult salmon may be found in the mainstem and estuary at all times of the year, as different species, life history strategies and size classes continually rear or move through these waters. A variety of human activities in the mainstem and estuary have decreased both the quantity and quality of habitat used by juvenile salmonids. These include floodplain development; loss of side channel habitat, wetlands and marshes; and alteration of flows due to upstream hydro operations and irrigation withdrawals.

Effects on salmonids of habitat changes in the mainstem and estuary are complex and poorly understood. Effects are similar for lower Cowlitz populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook which rear for extended periods in the mainstem and estuary than for steelhead and coho which move through more quickly. Estimates of the impacts of human-caused changes in mainstem and estuary habitat conditions are available based on changes in river flow, temperature, and predation as represented by EDT analyses for the NPCC Multispecies Framework Approach (Marcot et al. 2002). These estimates generally translate into a 10-60% reduction in salmonid productivity depending on species (Appendix E). Estuary effects are described more fully in the estuary subbasin volume of this plan (Volume II-A).

3.6.4 *Hydropower Construction and Operation*

The three hydro-electric dams on the Cowlitz River are considered to be located in the upper Cowlitz basin. However, lower Cowlitz species, in particular fall Chinook have been reduced by loss of habitat in the reservoirs and are affected by flow regimes from Cowlitz River hydro operations which effect spawning and rearing habitat in the lower Cowlitz. In addition, mainstem Columbia hydro operations and flow regimes affect habitat utilized by lower Cowlitz species in migration corridors and in the estuary. The mainstem Columbia River and estuary provide important habitats for anadromous species during juvenile and adult migrations between spawning and rearing streams and the ocean where they grow and mature. These habitats are particularly important for fall Chinook and chum which rear extensively in the Columbia mainstem and estuary. Aquatic habitats have been fundamentally altered throughout the

Columbia River basin by the construction and operation of a complex of tributary and mainstem dams and reservoirs for power generation, navigation, and flood control.

The hydropower infrastructure and flow regulation affects adult migration, juvenile migration, mainstem spawning success, estuarine rearing, water temperature, water clarity, gas supersaturation, and predation. Dams block or impede passage of anadromous juveniles and adults. Columbia River spring flows are greatly reduced from historical levels as water is stored for power generation and irrigation, while summer and winter flows have increased. These flow changes affect juvenile and adult migration, and have radically altered habitat forming processes. Flow regulation and reservoir construction have increased average water temperature in the Columbia River mainstem and summer temperatures regularly exceed optimums for salmon. Supersaturation of water with atmospheric gases, primarily nitrogen, when water is spilled over high dams causes gas bubble disease. Predation by fish, bird, and marine mammals has been exacerbated by habitat changes. The net effect of these direct and indirect effects is difficult to quantify but is expected to be less significant for populations originating from lower Columbia River subbasins than for upriver salmonid populations. Additional information on hydropower effects can be found in the Regional Recovery and Subbasin Plan Volume I.

3.6.5 *Ecological Interactions*

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Salmon and steelhead are affected throughout their lifecycle by ecological interactions with non native species, food web components, and predators. Each of these factors can be exacerbated by human activities either by direct actions or indirect effects of habitat alternation. Effects of non-native species on salmon, effects of salmon on system productivity, and effects of native predators on salmon are difficult to quantify. Strong evidence exists in the scientific literature on the potential for significant interactions but effects are often context- or case-specific.

Predation is one interaction where effects can be estimated although interpretation can be complicated. In the lower Columbia River, northern pikeminnow, Caspian tern, and marine mammal predation on salmon has been estimated at approximately 5%, 10-30%, and 3-12%, respectively of total salmon numbers (see Appendix E for additional details). Predation has always been a source of salmon mortality but predation rates by some species have been exacerbated by human activities.

3.6.6 *Ocean Conditions*

Salmonid numbers and survival rates in the ocean vary with ocean conditions and low productivity periods increase extinction risks of populations stressed by human impacts. The ocean is subject to annual and longer-term climate cycles just as the land is subject to periodic droughts and floods. The El Niño weather pattern produces warm ocean temperatures and warm, dry conditions throughout the Pacific Northwest. The La Niña weather patterns is typified by cool ocean temperatures and cool/wet weather patterns on land. Recent history is dominated by a high frequency of warm dry years, along with some of the largest El Niños on record—particularly in 1982-83 and 1997-98. In contrast, the 1960s and early 1970s were dominated by a cool, wet regime. Many climatologists suspect that the conditions observed since 1998 may herald a return to the cool wet regime that prevailed during the 1960s and early 1970s.

Abrupt declines in salmon populations throughout the Pacific Northwest coincided with a regime shift to predominantly warm dry conditions from 1975 to 1998 (Beamish and Bouillon 1993, Hare et al 1999, McKinnell et al. 2001, Pyper et al. 2001). Warm dry regimes result in generally lower survival rates and abundance, and they also increase variability in survival and wide swings in salmon abundance. Some of the largest Columbia River fish runs in recorded history occurred during 1985–1987 and 2001–2002 after strong El Niño conditions in 1982–83 and 1997–98 were followed by several years of cool wet conditions.

The reduced productivity that accompanied an extended series of warm dry conditions after 1975 has, together with numerous anthropogenic impacts, brought many weak Pacific Northwest salmon stocks to the brink of extinction and precipitated widespread ESA listings. Salmon numbers naturally ebb and flow as ocean conditions vary. Healthy salmon populations are productive enough to withstand these natural fluctuations. Weak salmon populations may disappear or lose the genetic diversity needed to withstand the next cycle of low ocean productivity (Lawson 1993).

Recent improvements in ocean survival may portend a regime shift to generally more favorable conditions for salmon. The large spike in recent runs and a cool, wet climate would provide a respite for many salmon populations driven to critical low levels by recent conditions. The National Research Council (1996) concluded: *“Any favorable changes in ocean conditions—which could occur and could increase the productivity of some salmon populations for a time—should be regarded as opportunities for improving management techniques. They should not be regarded as reasons to abandon or reduce rehabilitation efforts, because conditions will change again”*. Additional details on the nature and effects of variable ocean conditions on salmonids can be found in the Regional Recovery and Subbasin Plan Volume I.

3.7 Summary of Human Impacts on Salmon and Steelhead

Stream habitat, estuary/mainstem habitat, harvest, hatchery and ecological interactions have all contributed to reductions in productivity, numbers, and population viability. Pie charts in Figure 21 describe the relative magnitude of potentially-manageable human impacts in each category of limiting factor for Lower Cowlitz Basin salmon and steelhead. Impact values were developed for a base period corresponding to species listing dates. This depiction is useful for identifying which factors are most significant for each species and where improvements might be expected to provide substantial benefits. Larger pie slices indicate greater significance and scope for improvement in an impact for a given species. These numbers also serve as a working hypothesis for factors limiting salmonid numbers and viability.

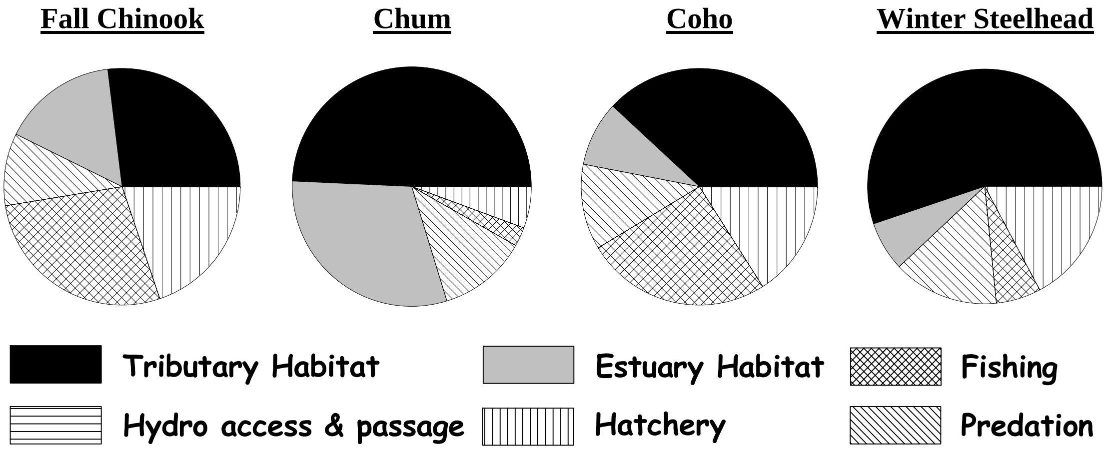


Figure 21. Relative contribution of potentially manageable impacts on lower Cowlitz salmonid populations.

This assessment indicates that current salmonid status is the result of large impacts distributed among several factors. No single factor accounts for a majority of effects on all species. Thus, substantial improvements in salmonid numbers and viability will require significant improvements in several factors. Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species except fall Chinook where fishing impacts dominate. Hatchery impacts are also relatively important for all species, except for chum which are limited to a greater degree by loss of estuary habitat quality and quantity. Harvest has a sizeable effect on fall Chinook and coho but is relatively minor for chum and winter steelhead. Loss of estuarine habitat quality and quantity are substantial for chum, moderate for fall Chinook, and relatively low for coho and winter steelhead. Predation impacts are moderate for all species. Hydrosystem access and passage impacts appear to be relatively minor for all species.

Impacts were defined as the proportional reduction in average numbers or productivity associated with each effect. Subbasin and estuary habitat impacts are the differences between the pre-development historical baseline and current conditions. Hydro impacts identify the percentage of historical habitat blocked by impassable dams and the mortality associated with juvenile and adult passage of other dams. Fishing impacts are the direct and indirect mortality in ocean and freshwater fisheries. Hatchery impacts include the equilibrium effects of reduced natural population productivity caused by natural spawning of less-fit hatchery fish and also effects of inter-specific predation by larger hatchery smolts on smaller wild juveniles. Hatchery impacts do not include other potentially negative indirect effects or potentially beneficial effects of augmentation of natural production. Predation includes mortality from northern pikeminnow, Caspian terns, and marine mammals in the Columbia River mainstem and estuary. Predation is not a direct human impact but was included because of widespread interest in its relative significance. Methods and data for these analyses are detailed in Appendix E.

Potentially-manageable human impacts were estimated for each factor based on the best available scientific information. Proportions are standardized to a total of 1.0 for plotting purposes. The index is intended to illustrate order-of-magnitude rather than fine-scale differences. Only the subset of factors we can potentially manage were included in this index – natural mortality factors beyond our control (e.g. naturally-occurring ocean mortality) are excluded. Not every factor of interest is included in this index – only readily-quantifiable impacts are included.

4.0 Key Programs and Projects

This section provides brief summaries of current federal, state, local, and non-governmental programs and projects pertinent to recovery, management, and mitigation measures and actions in this subbasin. These descriptions provide a context for descriptions of specific actions and responsibilities in the management plan portion of this subbasin plan. More detailed descriptions of these programs and projects can be found in the Comprehensive Program Directory (Appendix C).

4.1 Federal Programs

4.1.1 *NOAA Fisheries*

NOAA Fisheries is responsible for conserving, protecting and managing pacific salmon, ground fish, halibut, marine mammals and habitats under the Endangered Species Act, the Marine Mammal Protection Act, the Magnuson-Stevens Act, and enforcement authorities. NOAA administers the ESA under Section 4 (listing requirements), Section 7 (federal actions), and Section 10 (non-federal actions).

4.1.2 *US Army Corps of Engineers*

The U.S. Army Corps of Engineers (USACE) is the Federal government's largest water resources development and management agency. USACE programs applicable to Lower Columbia Fish & Wildlife include: 1) Section 1135 – provides for the modification of the structure or operation of a past USACE project, 2) Section 206 – authorizes the implementation of aquatic ecosystem restoration and protection projects, 3) Hydroelectric Program – applies to the construction and operation of power facilities and their environmental impact, 4) Regulatory Program – administration of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act.

4.1.3 *Environmental Protection Agency*

The Environmental Protection Agency (EPA) is responsible for the implementation of the Clean Water Act (CWA). The broad goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters so that they can support the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water. The CWA requires that water quality standards (WQS) be set for surface waters. WQS are aimed at translating the broad goals of the CWA into waterbody-specific objectives and apply only to the surface waters (rivers, lakes, estuaries, coastal waters, and wetlands) of the United States.

4.1.4 *Natural Resources Conservation Service*

Formerly the Soil Conservation Service, the USDA Natural Resources Conservation Service (NRCS) works with landowners to conserve natural resources on private lands. The NRCS accomplishes this through various programs including, but not limited to, the Conservation Technical Assistance Program, Soil Survey Program, Conservation Reserve Enhancement Program, and the Wetlands Reserve Program. The NRCS works closely with local Conservation Districts; providing technical assistance and support.

4.1.5 *Northwest Power and Conservation Council*

The Northwest Power and Conservation Council, an interstate compact of Idaho, Montana, Oregon, and Washington, has specific responsibility in the Northwest Power Act of 1980 to mitigate the effects of the hydropower system on fish and wildlife of the Columbia River

Basin. The Council does this through its Columbia River Basin Fish and Wildlife Program, which is funded by the Bonneville Power Administration. Beginning in Fiscal Year 2006, funding is guided by locally developed subbasin plans that are expected to be formally adopted in the Council's Fish and Wildlife Program in December 2004.

4.1.6 *Federal Energy Regulatory Commission*

Non-federal hydroelectric projects that meet certain criteria operate under licenses issued by the Federal Energy Regulatory Commission (FERC). A hydroelectric license prescribes operations and safety precautions, as well as environmental protection, mitigation and enhancements. The FERC relicensing process requires years of extensive planning, including environmental studies, agency consensus, and public involvement.

4.2 State Programs

4.2.1 *Washington Department of Natural Resources*

The Washington Department of Natural Resources governs forest practices on non-federal lands and is steward to state owned aquatic lands. Management of DNR public forest lands is governed by tenets of their proposed Habitat Conservation Plan (HCP). Management of private industrial forestlands is subject to Forest Practices regulations that include both protective and restorative measures.

4.2.2 *Washington Department of Fish & Wildlife*

WDFW's Habitat Division supports a variety of programs that address salmonids and other wildlife and resident fish species. These programs are organized around habitat conditions (Science Division, Priority Habitats and Species, and the Salmon and Steelhead Habitat Inventory and Assessment Program); habitat restoration (Landowner Incentive Program, Lead Entity Program, and the Conservation and Reinvestment Act Program, as well as technical assistance in the form of publications and technical resources); and habitat protection (Landowner Assistance, GMA, SEPA planning, Hydraulic Project Approval, and Joint Aquatic Resource Permit Applications).

4.2.3 *Washington Department of Ecology*

The Department of Ecology (DOE) oversees: the Water Resources program to manage water resources to meet current and future needs of the natural environment and Washington's communities; the Water Quality program to restore and protect Washington's water supplies by preventing and reducing pollution; and Shoreline and the Environmental Assistance program for implementing the Shorelines Management Act, the State Environmental Protection Act, the Watershed Planning Act, and 401 Certification of ACOE Permits.

4.2.4 *Washington Department of Transportation*

The Washington State Department of Transportation (WSDOT) must ensure compliance with environmental laws and statutes when designing and executing transportation projects. Programs that consider and mitigate for impacts to salmonid habitat include: the Fish Passage Barrier Removal program; the Regional Road Maintenance ESA Section 4d Program, the Integrated Vegetation Management & Roadside Development Program; Environmental Mitigation Program; the Stormwater Retrofit Program; and the Chronic Environmental Deficiency Program.

4.2.5 *Interagency Committee for Outdoor Recreation*

Created through the enactment of the Salmon Recovery Act (Washington State Legislature, 1999), the Salmon Recovery Funding Board provides grant funds to protect or restore salmon habitat and assist related activities with local watershed groups known as lead entities. SRFB has helped finance over 500 salmon recovery projects statewide. The Aquatic Lands Enhancement Account (ALEA) was established in 1984 and is used to provide grant support for the purchase, improvement, or protection of aquatic lands for public purposes, and for providing and improving access to such lands. The Washington Wildlife and Recreation Program (WWRP), established in 1990 and administered by the Interagency Committee for Outdoor Recreation, provides funding assistance for a broad range of land protection, park development, preservation/conservation, and outdoor recreation facilities.

4.2.6 *Lower Columbia Fish Recovery Board*

The Lower Columbia Fish Recovery Board encompasses five counties in the Lower Columbia River Region. The 15-member board has four main programs, including habitat protection and restoration activities, watershed planning for water quantity, quality, habitat, and instream flows, facilitating the development of an integrated recovery plan for the Washington portion of the lower Columbia Evolutionarily Significant Units, and conducting public outreach activities.

4.3 Local Government Programs

4.3.1 *Lewis County*

Lewis County is in the process of becoming compliant with the Growth Management Act in its Comprehensive Planning process. Lewis County manages lands through a Critical Areas Ordinance, Stormwater Management, and various other programs.

4.3.2 *Cowlitz County*

Cowlitz County updated its Comprehensive Plan to the minimum requirements of the Growth Management Act (GMA) by adding a Critical Areas Ordinance (CAO) in 1996, but it is not fully planning under the GMA. Cowlitz County manages natural resources primarily through its CAO.

4.3.3 *City of Longview*

The City's Comprehensive Plan was adopted in 1993 and is currently in the process of being updated. Natural resource impacts are managed primarily through critical areas protections, shorelines management, and stormwater management.

4.3.4 *City of Kelso*

The City of Kelso's Comprehensive Plan was adopted in 1980. Natural resource impacts are managed primarily through critical areas protections, shorelines management, and floodplain management.

4.3.5 *Cowlitz / Wahkiakum Conservation District*

The Cowlitz/Wahkiakum CD provides technical assistance, cost-share assistance, project and water quality monitoring, community involvement and education, and support of local stakeholder groups within the two county service area. The CD is involved in a variety of projects, including fish passage, landowner assistance an environmental incentive program an education program, and water quality monitoring.

4.3.6 *Lewis Conservation District*

The Lewis Conservation District provides technical assistance, cost-share assistance, and project monitoring in WRIA 26. The conservation district has developed projects in the Cowlitz Subbasin, including instream work and culvert replacement projects. Lewis CD works with agricultural landowners through CREP and farm planning activities and performs limited educational activities.

4.3.7 *Tacoma Public Utilities (Tacoma Power)*

Tacoma Power is a publicly owned division of Tacoma Public Utilities that operates Mayfield and Mossyrock Dams to provide electricity to the city of Tacoma and surrounding areas. Tacoma Power operates the facilities under a license agreement with the Federal Energy Regulatory Commission (FERC).

4.3.8 *Lewis County Public Utility District*

The Lewis County Public Utility District is a non-profit, customer-owned utility that provides electricity to Lewis County in southwest Washington. The Lewis County PUD and the BPA cooperatively developed the Cowlitz Falls Project. The PUD is owner of the Project, while the BPA has purchased the annual output of the Project under a long-term contract. In exchange for receiving the output of the Project, BPA pays all costs associated with its operation and maintenance. Lewis County PUD buys its power from BPA so the power generated by the Cowlitz Falls Project helps supply the needs of Lewis County residents and businesses.

4.4 Non-governmental Programs

4.4.1 *Columbia Land Trust*

The Columbia Land Trust is a private, non-profit organization founded in 1990 to work exclusively with willing landowners to find ways to conserve the scenic and natural values of the land and water. Landowners donate the development rights or full ownership of their land to the Land Trust. CLT manages the land under a stewardship plan and, if necessary, will legally defend its conservation values.

4.4.2 *Lower Columbia Fish Enhancement Group*

The Washington State Legislature created the Regional Fisheries Enhancement Group Program in 1990 to involve local communities, citizen volunteers, and landowners in the state's salmon recovery efforts. RFEGs help lead their communities in successful restoration, education and monitoring projects. Every group is a separate, nonprofit organization led by their own board of directors and operational funding from a portion of commercial and recreational fishing license fees administered by the WDFW, and other sources. The mission of the Lower Columbia RFEG (LCFEG) is to restore salmon runs in the lower Columbia River region through habitat restoration, education and outreach, and developing regional and local partnerships.

4.5 NPCC Fish & Wildlife Program Projects

There are no NPCC Fish & Wildlife Program Projects in the Lower Cowlitz Basin.

4.6 Washington Salmon Recovery Funding Board Projects

Type	Project Name	Subbasin
Restoration	Skook Creek Blockage	Lower Cowlitz
Restoration	Baxter Creek Culvert Replacement	Lower Cowlitz
Restoration	Lambert Creek Barrier Removal	Lower Cowlitz
Restoration	Curtis Creek Culvert Upgrade	Lower Cowlitz
Study	Monahan Creek Blockage	Lower Cowlitz

5.0 Management Plan

5.1 Vision

> ***Washington lower Columbia salmon, steelhead, and bull trout are recovered to healthy, harvestable levels that will sustain productive sport, commercial, and tribal fisheries through the restoration and protection of the ecosystems upon which they depend and the implementation of supportive hatchery and harvest practices.***
>
> ***The health of other native fish and wildlife species in the lower Columbia will be enhanced and sustained through the protection of the ecosystems upon which they depend, the control of non-native species, and the restoration of balanced predator/prey relationships.***

The Lower Cowlitz Subbasin will play a key role in the regional recovery of salmon and steelhead. Natural populations of fall Chinook, winter steelhead, chum, and coho will be restored by significant reductions in human impacts throughout the lifecycle. Salmonid recovery efforts will provide broad ecosystem benefits to a variety of subbasin fish and wildlife species. Recovery will be accomplished through a combination of improvements in subbasin, Columbia River mainstem, and estuary habitat conditions as well as careful management of hatcheries, fisheries, and ecological interactions among species.

Habitat protection or restoration will involve a wide range of Federal, State, Local, and non-governmental programs and projects. Success will depend on effective programs as well as a dedicated commitment to salmon recovery across a broad section of society.

Some hatchery programs will be realigned to focus on protection, conservation, and recovery of native fish. The need for hatchery measures will decrease as productive natural habitats are restored. Where consistent with recovery, other hatchery programs will continue to provide fish for fishery benefits for mitigation purposes in the interim until habitat conditions are restored to levels adequate to sustain healthy, harvestable natural populations.

Directed fishing on sensitive wild populations will be eliminated and incidental impacts of mixed stock fisheries in the Columbia River and ocean will be regulated and limited consistent with wild fish recovery needs. Until recovery is achieved, fishery opportunities will be focused on hatchery fish and harvestable surpluses of healthy wild stocks.

Columbia basin hydropower effects on Lower Cowlitz Subbasin salmonids will be addressed by mainstem Columbia and estuary habitat restoration measures. Hatchery facilities in the Lower Cowlitz River will also be called upon to produce fish to help mitigate for hydropower impacts on upriver stocks where compatible with wild fish recovery.

This plan uses a planning period or horizon of 25 years. The goal is to achieve recovery of the listed salmon species and the biological objectives for other fish and wildlife species of interest within this time period. It is recognized, however, that sufficient restoration of habitat conditions and watershed processes for all species of interest will likely take 75 years or more.

5.2 Biological Objectives

Biological objectives for Lower Cowlitz Subbasin salmonid populations are based on recovery criteria developed by scientists on the Willamette/Lower Columbia Technical Recovery Team convened by NOAA Fisheries. Criteria involve a hierarchy of ESU, Strata (i.e. ecosystem areas within the ESU – Coast, Cascade, Gorge), and Population standards. A recovery scenario describing population-scale biological objectives for all species in all three strata in the lower Columbia ESUs was developed through a collaborative process with stakeholders based on biological significance, expected progress as a result of existing programs, the absence of apparent impediments, and the existence of other management opportunities. Under the preferred alternative, individual populations will variously contribute to recovery according to habitat quality and the population's perceived capacity to rebuild. Criteria, objectives, and the regional recovery scenario are described in greater detail in the Regional Recovery and Subbasin Plan Volume I.

Focal populations in the Lower Cowlitz Subbasin are targeted to improve to a level that contributes to recovery of the species. The scenario differentiates the role of populations by designating primary, contributing, and stabilizing categories. *Primary populations* are those that would be restored to high or better probabilities of persistence. *Contributing populations* are those where low to medium improvements will be needed to achieve stratum-wide average of moderate persistence probability. *Stabilizing populations* are those maintained at current levels.

Recovery goals call for restoring coho to a high viability level, which provides for a 95% or better probability of population survival in 100 years., and calls for restoring fall chinook, winter steelhead, and chum to as medium viability level. This level will provide for a 74-95% probability of population survival over 100 years (Table 10). Cutthroat will benefit from improvements in stream habitat conditions for anadromous species. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and lower Cowlitz subbasin although specific spawning and rearing habitat requirements are not well known. Bull trout do not occur in the subbasin.

Table 10. Current viability status of lower Cowlitz populations and the biological objective status that is necessary to meet the recovery criteria for the Coastal strata and the lower Columbia ESU.

	ESA	Hatchery	Current		Objective	
Species	**Status**	**Component**	**Viability**	**Numbers**	**Viability**	**Numbers**
Fall Chinook	Threatened	Yes	Low+	1,000-13,000	Medium C	3,900-33,200
Chum	Threatened	No	Very Low	<150	Medium C	150-1,100
Coho	Candidate	Yes	Low	unknown	High P	600
Winter steelhead	Threatened	Yes	Low	unknown	Medium C	300

P = primary population in recovery scenario
C = contributing population in recovery scenario
S = stabilizing population in recovery scenario

5.3 Integrated Strategy

An Integrated Regional Strategy for recovery emphasizes that: 1) it is feasible to recover Washington lower Columbia natural salmon and steelhead to healthy and harvestable levels; 2) substantial improvements in salmon and steelhead numbers, productivity, distribution, and diversity will be required; 3) recovery cannot be achieved based solely on improvements in any one factor; 4) existing programs are insufficient to reach recovery goals, 5) all manageable effects on fish and habitat conditions must contribute to recovery, 6) actions needed for salmon recovery will have broader ecosystem benefits for all fish and wildlife species of interest, and 7) strategies and measures likely to contribute to recovery can be identified but estimates of the incremental improvements resulting from each specific action are highly uncertain. The strategy is described in greater detail in the Regional Recovery and Subbasin Plan Volume I.

The Integrated Strategy recognizes the importance of implementing measures and actions that address each limiting factor and risk category, prescribing improvements in each factor/threat category in proportion to its magnitude of contribution to salmon declines, identifying an appropriate balance of strategies and measures that address regional, upstream, and downstream threats, and focusing near term actions on species at-risk of extinction while also ensuring a long term balance with other species and the ecosystem.

Population productivity improvement increments identify proportional improvements in productivity needed to recover populations from current status to medium, high, and very high levels of population viability consistent with the recovery scenario. Productivity is defined as the inherent population replacement rate and is typically expressed by models as a median rate of population increase (PCC model) or a recruit per spawner rate (EDT model). Corresponding improvements in spawner numbers, juvenile outmigrants, population spatial structure, genetic and life history diversity, and habitat are implicit in productivity improvements.

Improvement targets were developed for each impact factor based on desired population productivity improvements and estimates of potentially manageable impacts (see Section 3.7). Impacts are estimates of the proportional reduction in population productivity associated with human-caused and other potentially manageable impacts from stream habitats, estuary/mainstem habitats, hydropower, harvest, hatcheries, and selected predators. Reduction targets were driven by the regional strategy of equitably allocating recovery responsibilities among the six manageable impact factors. Given the ultimate uncertainty in the effects of recovery actions and the need to implement an adaptive recovery program, this approximation should be adequate for developing order-of-magnitude estimates to which recovery actions can be scaled consistent with the current best available science and data. Objectives and targets will need to be confirmed or refined during plan implementation based on new information and refinements in methodology.

The following table identifies population and factor-specific improvements consistent with the biological objectives for this subbasin. Per factor increments are less than the population net because factor affects are compounded at different life stages and density dependence is largely limited to freshwater tributary habitat. For example, productivity of lower Cowlitz fall Chinook must increase by 20% to reach population viability goals which requires impact reductions equivalent to a 4% improvement in productivity or survival for each of six factor categories. Thus, tributary habitat impacts on fall Chinook must decrease from a 64% to a 63% impact in order to achieve the required 4% increase in tributary habitat potential from the current 36% historical potential to 37% of the historical potential.

Table 11. Productivity improvements consistent with biological objectives for the lower Cowlitz subbasin.

Species	Net increase	Per factor	Baseline impacts Trib.	Estuary	Hydro.	Pred.	Harvest	Hatch.
Fall Chinook	20%	4%	0.64	0.37	0.00	0.23	0.65	0.47
Chum	40%	2%	0.96	0.59	0.00	0.23	0.05	0.11
Winter Steelhead	10%	1%	0.89	0.11	0.00	0.24	0.10	0.28

5.4 Tributary Habitat

Habitat assessment results were synthesized in order to develop specific prioritized measures and actions that are believed to offer the greatest opportunity for species recovery in the subbasin. As a first step toward measure and action development, habitat assessment results were integrated to develop a multi-species view of 1) priority areas, 2) factors limiting recovery, and 3) contributing land-use threats. For the purpose of this assessment, limiting factors are defined as the biological and physical conditions serving to suppress salmonid population performance, whereas threats are the land-use activities contributing to those factors. Limiting Factors refer to local (reach-scale) conditions believed to be directly impacting fish. Threats, on the other hand, may be local or non-local. Non-local threats may impact instream limiting factors in a number of ways, including: 1) through their effects on habitat-forming processes – such as the case of forest road impacts on reach-scale fine sediment loads, 2) due to an impact in a contributing stream reach – such as riparian degradation reducing wood recruitment to a downstream reach, or 3) by blocking fish passage to an upstream reach.

Priority areas and limiting factors were determined through the technical assessment, including primarily EDT analysis and the Integrated Watershed Assessment (IWA). As described later in this section, priority areas are also determined by the relative importance of subbasin focal fish populations to regional recovery objectives. This information allows for scaling of subbasin recovery effort in order to best accomplish recovery at the regional scale. Land-use threats were determined from a variety of sources including Washington Conservation Commission Limiting Factors Analyses, the IWA, the State 303(d) list, air photo analysis, the Barrier Assessment, personal knowledge of investigators, or known cause-effect relationships between stream conditions and land-uses.

Priority areas, limiting factors and threats were used to develop a prioritized suite of habitat measures. Measures are based solely on biological and physical conditions. For each measure, the key programs that address the measure are identified and the sufficiency of existing programs to satisfy the measure is discussed. The measures, in conjunction with the program sufficiency considerations, were then used to identify specific actions necessary to fill gaps in measure implementation. Actions differ from measures in that they address program deficiencies as well as biophysical habitat conditions. The process for developing measures and actions is illustrated in Figure 22 and each component is presented in detail in the sections that follow.

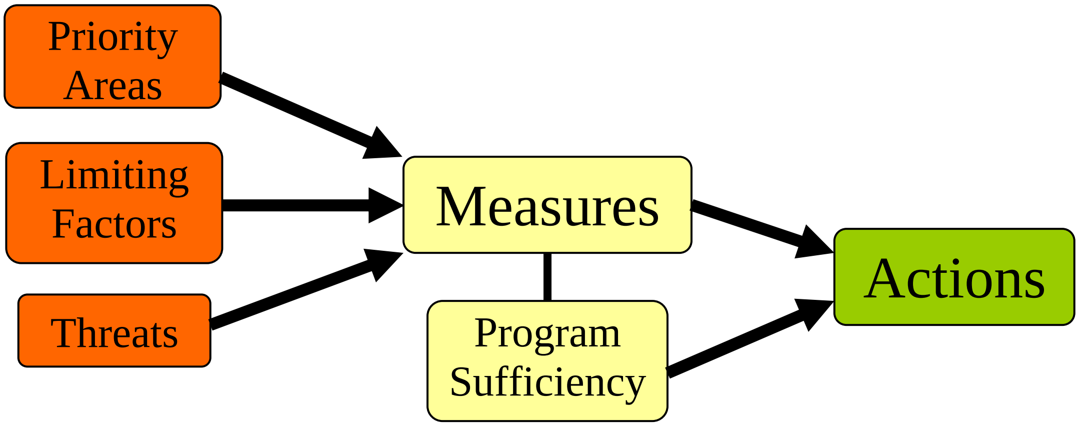


Figure 22. Flow chart illustrating the development of subbasin measures and actions.

5.4.1 *Priority Areas, Limiting Factors and Threats*

Priority habitat areas and factors in the subbasin are discussed below in two sections. The first section contains a generalized (coarse-scale) summary of conditions throughout the basin. The second section is a more detailed summary that presents specific reach and subwatershed priorities.

Summary

Decades of human activity in the Lower Cowlitz Basin have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Moreover, with the exception of fall Chinook, stream habitat conditions within the Lower Cowlitz Basin have a high impact on the health and viability of salmon and steelhead relative to other limiting factors. The following bullets provide a brief overview of each of the priority areas in the basin. These descriptions are a summary of the reach-scale priorities that are presented in the next section. These descriptions summarize the species most affected, the primary limiting factors, the contributing land-use threats, and the general type of measures that will be necessary for recovery. A tabular summary of the key limiting factors and land-use threats can be found in Table 12.

- **Lower mainstem & tributaries** *(reaches Lower Cowlitz 1-2; Salmon Cr 1-5; Delameter 1-2; Ostrander 1)* – The lower mainstem Cowlitz and lower tributaries (e.g. Ostrander Creek, Lower Salmon Creek, Delameter Creek) historically provided productive habitat for chum, coho, and fall Chinook. These habitats, especially the mainstem, have been heavily impacted by mixed use development. In addition to the influence of hydro-regulation from upstream dams, the primary impacts include channel manipulations, increased watershed imperviousness, and riparian degradation. Effective recovery measures will include riparian and floodplain restoration and land-use planning that protects and restores habitat and habitat-forming processes.
- **Middle mainstem & Mill Creek** *(reaches Mid Cowlitz 5B-6; Mill Creek)* – Reaches with the greatest historical productivity in the middle mainstem are located between Skook Creek and Mayfield Dam. These reaches supported chum, fall Chinook, coho, and winter steelhead. Mill Creek was historically productive for coho and winter steelhead. These reaches have high preservation as well as restoration value. One of the most

effective recovery measures will be to preserve the canyon reaches downstream of the dam. In other areas, emphasis should be placed on restoration and preservation of riparian areas and floodplains. This mixed use area will also benefit from land-use planning that protects and restores habitat and habitat-forming processes.

- **Olequa Creek & tributaries** *(reaches Olequa 1-7; Stillwater 1-5)* – The Olequa Creek basin contains potentially productive habitat for coho and winter steelhead. Key reaches include the mainstem Olequa and Stillwater Creek. These reaches are impacted primarily by urban and rural development and agriculture. Recovery emphasis is for restoration of riparian areas, floodplains, and commercial forest lands. As with other rapidly developing portions of the lower Cowlitz basin, this areas will benefit from land-use planning that protects and restores habitat and habitat-forming processes.
- **Lacamas Creek** *(reaches Lacamas 1-2, 4-7)* – Lacamas Creek contains potentially productive habitats for coho, although winter steelhead also utilize these reaches. Lacamas Creek is impacted primarily by agriculture and rural development. The most effective recovery measures are consistent with those identified above for Olequa Creek.
- **Salmon Creek & tributaries** *(reaches upper Salmon Creek 1-3; Cedar Creek)* – Salmon Creek contains productive habitat for coho and winter steelhead. Salmon Creek is impacted by agriculture along the first few reaches and by forest practices throughout the remainder of the basin. Riparian and floodplain restoration should be the emphasis along the first few reaches while restoration and preservation of watershed processes should be the emphasis on forest lands

Table 12. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem and tributaries (LM), middle mainstem and Mill Creek (MM), Olequa Creek and tributaries (OC), Lacamas Creek (LC), and Salmon Creek (upper) and tributaries (SC). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	LM	MM	OC	LC	SC
Habitat connectivity					
Blockages to off-channel habitats	✓	✓	✓		
Blockages to channel habitats	✓	✓			✓
Habitat diversity					
Lack of stable instream woody debris	✓	✓	✓	✓	✓
Altered habitat unit composition	✓	✓	✓	✓	✓
Loss of off-channels/side-channels	✓	✓	✓		
Channel stability					
Bed and bank erosion	✓			✓	
Channel down-cutting (incision)	✓				
Riparian function					
Reduced stream canopy cover	✓		✓		✓
Reduced bank/soil stability	✓	✓	✓	✓	✓
Exotic and/or noxious species	✓	✓	✓	✓	✓
Reduced wood recruitment	✓	✓	✓	✓	✓
Floodplain function					
Altered nutrient exchange processes	✓	✓	✓	✓	✓
Reduced flood flow dampening	✓	✓	✓	✓	✓
Restricted channel migration	✓	✓	✓	✓	✓
Disrupted hyporheic processes	✓	✓	✓	✓	✓
Stream flow					
Altered magnitude, duration, rate of chg	✓	✓	✓	✓	✓
Alterations to temporal pattern of flow	✓	✓			
Water quality					
Altered stream temperature regime	✓		✓		✓
Bacteria	✓				
Chemical contaminants			✓		
Substrate and sediment					
Lack of adequate spawning substrate	✓				
Excessive fine sediment	✓	✓	✓		✓
Embedded substrates	✓	✓	✓		✓
Disrupted sediment transport (hydro)	✓	✓			

Threats	LM	MM	OC	LC	SC
Hydropower operations					
Flow manipulations	✓	✓			
Alterations to stream temperature regime	✓	✓			
Changes to sediment transport dynamics	✓	✓			
Agriculture grazing					
Clearing of vegetation	✓	✓		✓	✓
Riparian grazing	✓	✓		✓	✓
Floodplain filling	✓	✓		✓	✓
Application of chemicals			✓		
Urban/rural/suburban development					
Clearing of vegetation	✓	✓	✓		
Floodplain filling	✓	✓	✓		
Increased impervious surfaces	✓	✓	✓		
Increased drainage network	✓	✓	✓		
Roads – riparian/floodplain impacts	✓	✓	✓		
Leaking septic systems	✓				
Forest practices					
Timber harvest –sediment supply impacts			✓		✓
Timber harvests – impacts to runoff			✓	✓	✓
Riparian harvests (historical)					✓
Forest roads – sediment supply impacts			✓		✓
Forest roads – impacts to runoff			✓	✓	✓
Channel manipulations					
Bank hardening	✓	✓	✓	✓	✓
Channel straightening	✓	✓	✓	✓	✓
Artificial confinement	✓	✓	✓	✓	✓
Clearing and snagging	✓	✓			
Dredge and fill activities	✓				

Specific Reach and Subwatershed Priorities

Specific reaches and subwatersheds have been prioritized based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Reaches have been placed into Tiers (1-4), with Tier 1 reaches representing the areas where recovery measures would yield the greatest benefits towards accomplishing the biological objectives. The reach tiering factors in each fish population's importance relative to regional recovery objectives, as well as the relative importance of reaches within the populations themselves. Reach tiers are most useful for identifying habitat recovery measures in channels, floodplains, and riparian areas. Reach-scale priorities were initially identified within individual populations (species) through the EDT Restoration and Preservation Analysis. This resulted in reaches grouped into categories of high, medium, and low priority for each population (see Stream Habitat Limitations section). Within a subbasin, reach rankings for all of the modeled populations were combined, using population designations as a weighting factor. Population designations for this subbasin are described in the Biological Objectives section. The population designations are 'primary', 'contributing', and 'stabilizing'; reflecting the level of emphasis that needs to be placed on population recovery in order to meet ESA recovery criteria.

Spatial priorities were also identified at the subwatershed scale. Subwatershed-scale priorities were directly determined by reach-scale priorities, such that a Group A subwatershed contains one or more Tier 1 reaches. Scaling up from reaches to the subwatershed level was done in recognition that actions to protect and restore critical reaches might need to occur in adjacent and/or upstream upland areas. For example, high sediment loads in a Tier 1 reach may originate in an upstream contributing subwatershed where sediment supply conditions are impaired because of current land use practices. Subwatershed-scale priorities can be used in conjunction with the IWA to identify watershed process restoration and preservation opportunities. The specific rules for designating reach tiers and subwatershed groups are presented in Table 13. Reach tier designations for this basin are included in Table 14. Reach tiers and subwatershed groups are displayed on a map in Figure 23. A summary of reach- and-subwatershed-scale limiting factors is included in Table 15.

Table 13. Rules for designating reach tier and subwatershed group priorities. See Biological Objectives section for information on population designations.

Designation	Rule
Reaches	
Tier 1:	All high priority reaches (based on EDT) for one or more primary populations.
Tier 2:	All reaches not included in Tier 1 and which are medium priority reaches for one or more primary species and/or all high priority reaches for one or more contributing populations.
Tier 3:	All reaches not included in Tiers 1 and 2 and which are medium priority reaches for contributing populations and/or high priority reaches for stabilizing populations.
Tier 4:	Reaches not included in Tiers 1, 2, and 3 and which are medium priority reaches for stabilizing populations and/or low priority reaches for all populations.
Subwatersheds	
Group A:	Includes one or more Tier 1 reaches.
Group B:	Includes one or more Tier 2 reaches, but no Tier 1 reaches.
Group C:	Includes one or more Tier 3 reaches, but no Tier 1 or 2 reaches.
Group D:	Includes only Tier 4 reaches.

Table 14. Reach Tiers in the lower Cowlitz Basin.

Tier 1	Tier 2	Tier 3	Tier 4	
Arkansas Cr 1	Arkansas Cr 4	Lacamas Cr 3	Arkansas Cr 2	LB tribB (26.0215)
Borrow pit	Campbell Cr 1	Leckler Cr	Arkansas Cr 3	LB tribC (right fork) (26.0427)
Campbell Pond	Campbell Cr 2	MID COWLITZ-1	Baker Cr	LB tribD (26.0462)
Cedar Cr	Delameter Cr 1	MID COWLITZ-5A	Baxter Cr	Little Salmon Cr
Hill Cr	Delameter Cr 2		Bear Cr	Masonry Dam
Lacamas Cr 1	Jones Cr		Becker Cr	Mill Cr (Lacamas Trib)
Lacamas Cr 2	King Cr 1		Blue Cr	Monahan Cr
Lacamas Cr 7	Lacamas Cr 4		Brights Cr	Olequa Cr 8 (center fork)
Lake 2	Lacamas Cr 5		Brim Cr	Ostrander Cr 2
Lower Cowlitz-1	Lacamas Cr 6		Campbell Cr 3	Ostrander Cr 3
MID COWLITZ-5B	Lake 1		Coon Cr	Otter Cr
Olequa Cr 1	LB tribA (No number)		Curtis Cr	RB trib A (left fork) (26.0427)
Olequa Cr 2	Lower Cowlitz-2		Delameter Cr 3	RB trib Ostrander (No number)
Olequa Cr 3	MID COWLITZ-2		Delameter Cr 4	Rb trib1 (26.0123)
Olequa Cr 4	MID COWLITZ-3		Ferrier Cr	RB trib2 (26.0163)
Olequa Cr 5	MID COWLITZ-4		Foster Cr	RB tribB (26.0440)
Olequa Cr 6	MID COWLITZ-6		King Cr 2	Skook Cr
Olequa Cr 7	MID COWLITZ-7		LB trib1 (26.0127)	Snow Cr
Ostrander Cr 1	Mill Cr		LB trib2 (26.0129)	Stillwater Cr 6
Owens Cr	Rock Cr		LB trib3 (26.0186)	Tucker Cr
Pond 1	Salmon Cr 1		LB trib4 (No number)	Whittle Cr 1
Pond 2	Salmon Cr 2 (Upper)			Whittle Cr2
Salmon Cr 1 (Upper)	Salmon Cr 3 (Upper)			
Salmon Cr 2	Salmon Cr 5			
Salmon Cr 3	Stillwater Cr 2			
Salmon Cr 4				
Stillwater Cr 1				
Stillwater Cr 3				
Stillwater Cr 4				
Stillwater Cr 5				
Whittle Lake				

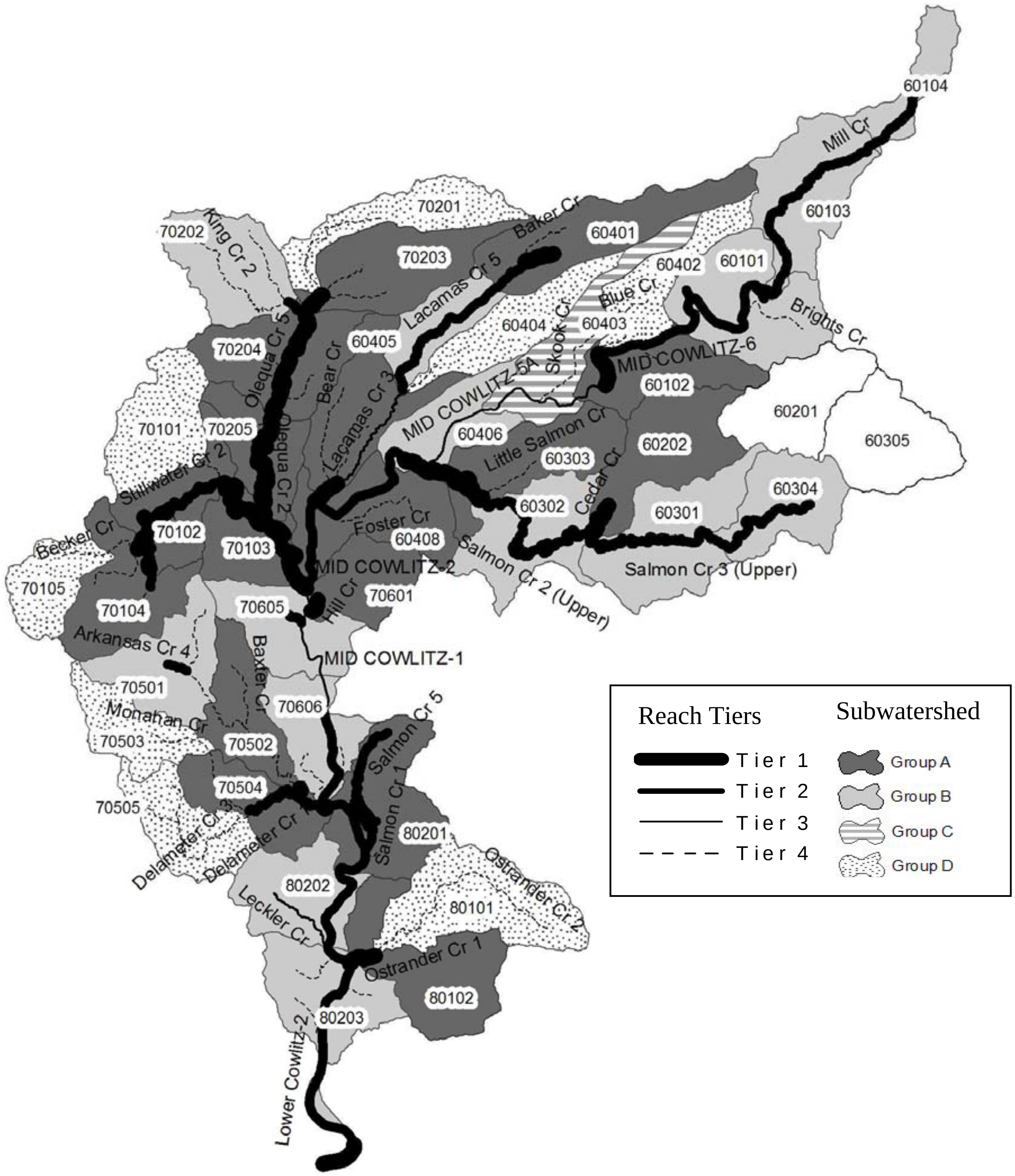


Figure 23. Reach tiers and subwatershed groups in the Lower Cowlitz Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach scale are useful for identifying stream corridor recovery measures. Priorities at the subwatershed scale are useful for identifying watershed process recovery measures. Watershed process recovery measures for stream reaches will need to occur within the surrounding (local) subwatershed as well as in upstream contributing subwatersheds.

Table 15. Reach- and subwatershed-scale limiting factors in priority areas. The table is organized by subwatershed groups, beginning with the highest priority group. Species-specific reach priorities, critical life stages, high impact habitat factors, and recovery emphasis (P=preservation, R=restoration, PR=restoration and preservation) are included. Watershed process impairments: F=functional, M=moderately impaired, I=impaired. Species abbreviations: ChS=spring Chinook, ChF=fall Chinook, StS=summer steelhead, StW=winter steelhead.

								Watershed processes (local)			Watershed processes (watershed)	
Sub-watershed Group	Sub-watershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors	Preservation or restoration emphasis	Hydrology	Sediment	Riparian	Hydrology	Sediment
A	80407	Lower Cowlitz-1	Chum	Lower Cowlitz-1	Spawning Egg incubation Fry colonization Adult migrant Adult holding	habitat diversity key habitat quantity	R	I	M	I	I	M
			Coho	none								
			ChF	none								
			StW	none								
	80201	Salmon Cr 2 Pond 1 Pond 2 Salmon Cr 3 Salmon Cr 4 Borrow pit Salmon Cr 1 LB tribA (No number) Salmon Cr 5 LB trib3 (26.0186)	Chum	Salmon Cr 2	Spawning Egg incubation Fry colonization Adult migrant Adult holding	habitat diversity	R	I	M	H	I	M
			Coho	Salmon Cr 2 Pond 1 Pond 2 Salmon Cr 3 Salmon Cr 4 Borrow pit	Spawning Egg incubation Summer rearing Winter rearing	habitat diversity temperature sediment	R					
			StW	none								
	80102	Ostrander Cr 1	Chum	none				I	M	M	I	M
			Coho	Ostrander Cr 1	Egg incubation Juvenile migrant	sediment	R					
			StW	none								
	70601	Hill Cr	Coho	Hill Cr	Spawning Egg incubation Fry colonization Summer rearing Winter rearing	none	PR	I	M	M	I	M
			StW	none								
	70504	Arkansas Cr 1 Delameter Cr 1 Delameter Cr 2 Lake 1 Monahan Cr	Chum	none				I	M	H	I	M
			Coho	Arkansas Cr 1	Egg incubation Fry colonization Summer rearing	channel stability habitat diversity temperature sediment key habitat quantity	R					
			StW	none								
	70502	Lake 2 Arkansas Cr 2 Arkansas Cr 3 Baxter Cr	Coho	Lake 2	Egg incubation Summer rearing Winter rearing	channel stability habitat diversity key habitat quantity	R	I	M	H	I	M
			StW	none								
	70205	Olequa Cr 2 Olequa Cr 3 Snow Cr Olequa Cr 3 Olequa Cr 4 Olequa Cr 5 King Cr 1 Ferrier Cr Curtis Cr	Coho	Olequa Cr 2 Olequa Cr 3	Egg incubation Fry colonization Summer rearing Winter rearing	habitat diversity	R	I	M	H	I	M
			StW	Olequa Cr 2 Olequa Cr 3	Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	habitat diversity temperature	R					
	70204		Coho	Olequa Cr 3 Olequa Cr 4 Olequa Cr 5	Egg incubation Fry colonization Summer rearing Juvenile migrant (age 0) Winter rearing Juvenile migrant (age 1)	habitat diversity key habitat quantity	R	I	M	H	I	M
			StW	Olequa Cr 3 Olequa Cr 4	Egg incubation Fry colonization Summer rearing Juvenile migrant (age 0) Winter rearing Juvenile migrant (age 1)	habitat diversity	R					
	70203	Olequa Cr 5 Olequa Cr 6 Olequa Cr 7 LB tribC (right fork) (26.0427) Olequa Cr 8 (center fork)	Coho	Olequa Cr 5 Olequa Cr 6 Olequa Cr 7	Egg incubation Fry colonization Summer rearing Juvenile migrant (age 0) Winter rearing Juvenile migrant (age 1)	channel stability habitat diversity temperature sediment key habitat quantity	R	I	M	H	I	M
			StW	Olequa Cr 5 Olequa Cr 6 Olequa Cr 7	Spawning Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	habitat diversity	PR					

Sub-watershed Group	Sub-watershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors	Preservation or restoration emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
A	70104	Stillwater Cr 5 Campbell Cr 2 Becker Cr Campbell Cr 3 Masonry Dam Stillwater Cr 6	Coho	Stillwater Cr 5	Egg incubation Fry colonization Summer rearing Winter rearing	none	H	I	M	M	I	M
			StW	Stillwater Cr 5	Egg incubation Fry colonization Summer rearing	temperature sediment	PR					
	70103	Olequa Cr 1 Stillwater Cr 1	Chum	Olequa Cr 1	Spawning Egg incubation Fry colonization Adult holding	none	PR	I	M	M	I	M
			Coho	Olequa Cr 1 Stillwater Cr 1	Egg incubation Summer rearing Winter rearing	habitat diversity	R					
			StW	none								
	70102	Stillwater Cr 5 Stillwater Cr 1 Stillwater Cr 3 Stillwater Cr 4 Campbell Pond Owens Cr Stillwater Cr 2 Campbell Cr 1 Campbell Cr 2 Brim Cr RB tribB (26.0440)	Coho	Stillwater Cr 5 Stillwater Cr 1 Stillwater Cr 3 Stillwater Cr 4 Campbell Pond Owens Cr	Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	channel stability habitat diversity temperature sediment key habitat quantity	PR	I	M	H	I	M
			StW	Stillwater Cr 5	Egg incubation Fry colonization Summer rearing	temperature sediment	PR					
	60408	Lacamas Cr 1 MID COWLITZ-4 MID COWLITZ-2 MID COWLITZ-3 Foster Cr	Chum	Lacamas Cr 1	Egg incubation Fry colonization Adult holding	habitat diversity	PR	I	M	H	I	M
			Coho	Lacamas Cr 1	Egg incubation Fry colonization Summer rearing	none	R					
			ChF	MID COWLITZ-4 MID COWLITZ-3	Egg incubation Fry colonization Adult holding	sediment	P					
			StW	none								
	60406	Lacamas Cr 1 Lacamas Cr 2 Lacamas Cr 3 Bear Cr Coon Cr	Chum	Lacamas Cr 1	Spawning Egg incubation Fry colonization Adult holding	habitat diversity	PR	I	M	M	I	F
			Coho	Lacamas Cr 1 Lacamas Cr 2	Egg incubation Fry colonization Summer rearing Winter rearing	channel stability habitat diversity sediment	R					
			StW	none								
	60401	Lacamas Cr 7 Lacamas Cr 6 Baker Cr	Coho	Lacamas Cr 7	Egg incubation Fry colonization Summer rearing Winter rearing	none	PR	I	F	H	I	F
			StW	none								
	60303	Salmon Cr 1 (Upper) Little Salmon Cr	Chum	Salmon Cr 1 (Upper)	Spawning Egg incubation Fry colonization Adult holding	none	PR	I	F	H	I	M
			Coho	Salmon Cr 1 (Upper)	Egg incubation Fry colonization Summer rearing Winter rearing	habitat diversity	R					
			StW	none								
	60202	Cedar Cr	Coho	Cedar Cr	Spawning Egg incubation Fry colonization Summer rearing Juvenile migrant (age 0) Winter rearing	none	R	I	M	M	I	M
			StW	none								
	60102	MID COWLITZ-6 MID COWLITZ-5B MID COWLITZ-5A Otter Cr	Chum	MID COWLITZ-6	Spawning Egg incubation Fry colonization Adult holding	none	P	I	M	M	M	M
			Coho	MID COWLITZ-5B	Egg incubation Summer rearing Winter rearing	habitat diversity key habitat quantity	R					
			ChF	none								
			StW	MID COWLITZ-6	Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	habitat diversity pathogens	R					

Sub-watershed Group	Sub-watershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors	Preservation or restoration emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
B	60101	MID COWLITZ-7 MID COWLITZ-6 Jones Cr Brights Cr	Chum	MID COWLITZ-6 MID COWLITZ-7	Spawning Egg incubation Fry colonization Adult holding	habitat diversity	PR	I	M	M	M	M
			Coho	none								
			ChF	none								
			StW	MID COWLITZ-6 MID COWLITZ-7	Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	habitat diversity pathogens	R					
	70605	Rock Cr MID COWLITZ-1	All	none				I	M	M	I	M
	70606	Whittle Lake Lower Cowlitz-2 Whittle Cr 1 Whittle Cr2 LB trib4 (No number)	Chum	none				I	I	H	I	M
			Coho	Whittle Lake	Egg incubation Summer rearing Winter rearing	none	PR					
			ChF	none								
			StW	none								
	70501	Arkansas Cr 4 Arkansas Cr 3 LB tribB (26.0215)	Coho	none				I	M	M	I	M
			StW	none								
	70202	King Cr 1 King Cr 2 LB tribD (26.0462)	Coho	none				I	M	M	I	M
			StW	none								
	60407	MID COWLITZ-4 MID COWLITZ-5A	Chum	none				I	M	H	I	M
			Coho	none								
			ChF	MID COWLITZ-4	Egg incubation Fry colonization Adult holding	none	P					
			StW	none								
	60405	Lacamas Cr 4 Lacamas Cr 5	Coho	none				I	M	M	I	F
			StW	none								
	60304	Salmon Cr 3 (Upper)	Coho	none				I	M	M	I	M
			StW	none								
	60302	Salmon Cr 2 (Upper)	Chum	none				I	M	M	I	M
			Coho	none								
			StW	Salmon Cr 2 (Upper)	Spawning Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	habitat diversity	R					
	60301	Salmon Cr 3 (Upper)	Coho	none				I	M	M	I	M
			StW	none								
	60104	Mill Cr	Coho	none				I	M	M	I	M
			StW	none								
	60103	Mill Cr	Coho	none				I	M	M	I	M
			StW	none								
	80203	LB trib1 (26.0127) LB trib2 (26.0129) Rb trib1 (26.0123) RB trib2 (26.0163)	Coho	none				I	I	H	I	M
			StW	none								
	80202	Leckler Cr	Coho	none				I	M	H	I	M
			StW	none								
C	70506	MID COWLITZ-1	All	none				I	M	M	I	M
	60403	MID COWLITZ-5A Skook Cr	All	none				I	F	M	M	M
D	80101	Ostrander Cr 2 Ostrander Cr 3 RB trib Ostrander (No number)	Coho	none				I	M	M	I	M
			StW	none								
	70505	Delameter Cr 3 Delameter Cr 4 Tucker Cr	Coho	none				I	M	M	I	M
			StW	none								
	70503	Monahan Cr	Coho	none				I	I	M	I	I
			StW	none								
	70201	RB trib A (left fork) (26.0427)	Coho	none				I	M	H	I	M
			StW	none								
	70105	Stillwater Cr 6	Coho	none				I	M	M	I	M
			StW	none								
	70101	Brim Cr	Coho	none				I	M	M	I	M
			StW	none								
	60404	Mill Cr (Lacamas Trib)	Coho	none				M	F	H	M	F
	60402	Blue Cr	Coho	none				I	M	M	I	M
			StW	none								

5.4.2 *Habitat Measures*

Measures are means to achieve the regional strategies that are applicable to the Lower Cowlitz Basin and are necessary to accomplish the biological objectives for focal fish species. Measures are based on the technical assessments for this subbasin (Section 3.0) as well as on the synthesis of priority areas, limiting factors, and threats presented earlier in this section. The measures applicable to the Lower Cowlitz Basin are presented in priority order in Table 16. Each measure has a set of submeasures that define the measure in greater detail and add specificity to the particular circumstances occurring within the subbasin. The table for each measure and associated submeasures indicates the limiting factors that are addressed, the contributing threats that are addressed, the species that would be most affected, and a short discussion. Priority locations are given for some measures. Priority locations typically refer to either stream reaches or subwatersheds, depending on the measure. Addressing measures in the highest priority areas first will provide the greatest opportunity for effectively accomplishing the biological objectives.

Following the list of priority locations is a list of the programs that are the most relevant to the measure. Each program is qualitatively evaluated as to whether it is sufficient or needs expansion with respect to the measure. This exercise provides an indication of how effectively the measure is already covered by existing programs, policy, or projects; and therefore indicates where there is a gap in measure implementation. This information is summarized in a discussion of Program Sufficiency and Gaps.

The measures themselves are prioritized based on the results of the technical assessment and in consideration of principles of ecosystem restoration (e.g. NRC 1992, Roni et al. 2002). These principles include the hypothesis that the most efficient way to achieve ecosystem recovery in the face of uncertainty is to focus on the following prioritized approaches: 1) protect existing functional habitats and the processes that sustain them, 2) allow no further degradation of habitat or supporting processes. 3) re-connect isolated habitat, 4) restore watershed processes (ecosystem function), 5) restore habitat structure, and 6) create new habitat where it is not recoverable. These priorities have been adjusted for the specific circumstances occurring in the Lower Cowlitz Basin. These priorities are adjusted depending upon the results of the technical assessment and on the specific circumstances occurring in the basin. For example, re-connecting isolated habitat could be adjusted to a lower priority if there is little impact to the population created from passage barriers.

5.4.3 *Habitat Actions*

The prioritized measures and associated gaps are used to develop specific Actions for the subbasin. These are presented in Table 17. Actions are different than the measures in a number of ways: 1) actions have a greater degree of specificity than measures, 2) actions consider existing programs and are therefore not based strictly on biophysical conditions, 3) actions refer to the agency or entity that would be responsible for carrying out the action, and 4) actions are related to an expected outcome with respect to the biological objectives. Actions are not presented in priority order but instead represent the suite of activities that are all necessary for recovery of listed species. The priority for implementation of these actions will consider the priority of the measures they relate to, the “size” of the gap they are intended to fill, and feasibility considerations.

Table 16. Prioritized measures for the Lower Cowlitz Basin.

#1 – Protect stream corridor structure and function

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect floodplain function and channel migration processes B. Protect riparian function C. Protect access to habitats D. Protect instream flows through management of water withdrawals E. Protect channel structure and stability F. Protect water quality G. Protect the natural stream flow regime	Potentially addresses many limiting factors	Potentially addresses many limiting factors	All Species	The mainstem Cowlitz below Mayfield Dam has been heavily altered due to adjacent land uses including agriculture, rural residential development, transportation corridors, urbanization, and industry. The river is heavily channelized in many areas. The lower river (below the Toutle confluence) was heavily impacted by sediment and subsequent channel dredging and confinement related to the 1980 Mount St. Helens eruption. The flow regime of the lower river has been altered through hydro-regulation. Many lower river tributary streams have been altered by agriculture, rural residential development, and past riparian timber harvest. Preventing further degradation of stream channel structure, riparian function, and floodplain function will be an important component of recovery.

Priority Locations

1st- Tier 1 or 2 reaches in mixed-use lands at risk of further degradation
Reaches: Lower Cowlitz 1-2; Salmon Cr 1-5; Delameter Cr 1-2; Ostrander Cr 1; Mid Cowlitz 2-4, 5B-7; Mill Cr; Olequa 1-7; Stillwater 1-5; Lacamas 1-2, 4-7; Salmon Cr (upper) 1-3; Salmon Cr (lower) 1-5; Cedar Cr
2nd- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NOAA Fisheries	ESA Section 7 and Section 10	✓	
US Army Corps of Engineers (USACE)	Dredge & fill permitting (Clean Water Act sect. 404); Navigable waterways protection (Rivers & Harbors Act Sect, 10)	✓	
WA Department of Natural Resources (WDNR)	State Lands HCP, Forest Practices Rules, Riparian Easement Program, Aquatic Lands Authorization	✓	
WA Department of Fish and Wildlife (WDFW)	Hydraulics Projects Approval	✓	
Lewis County	Comprehensive Planning		✓
Cowlitz County	Comprehensive Planning		✓
City of Longview	Comprehensive Planning		✓
City of Castle Rock	Comprehensive Planning, Water Supply		✓
City of Winlock	Comprehensive Planning, Water Supply		✓

Vader	Comprehensive Planning	✓
Cowlitz/Wahkiakum Conservation District	Agricultural land habitat protection, Education	✓
Lewis County Conservation District & NRCS	Agricultural land habitat protection, Education	✓
Lewis County Noxious Weed Control Board	Noxious Weed Education, Enforcement, Control	✓
Cowlitz County Noxious Weed Control Board	Noxious Weed Education, Enforcement, Control	✓
Non-Governmental Organizations (NGOs) (e.g. Columbia Land Trust) and public agencies	Land acquisition and easements	✓

Program Sufficiency and Gaps

Alterations to stream corridor structure that may impact aquatic habitats are regulated through the WDFW Hydraulics Project Approval (HPA) permitting program. Other regulatory protections are provided through USACE permitting, ESA consultations, HCPs, DNR Aquatics Lands Authorization, and local government ordinances. Riparian areas within private timberlands are protected through the Forest Practices Rules (FPR) administered by WDNR. The FPRs came out of an extensive review process and are believed to adequately protect riparian areas with respect to stream shading, bank stability, and LWD recruitment. The program is new, however, and careful monitoring of the effect of the regulations is necessary, particularly for effects on watershed hydrology and sediment delivery. Land-use conversion and development are increasing throughout the basin and local government ordinances must ensure that new development occurs in a manner that protects key habitats. Conversion of land-use from forest or agriculture to residential use has the potential to increase impairment of aquatic habitat, particularly when residential development is paired with flood control measures. Local governments can limit potentially harmful land-use conversions by thoughtfully directing growth through comprehensive planning and tax incentives, by providing consistent protection of critical areas across jurisdictions, and by preventing development in floodplains. In cases where programs are unable to protect critical habitats due to inherent limitations of regulatory mechanisms, conservation easements and land acquisition may be necessary.

#2 – Protect hillslope processes

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Manage forest practices to minimize impacts to sediment supply processes, runoff regime, and water quality B. Manage agricultural practices to minimize impacts to sediment supply processes, runoff regime, and water quality C. Manage growth and development to minimize impacts to sediment supply processes, runoff regime, and water quality	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Agricultural practices – impacts to sediment supply, water quality, and runoff processes • Development – impacts to sediment supply, water quality, and runoff processes	All species	Hillslope runoff, sediment delivery, and water quality processes have been severely degraded due to past intensive timber harvest, forest roads, agriculture and development. Limiting additional degradation will be necessary to prevent further habitat impairment.

Priority Locations

1st- Functional subwatersheds contributing to Tier 1 or 2 reaches (functional for sediment *or* flow according to the IWA – local rating)
Subwatersheds: 60401, 60404, 60403, 60303
2nd- All other functional subwatersheds plus Moderately Impaired subwatersheds contributing to Tier 1 or 2 reaches
Subwatersheds: All remaining subwatersheds except 70503, 70606, 80203
3rd- All other Moderately Impaired subwatersheds plus Impaired subwatersheds contributing to Tier 1 or 2 reaches
Subwatersheds: 70503, 70606, 80203

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, State Lands HCP	✓	
Lewis County	Comprehensive Planning		✓
Cowlitz County	Comprehensive Planning		✓
City of Longview	Comprehensive Planning		✓
City of Kelso	Comprehensive Planning		✓
City of Winlock	Comprehensive Planning		✓
Vader	Comprehensive Planning		✓
Lewis Conservation District / NRCS	Agricultural land habitat protection, Education		✓
Cowlitz/Wahkiakum Conservation District	Agricultural land habitat protection, Education		✓

Program Sufficiency and Gaps

Hillslope processes on private forest lands are protected through Forest Practices Rules administered by the WDNR. These rules, developed as part of the Forests & Fish Agreement, are believed to be adequate for protecting watershed sediment supply, runoff processes, and water quality on private forest lands. Small private landowners may be unable to meet some of the requirements on a timeline commensurate with large industrial landowners. Financial assistance to small owners would enable greater and quicker compliance. On non-forest lands (agriculture and developed), local government comprehensive planning is the primary nexus for protection of hillslope processes. Local governments can control impacts through zoning that protects existing uses, through stormwater management ordinances, and through tax incentives to prevent agricultural and forest lands from becoming developed. These protections are especially important in the lower Cowlitz basin due to expanding growth. There are few to no regulatory protections of hillslope processes that relate to agricultural practices; such deficiencies need to be addressed through local or state authorities. Protecting hillslope processes on agricultural lands would also benefit from the expansion of technical assistance and landowner incentive programs (NRCS, Conservation Districts).

#3 – Manage regulated stream flows to provide for critical components of the natural flow regime

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Provide adequate flows for specific life stage requirements (i.e. fry to smolt rearing for fall chinook) B. Address geomorphic effects of hydro-regulation (i.e. channel-forming flows, spawning gravel recruitment)	• Alterations to the temporal pattern of stream flow • Altered stream temperature regime • Disrupted sediment transport processes • Lack of channel-forming flows	• Hydropower operations – changes to flow regime, sediment transport, and stream temperature	All species	Hydro-regulation on the Cowlitz River has altered the natural stream flow regime below Mayfield Dam. In general, summer, fall, and winter flows have increased, spring flows have decreased, and flood (pulse) flows have decreased in frequency and magnitude. To support fish and their habitat, hydro-regulation will need to provide adequate flows for habitat formation, fish migration, water quality, floodplain connectivity, habitat capacity, and sediment transport below Mayfield Dam.

Priority Locations

Lower mainstem Cowlitz (below Mayfield Dam)

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Federal Energy Regulatory Commission (FERC)	Hydropower facility re-licensing	✓	
Tacoma Public Utilities	Operations at Barrier, Mayfield and Mossyrock Dams		✓
Lewis County PUD	Operations at Cowlitz Falls Dam		✓
WA Department of Ecology (WDOE)	Water Quality Program (Water Quality Certification-section 401)	✓	
WDFW	Hydroelectric Facility Re-licensing Program	✓	

Program Sufficiency and Gaps

In 2002, Tacoma Power received a new 35-year license from FERC to operate the Cowlitz River hydropower system, including Mayfield Dam, Mossyrock Dam, and the Barrier Dam (Cowlitz Falls Dam is covered under a separate license held by Lewis County PUD). The license contains a number of articles that address habitat, water quality, and flow issues in the lower river. These articles are the product of a 3-year negotiation process with agency, tribal, recreational, and NGO representatives. Instream flow requirements were based on an IFIM/PHABSIM analysis conducted on the lower river in 1997-1998, but include flexibility for Tacoma Power to ensure reservoir refill before the summer low precipitation season begins. An alternative flow regime was proposed by the NGOs based on an independent assessment of instream flows using the Indicators of Hydrologic Alteration/Range of Variability Approach (Richter et al. 1997). As part of a license-associated requirement by the Washington State Pollution Control Hearing Board, Tacoma Power assessed how the IHA/RVA methodology (and other similar methodologies) may supplement existing flow setting methodologies and determined that existing flow regulations adequately address the multiple objectives of river management and that IHA/RVA could be utilized in the future as part of the adaptive management process (Meridian Environmental 2004). Other issues beyond instream flow setting are also covered in the license articles. These include provisions by Tacoma Power to augment spawning gravel and LWD in the lower river, among others. All of the license prescriptions are new and it will be critical that the adaptive management approach ensures that adequate flows are provided for all salmonid life-stages at all seasons, that geomorphic processes (sediment transport and habitat creation) are restored or mitigated for, that water quality is maintained, and that floodplain function is maintained to the extent possible given lower river channel confinement. There has been relatively little focus on the effects of flow regime alteration on other aquatic species, an issue that warrants further investigation.

#4 – Create/restore off-channel and side-channel habitat

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore historical off-channel and side-channel habitats where they have been eliminated B. Create new channel or off-channel habitats (i.e. spawning channels)	• Loss of off-channel and/or side-channel habitat	• Floodplain filling • Channel straightening • Artificial confinement	chum coho	There has been significant loss of off-channel and side-channel habitats, especially along the lower mainstem that has been extensively channelized. This has severely limited chum spawning habitat and coho overwintering habitat. Targeted restoration or creation of habitats would increase available habitat where full floodplain and CMZ restoration is not possible.

Priority Locations

1st- Mainstem Cowlitz and lower portions of large mainstem tributaries
2nd- Other priority reaches that may have potential for off-channel and side-channel habitat restoration or creation

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDFW	Habitat Program		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Lower Columbia Fish Enhancement Group	Habitat Program		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for creating or restoring off-channel and side-channel habitat. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

#5 - Restore floodplain function and channel migration processes in the mainstem and major tributaries

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Set back, breach, or remove artificial confinement structures	•Bed and bank erosion •Altered habitat unit composition •Restricted channel migration •Disrupted hyporheic processes •Reduced flood flow dampening •Altered nutrient exchange processes •Channel incision •Loss of off-channel and/or side-channel habitat •Blockages to off-channel habitats	•Floodplain filling •Channel straightening •Artificial confinement	chum, fall chinook, coho	There has been significant degradation of floodplain connectivity and constriction of channel migration zones throughout the basin, especially along the mainstem below Mayfield Dam and along lower mainstem tributaries. Selective breaching, setting back, or removing confining structures would help to restore floodplain and CMZ function as well as facilitate the creation of off-channel and side channel habitats. There are feasibility issues with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.

Priority Locations

1st- Tier 1 reaches with hydro-modifications (obtained from EDT ratings)
Reaches: Mid Cowlitz-5B; Salmon Cr 1 (upper); Salmon Cr 2-4; Stillwater Cr 1, 3, 4 & 5; Pond 1-2; Ostrander Cr 1; Olequa Cr 1-6; Lake 2; Lacamas Cr 1; Hill Cr; Campbell Pond; Arkansas Cr 1; Borrow pit
2nd- Tier 2 reaches with hydro-modifications
Reaches: Lower Cowlitz 2; Mid Cowlitz 2-4, 6-7; Mill Cr; Salmon Cr 1, 5; Stillwater Cr 2; Lake 1; Lacamas Cr 4-6; King Cr 1; Jones Cr; Delameter Cr 1; Campbell Cr 1-2
3rd- Other reaches with hydro-modifications
Reaches: Arkansas Cr 2; Becker Cr; Blue Cr; Brim Cr; Curtis Cr; Delameter Cr 3-4; Ferrier Cr; Foster Cr; King Cr 2; Lacamas Cr 3; Leckler Cr; Little Salmon Cr; Mid Cowlitz 1, 5A; Mill Cr (Lacamas trib); Olequa Cr 8; Ostrander Cr 2; Skook Cr; Snow Cr; Stillwater Cr 6; Whittle Cr 1; & several LB and RB tribs

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDFW	Habitat Program		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Lower Columbia Fish Enhancement Group	Habitat Program		✓
WDNR	Aquatic Lands Authorization	✓	

Program Sufficiency and Gaps

There currently are no programs that set forth strategies for restoring floodplain function and channel migration processes in the Lower Cowlitz Basin. Without programmatic changes, projects are likely to occur only seldom as opportunities arise and only if financing is made available. The level of floodplain and CMZ impairment in the Lower Cowlitz and the importance of these processes to listed fish species put an increased emphasis on restoration. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, landowners, and government entities to conduct projects. Floodplain restoration projects are often expensive, large-scale efforts that require partnerships among many agencies, NGOs, and landowners. Building partnerships is a necessary first step toward floodplain and CMZ restoration.

#6 – Restore access to habitat blocked by artificial barriers

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore access to isolated habitats blocked by culverts, dams, or other barriers	• Blockages to channel habitats • Blockages to off-channel habitats	• Dams, culverts, in-stream structures	All species	As many as 50 miles of potentially accessible habitat are blocked by culverts or other barriers (approximately 25 barriers total). The blocked habitat is believed to be marginal in most cases. Passage restoration projects should focus on cases where it can be demonstrated that there is good potential benefit and reasonable project costs.

Priority Locations

1st- Mill Creek, Leckler Creek; Salmon Creek (lower); Foster Creek; Skook Creek; Blue Creek
2nd- Other small tributaries with blockages

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, Family Forest Fish Passage, State Forest Lands HCP		✓
WDFW	Habitat Program		✓
Washington Department of Transportation / WDFW	Fish Passage Program		✓
Lower Columbia Fish Enhancement Group	Habitat Program		✓
Cowlitz County	Roads Maintenance		✓
Lewis County	Roads Maintenance		✓

Program Sufficiency and Gaps

The Forest Practices Rules require forest landowners to restore fish passage at artificial barriers by 2016. Small forest landowners are given the option to enroll in the Family Forest Fish Program in order to receive financial assistance to fix blockages. The Washington State Department of Transportation, in a cooperative program with WDFW, manages a program to inventory and correct blockages associated with state highways. The Salmon Recovery Funding Board, through the Lower Columbia Fish Recovery Board, funds barrier removal projects. Past efforts have corrected major blockages and have identified others in need of repair. Additional funding is needed to correct remaining blockages. Further monitoring and assessment is needed to ensure that all potential blockages have been identified and prioritized.

#7 – Provide for adequate instream flows during critical periods in tributaries

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect instream flows through water rights closures and enforcement B. Restore instream flows through acquisition of existing water rights C. Restore instream flows through implementation of water conservation measures	• Stream flow—maintain or improve flows in tributaries during low-flow Summer months	• Water withdrawals	All species	Instream flow management strategies for the Lower Cowlitz Basin have been identified as part of Watershed Planning for WRIA 26 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies. This measure applies to instream flows associated with water withdrawals and diversions, generally a concern only during low flow periods. Hydropower regulation and hillslope processes also affect low flows but these issues are addressed in separate measures.

Priority Locations

Entire Basin

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Washington Department of Ecology	Water Resources Program		✓
WRIA 25/26 Watershed Planning Unit	Watershed Planning	✓	
City of Longview	Water Supply Program	✓	
City of Kelso	Water Supply Program	✓	
City of Castle Rock	Water Supply Program	✓	
City of Winlock	Water Supply Program		✓

Program Sufficiency and Gaps

The Water Resources Program of the WDOE, in cooperation with the WDFW and other entities, manages water rights and instream flow protections. A collaborative process for setting and managing instream flows was launched in 1998 with the Watershed Planning Act (HB 2514), which called for the establishment of local watershed planning groups who's objective was to recommend instream flow guidelines to WDOE through a collaborative process. The current status of this planning effort is to adopt a watershed plan by December 2004. Instream flow management in the Lower Cowlitz Basin will be conducted using the recommendations of the WRIA 25/26 Planning Unit, which is coordinated by the LCFRB. Draft products of the WRIA 25/26 watershed planning effort can be found on the LCFRB website: www.lcfrb.gen.wa.us. The recommendations of the planning unit have been developed in close coordination with recovery planning and the instream flow prescriptions developed by this group are anticipated to adequately protect instream flows necessary to support healthy fish populations. The measures specified above are consistent with the Planning Unit's recommended strategies. Water supply for Winlock is limited and expansion may affect instream flows in Olequa Creek. Ecology should implement the recommendations of the WRIA 25/26 Planning Unit relative to instream flow rule development

#8- Restore degraded hillslope processes on forest, agricultural, and developed lands

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Upgrade or remove problem forest roads B. Reforest heavily cut areas not recovering naturally C. Employ agricultural Best Management Practices with respect to contaminant use, erosion, and runoff D. Reduce watershed imperviousness E. Reduce effective stormwater runoff from developed areas	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Agricultural practices – impacts to sediment supply, water quality, and runoff processes • Development – impacts to water quality and runoff processes	All species	Hillslope runoff and sediment delivery processes have been degraded due to past intensive timber harvest, road building, agriculture, and development. These processes must be addressed for reach-level habitat recovery to be successful.

Priority Locations

1st- Moderately impaired or impaired subwatersheds contributing to Tier 1 reaches (mod. impaired or impaired for sediment *or* flow according to IWA – local rating)
Subwatersheds: All subwatersheds

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
Lewis Conservation District / NRCS	Agricultural land habitat restoration		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Agricultural land habitat restoration		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
City of Longview	Stormwater Management		✓
City of Kelso	Stormwater Management		✓
City of Castlerock	Stormwater Management		✓
Cowlitz County	Stormwater Management		✓

Program Sufficiency and Gaps

Forest management programs including the new Forest Practices Rules (private timber lands) and the WDNR HCP (state timber lands) are expected to afford protections that will passively and actively restore degraded hillslope conditions. Timber harvest rules are expected to passively restore sediment and runoff processes. The road maintenance and abandonment requirements for private timber lands are expected to actively address road-related impairments within a 15 year time-frame. While these strategies are believed to be largely adequate to protect watershed processes, the degree of implementation and the effectiveness of the prescriptions will not be fully known for at least another 15 or 20 years. Of particular concern is the capacity of some forest land owners, especially small forest owners, to conduct the necessary road improvements (or removal) in the required timeframe. Additional financial and technical assistance would enable small forest landowners to conduct the necessary improvements in a timeline parallel to large industrial timber land owners. Ecological restoration of existing developed and agricultural lands occurs relatively infrequently and there are no programs that specifically require restoration in these areas. Restoring existing developed and farmed lands can involve retrofitting facilities with new materials, replacing existing systems, adopting new management practices, and creating or re-configuring landscaping. Means of increasing restoration activity include increasing landowner participation through education and incentive programs, building support for projects on public lands/facilities, requiring Best Management Practices through permitting and ordinances, and increasing available funding for entities to conduct restoration projects.

#9 - Restore riparian conditions throughout the basin

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore the natural riparian plant community B. Exclude livestock from riparian areas C. Eradicate invasive plant species from riparian areas	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or invasive species • Bacteria	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to agriculture and residential development	All species	Riparian systems are degraded throughout the basin due to past timber harvest, agriculture, roadways, flood control structures, and development. Riparian restoration has a high potential benefit due to the many limiting factors that are addressed. The increasing abundance of exotic and invasive species is of particular concern. Riparian restoration projects are relatively inexpensive and are often supported by landowners.

Priority Locations

1st- Tier 1 reaches
2nd- Tier 2 reaches
3rd- Tier 3 reaches
4th- Tier 4 reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program		✓
Lewis Conservation District	Agricultural land habitat restoration		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Agricultural land habitat restoration		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, agencies, landowners	Habitat Projects		✓
Lewis County Noxious Weed Control Board	Noxious Weed Education, Control, and Enforcement		✓
Cowlitz County Noxious Weed Control Board	Noxious Weed Education, Control, and Enforcement		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring riparian conditions; however, existing programs will afford protections that will allow for the *passive* restoration of riparian forests. These protections are believed to be adequate for riparian areas on forest lands that are subject to Forest Practices Rules or the State forest lands HCP. Other lands receive variable levels of protection and passive restoration through the Lewis and Cowlitz Counties Comprehensive Plans. Many degraded riparian zones in urban lands, agricultural lands, rural residential lands, or transportation corridors will not passively restore with existing regulatory protections and will require active measures. Riparian restoration in these areas may entail livestock exclusion, tree planting, road relocation, invasive species eradication, and adjusting current land-use in the riparian zone. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

#10 – Restore degraded water quality with emphasis on temperature impairments

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Exclude livestock from riparian areas B. Increase riparian shading in tributaries C. Decrease channel width-to-depth ratios D. Reduce delivery of chemical contaminants to streams E. Address leaking septic systems	• Bacteria • Altered stream temperature regime • Chemical contaminants	• Timber harvest – riparian harvests • Riparian grazing • Leaking septic systems • Clearing of vegetation due to rural development and agriculture • Chemical contaminants from agricultural and developed lands	• All species	The lower Cowlitz mainstem and several tributaries are listed on the 2002-2004 draft 303(d) list for temperature impairment. There are also a few tributaries listed for fecal coliform bacteria impairment, although bacteria is more of a human health concern than a fish health concern. Restoration of riparian canopy cover and livestock exclusion can be used to address temperature and bacteria impairments. Leaking septic systems may be contributing to bacteria levels in areas with concentrated residential development. The degree of impact of agricultural pollutants is unknown and needs further assessment.

Priority Locations

1st- Tier 1 or 2 reaches with 303(d) listings (2002-2004 draft list)
Reaches: Lower Cowlitz 2 (temperature, bacteria); Ostrander Cr 1 (temperature); Lake 1-2 (temperature); Delameter Cr 1-2 (bacteria)
2nd- Other reaches with 303(d) listings
Reaches: Delameter Cr 3 (temperature); Ostrander Cr 2 (temperature); Arkansas Cr 2-3 (temperature)
3rd- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Washington Department of Ecology	Water Quality Program		✓
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program		✓
Lower Columbia Fish Enhancement Group	Habitat Program		✓
Lewis Conservation District / NRCS	Agricultural land habitat restoration, Septic System Programs		✓
Cowlitz/Wahkiakum Conservation District/ NRCS	Agricultural land habitat restoration, Septic System Programs		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Lewis County Health Department	Septic System Program		✓
Cowlitz County Health Department	Septic System Program		✓

Program Sufficiency and Gaps

The WDOE Water Quality Program manages the State 303(d) list of impaired water bodies. There are a few listings in the lower Cowlitz Basin (WDOE 2004). Water Quality Clean-up Plans (TMDLs) are required by the WDOE and it is anticipated that the TMDLs will adequately set forth strategies to address the temperature and bacteria impairments. It will be important that the strategies specified in the TMDLs are implementable and adequately funded. The 303(d) listings are believed to address the primary water quality concerns; however, other impairments may exist that the current monitoring effort is unable to detect. Additional monitoring is needed to fully understand the degree of water quality impairment in the basin, especially regarding agricultural pollutants.

#11 - Restore channel structure and stability

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting B. Structurally modify channel morphology to create suitable habitat C. Restore natural rates of erosion and mass wasting within river corridors	• Lack of stable instream woody debris • Altered habitat unit composition • Reduced bank/soil stability • Excessive fine sediment • Excessive turbidity • Embedded substrates	• None (symptom-focused restoration strategy)	All species	Large wood installation projects could benefit habitat conditions in many areas although watershed processes contributing to wood deficiencies should be considered and addressed prior to placing wood in streams. Other structural enhancements to stream channels may be warranted in some places.

Priority Locations

1st- Tier 1 reaches
2nd- Tier 2 reaches
3rd- Tier 3 reaches
4th- Tier 4 reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
WDFW	Habitat Program		✓
Lower Columbia Fish Enhancement Group	Habitat Program		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring channel stability and structure. Passive restoration is expected to slowly occur as a result of protections afforded to riparian areas and hillslope processes. Past projects have largely been opportunistic and have been completed due to the efforts of local NGOs, landowners, and government agencies; such projects are likely to continue in a piecemeal fashion as opportunities arise and if financing is made available. The lack of LWD in stream channels, and the importance of wood for habitat of listed species, places an emphasis on LWD supplementation projects. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

Table 17. Habitat actions for the Lower Cowlitz Basin.

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
L Cow 1. Manage regulated stream flows to provide for critical components of the natural flow regime	Expansion of existing program or activity	Tacoma Power, Lewis County PUD, FERC, WDFW	3	High: Lower mainstem Cowlitz River	High: Adequate flows for life stage requirements and habitat-forming processes	High
L Cow 2. Expand standards in local government Comprehensive Plans to afford adequate protections of ecologically important areas (i.e. stream channels, riparian zones, floodplains, CMZs, wetlands, unstable geology)	Expansion of existing program or activity	Lewis County, Cowlitz County, Longview, Kelso, Castle Rock, Winlock, WDOE	1 & 2	High: Private lands. Applies primarily to residential, agricultural, and forest lands at risk of development	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
L Cow 3. Manage future growth and development patterns to ensure the protection of watershed processes. This includes limiting the conversion of agriculture and timber lands to developed uses through zoning regulations and tax incentives	Expansion of existing program or activity	Lewis County, Cowlitz County, Longview, Kelso, Castle Rock, Winlock	1 & 2	High: Private lands. Applies primarily to residential, agricultural, and forest lands at risk of development	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
L Cow 4. Monitor and notify FERC of significant license violations, enforce terms and conditions of section 7 consultations on FERC relicensing agreements, and encourage implementation of section 7 conservation recommendations of section 7	Expansion of existing program or activity	NOAA, USFWS	3	High: Lower mainstem Cowliz River	High: Adequate flows for life stage requirements and habitat-forming processes, protection of water quality, increased habitat availability for spawning and rearing	High
L Cow 5. Review and adjust operations to ensure compliance with the Endangered Species Act; examples include roads, parks, and weed management	Expansion of existing program or activity	Cowlitz County, Lewis County, Kelso, Longview, Winlock, Vader,	1, 8, 9, & 10	Low: Applies to lands under public jurisdiction	Medium: Protection of water quality, greater streambank stability, reduction in road-related fine sediment delivery, restoration and preservation of fish access to habitats	High
L Cow 6. Conduct floodplain restoration where feasible along the mainstem and in major tributaries that have experienced channel confinement. Survey landowners, build partnerships, and provide financial incentives	New program or activity	NRCS, W/Cowlitz CD, LCD, NGOs, WDFW, LCFRB, USACE, LCFEG	4, 5, 6, 9, 10 & 11	High: Mainstem Cowlitz and several of the major tributaries	Medium: Restoration of floodplain function, habitat diversity, and habitat availability.	High
L Cow 7. Prevent floodplain impacts from new development through land use controls and Best Management Practices	New program or activity	Lewis County, Cowlitz County, WDOE, Longview, Kelso, Winlock	1	Medium: Private lands currently in agriculture or timber production in lowland areas.	High: Protection of floodplain function, CMZ processes, and off-channel/side-channel habitat. Prevention of reduced habitat diversity and key habitat availability	High
L Cow 8. Create and/or restore lost side-channel/off-channel habitat for chum spawning and coho	New program or activity	LCFRB, BPA (NPCC), NGOs,	4	High: Lower mainstem Cowlitz	High: Increased habitat availability for spawning and rearing	Medium

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[1] Relative amount of basin affected by action
[2] Expected response of action implementation
[3] Relative certainty that expected results will occur as a result of full implementation of action

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
overwintering		WDFW, NRCS, W/CCD, LCD, LCFEG		and lower portion of lower mainstem tributaries		
L Cow 9. Increase funding available to purchase easements or property in sensitive areas where existing programs may not be able to adequately protect watershed function	Expansion of existing program or activity	LCFRB, NGOs, WDFW, USFWS, BPA (NPCC)	1 & 2	Medium: Residential, agricultural, or forest lands at risk of further degradation	High: Protection of riparian function, floodplain function, water quality, wetland function, and runoff and sediment supply processes	High
L Cow 10. Increase technical assistance to landowners and increase landowner participation in conservation programs that protect and restore habitat and habitat-forming processes. Includes increasing incentives (financial or otherwise) and increasing program marketing and outreach	Expansion of existing program or activity	NRCS, W/CCD, LCD, WDNR, WDFW, Cowlitz County, Lewis County, Kelso	All measures	High: Private lands. Applies primarily to lands in agriculture, rural residential, and forestland uses throughout the basin	High: Increased landowner stewardship of habitat. Potential improvement in all factors	Medium
L Cow 11. Fully implement and enforce the Forest Practices Rules (FPRs) on private timber lands in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 6, 8, 9 & 10	Medium: Private commercial timber lands	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
L Cow 12. Implement the prescriptions of the WRIA 25/26 Watershed Planning Unit regarding instream flows	Activity is currently in place	WDOE, WDFW, WRIA 25/26 Planning Unit, Castle Rock, Winlock, Longview, Kelso	7	High: Entire basin	Medium: Adequate instream flows to support life stages of salmonids and other aquatic biota.	Medium
L Cow 13. Increase the level of implementation of voluntary habitat enhancement projects in high priority reaches and subwatersheds. This includes building partnerships, providing incentives to landowners, and increasing funding	Expansion of existing program or activity	LCFRB, BPA (NPCC), NGOs, WDFW, NRCS, W/CCD, LCD, LCFEG	4, 5, 6, 8, 9, 10 & 11	High: Priority stream reaches and subwatersheds throughout the basin	Medium: Improved conditions related to water quality (temperature and bacteria), LWD quantities, bank stability, key habitat availability, habitat diversity, riparian function, floodplain function, sediment availability, & channel migration processes	Medium
L Cow 14. Increase technical support and funding to small forest landowners faced with implementation of Forest and Fish requirements for fixing roads and barriers to ensure full and timely compliance with regulations	Expansion of existing program or activity	WDNR	1, 2, 6, 8, 9 & 10	Low: Small private timberland owners	High: Reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
L Cow 15. Expand local government Comprehensive Planning to ensure consistent protections are in place to initiate review of development and real estate transactions that may affect natural resources	Expansion of existing program or activity	Lewis County, Cowlitz County, Kelso, Longview, Castle Rock, Winlock	1 & 2	High: Private lands. Applies primarily to residential, agricultural, and forest lands at risk	Medium: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	Medium

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
				of development		
L Cow 16. Protect and restore native plant communities from the effects of invasive species	Expansion of existing program or activity	Weed Control Boards (local and state); NRCS, W/CCD, LCD, LCFEG	1 & 9	High: Greatest risk is in agriculture and residential use areas	Medium: restoration and protection of native plant communities necessary to support watershed and riparian function	Low
L Cow 17. Assess the impact of fish passage barriers throughout the basin and restore access to potentially productive habitats	Expansion of existing program or activity	WDFW, WDNR, Lewis County, Cowlitz County WSDOT, LCFEG	6	Medium: As many as 50 miles of stream are potentially blocked by artificial barriers	Medium: Increased spawning and rearing capacity due to access to blocked habitat. Habitat is marginal in most cases	Medium
L Cow 18. Conduct forest practices on state lands in accordance with the Habitat Conservation Plan in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 6, 8, 9 & 10	Low: State timber lands in the Lower Cowlitz Watershed (approximately 10% of the basin area)	Medium: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats. Response is medium because of location and quantity of state lands	Medium
L Cow 19. Assess, upgrade, and replace on-site sewage systems that may be contributing to water quality impairment	Expansion of existing program or activity	Lewis County, Cowlitz County, Cowlitz CD, Lewis CD	10	Medium: Private agricultural and rural residential lands	Medium: Protection and restoration of water quality (bacteria)	Low

5.5 Hatcheries

5.5.1 *Subbasin Hatchery Strategy*

The desired future state of fish production within the Lower Cowlitz River Basin includes natural salmon and steelhead populations that are improving on a trajectory to recovery and hatchery programs that either enhance the natural fish recovery trajectory or are operated to not impede progress towards recovery. Hatchery recovery actions in each subbasin are tailored to the specific ecological and biological circumstances for each species in the subbasin. This may involve substantial changes in some hatchery programs from their historical focus on production for mitigation for lost fishing benefits. The recovery strategy includes a mixture of conservation programs and mitigation programs. Mitigation programs involve areas or practices selected for consistency with natural population conservation and recovery objectives. A summary of the types of natural production enhancement strategies and fishery enhancement strategies to be implemented in the Lower Cowlitz Basin are displayed by species in Table 18. More detailed descriptions and discussion of the regional hatchery strategy can be found in the Regional Recovery and Subbasin Plan Volume I.

Table 18. Summary of natural production and fishery enhancement strategies to be implemented in the Lower Cowlitz

		Species					
		Fall Chinook	**Spring Chinook**	**Coho**	**Chum**	**Winter Steelhead**	**Summer Steelhead**
Natural Production Enhancement	Supplementation			✓			
	Hatch/Nat Conservation [1/]	✓					
	Isolation						
	Refuge						
Fishery Enhancement	Hatchery Production		✓	✓		✓	✓

1/ Hatchery and natural population management strategy coordinated to meet biological recovery objectives. Strategy may include integration and/or isolation strategy over time. Strategy will be unique to biological and ecological circumstances in each watershed.

Conservation-based hatchery programs include strategies and actions which are specifically intended to enhance or protect production of a particular wild fish population within the basin. A unique conservation strategy is developed for each species and watershed depending on the status of the natural population, the biological relationship between the hatchery and natural populations, ecological attributes of the watershed, and logistical opportunities to jointly manage the populations. Four types of hatchery conservation strategies may be employed:

Natural Refuge Watersheds: In this strategy, certain sub-basins are designated as wild-fish-only areas for a particular species. The refuge areas include watersheds where populations have persisted with minimum hatchery influence and areas that may have a history of hatchery production but would not be subjected to future hatchery influence as part of the recovery strategy. More refuge areas may be added over time as wild populations recover. These refugia provide an opportunity to monitor population trends independent of the confounding influence of hatchery fish natural population on fitness and our ability to measure natural population productivity and will be key indicators of natural population status within the ESU. This strategy would not be included in near-term measures for the lower Cowlitz Basin.

Hatchery Supplementation: This strategy utilizes hatchery production as a tool to assist in rebuilding depressed natural populations. Supplementation would occur in selected areas that are producing natural fish at levels significantly below current capacity or capacity is expected to increase as a result of immediate benefits of habitat or passage improvements. This is intended to be a temporary measure to jump start critically low populations and to bolster natural fish numbers above critical levels in selected areas until habitat is restored to levels where a population can be self sustaining. This strategy would include coho in the Lower Cowlitz Basin.

Hatchery/Natural Isolation: This strategy is focused on physically separating hatchery adult fish from naturally-produced adult fish to avoid or minimize spawning interactions to allow natural adaptive processes to restore native population diversity and productivity. The strategy may be implemented in the entire watershed or more often in a section of the watershed upstream of a barrier or trap where the hatchery fish can be removed. This strategy is currently aimed at hatchery steelhead in watersheds with trapping capabilities. The strategy may also become part of spring and fall Chinook as well as coho strategy in certain watersheds in the future as unique wild runs develop. This strategy would not be included in near-term measures for the Lower Cowlitz Basin but could be considered in the future for coho. This definition refers only to programs where fish are physically sorted using a barrier or trap. Some fishery mitigation programs, particularly for steelhead, are managed to isolate hatchery and wild stocks based on run timing and release locations.

Hatchery/Natural Merged Conservation Strategy: This strategy addresses the case where natural and hatchery fish have been homogenized over time such that they are principally all one stock that includes the native genetic material for the basin. Many spring Chinook, fall Chinook, and coho populations in the lower Columbia currently fall into this category. In many cases, the composite stock productivity is no longer sufficient to support a self-sustaining natural population especially in the face of habitat degradation. The hatchery program will be critical to maintaining any population until habitat can be improved and a strictly natural population can be re-established. This merged strategy is intended to transition these mixed populations to a self-supporting natural population that is not subsidized by hatchery production or subject to deleterious hatchery impacts. Elements include separate management of hatchery and natural subpopulations, regulation of hatchery fish in natural areas, incorporation of natural fish into hatchery broodstock, and annual abundance-driven distribution. Corresponding programs are expected to evolve over time dependent on changes in the populations and in the habitat productivity. This strategy is primarily aimed at Chinook salmon in areas where harvest production occurs and is included as a near term strategy for fall Chinook in the Lower Cowlitz Basin.

Not every lower Columbia River hatchery program will be turned into a conservation program. The majority of funding for lower Columbia basin hatchery operations (including the Carson National Fish Hatchery) is for producing salmon and steelhead for harvest to mitigate for lost harvest of natural production due to hydro development and habitat degradation. Programs for fishery enhancement will continue during the recovery period, but will be managed to minimize risks and ensure they do not compromise recovery objectives for natural populations. It is expected that the need to produce compensatory fish for harvest through artificial production will reduce in the future as natural populations recover and become harvestable. There are fishery enhancement programs for spring Chinook, coho, and summer and winter steelhead in the Lower Cowlitz Basin.

The Cowlitz Hatchery Complex will be operated to include natural production enhancement and fishery enhancement strategies for Cowlitz populations as identified in Table 19.

Table 19. A summary of conservation and harvest strategies to be implemented in the Lower Cowlitz basin through the Cowlitz HatcheryComplex programs.

		Stock
Natural Production Enhancement	Supplementation	L. Cowlitz Coho √
		U. Cowlitz Spring Chinook
		U. Cowlitz Coho
		U. Cowlitz Winter Steelhead
		Lower Columbia Chum √
	Hatch/Nat Conservation 1/	L. Cowlitz Fall Chinook √
		U. Cowlitz Spring Chinook
	Isolation	U. Cowlitz Winter Steelhead
	Broodstock development	Cowlitz Chum √
		Cowlitz Late Winter Steelhead
Fishery Enhancement	In-basin releases (final rearing at Cowlitz)	Cowlitz Late Coho
		Cowlitz Fall Chinook
		Cowlitz Spring Chinook
		Cowlitz Winter Steelhead
		Cowlitz Summer Steelhead
		Cowlitz Sea-run Cutthroat
	Out of Basin Releases (final rearing at Cowlitz)	

1/ May include integrated and/or isolated strategy over time.
√ Denotes new program

5.5.2 *Hatchery Measures and Actions*

Hatchery strategies and actions are focused on evaluating and reducing biological risks consistent with the conservation strategies identified for each natural population. Artificial production programs within the Cowlitz River facilities have been evaluated in detail through the WDFW Benefit-Risk Assessment Procedure (BRAP) relative to risks to natural populations. The BRAP results were utilized to inform the development of these program actions specific to the Lower Cowlitz River Basin (Table 20). The Sub-Basin plan hatchery recovery actions were developed in coordination with WDFW and at the same time as the Hatchery and Genetic Management Plans (HGMP) were developed by WDFW for each hatchery program. As a result, the hatchery actions represented in this document will provide direction for specific actions which will be detailed in the HGMPs submitted by WDFW for public review and for NOAA fisheries approval. It is expected that the HGMPs and these recovery actions will be complimentary and provide a coordinated strategy for the Cowlitz River Basin hatchery programs. Further explanation of specific strategies and measures for hatcheries can be found in the Regional Recovery and Subbasin Plan Volume I.

Table 20. Hatchery program actions to be implemented in the Lower Cowlitz River Basin.

Activity	Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed
• Unique conservation strategy is developed for Cowlitz fall chinook based on status of natural population and biological relationship between natural and hatchery populations. Options may include integration and/or segregation strategies over time as developed to meet recovery objectives. Actions may include: • Deliberate and consistent infusion of natural produced fall chinook adults into the hatchery program. • Monitor and evaluate first generation hatchery origin fall chinook spawning naturally (adaptive management plan developed) • Continue long-standing WDFW policy of no outside chinook or coho transfers into the Cowlitz Basin.	**Conservation management strategy implemented for fall chinook natural and hatchery production. *preclude outside basin transfers of fall chinook, spring chinook, or coho eggs or juveniles for release into the lower Cowlitz basin	Cowlitz Salmon Hatchery fall chinook, coho, and spring chinook	Lower Cowlitz fall chinook and coho	Domestication Diversity Abundance	• In-breeding • Non-local genetic traits
• Establish a mass marking program for fall chinook to enable selective fishing options and to distinguish hatchery and natural produced adults in the escapement. • Evaluate the feasibility of marking 100 percent of hatchery fall chinook production (5 million). Evaluate alternatives. • Continue 100 percent mark of hatchery produced steelhead, coho, spring chinook, and sea-run cutthroat released into the lower Cowlitz.	**Adipose fin-clip mark hatchery released fall chinook *Adipose fin-clip mark hatchery produced coho, spring chinook, steelhead, and sea-run cutthroat	Cowlitz Salmon Hatchery fall chinook spring chinook and coho. Cowlitz Trout Hatchery sttelhead and cutthroat	Lower Cowlitz fall chinook, coho, and steelhead.	Domestication, Diversity, Abundance	• In-breeding • Harvest
• Develop a coho brood stock using the latest (December-January) arriving late hatchery coho. Utilize production from the existing programs and new late program to supplement wild coho production in the lower Cowlitz tributaries and for harvest. • Develop a chum brood stock utilizing natural returns to the Cowlitz Salmon Hatchery and/or adjacent stream populations based on assessment of genetic similarity. Utilize broodstock for supplementation and risk management of Lower Columbia chum.	**Cowlitz Basin hatchery facilities utilized for supplementation and enhancement of natural coho and chum populations	Cowlitz Hatchery late coho, and space for chum (if needed for lower Columbia chum enhancement).	Lower Cowlits coho, Lower Columbia chum	Abundance, Spatial distribution	• Low numbers of natural spawners • Ecologically appropriate natural brood stock

Activity	Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed
• Hatchery produced steelhead, coho, and fall chinook will be scheduled for release during the time when the maximum numbers of fish are smolted and prepared to emigrate rapidly. • Juvenile rearing strategies will be implemented to provide a fish growth schedule which coincides with an optimum release time for hatchery production success and to minimize time spent in the Cowlitz River.	*Juvenile release strategies to minimize impacts to natural populations	Cowlitz Salmon Hatchery spring chinook, coho, and fall chinook. Cowlitz Trout Hatchery steelhead and sea-run cutthroat	Lower Cowlitz fall chinook, chum, and coho	Predation, Competition	• Hatchery smolt residence time in the lower Cowlitz River.
• Evaluate in-take screens at the facilities to assure they do not pose risks to wild fall chinook juveniles • Hatchery effluent discharge complies with NPDES permit monitoring requirements. Fish health monitored and treated as per co-managers fish health policy.	*Evaluate facility operations	All species	All species	Habitat quality, survival	• water quality, • In-take screens
• Research, monitoring , and evaluation of performance of the above actions in relation to expected outcomes • Performance standards developed for each actions with measurable criteria to determine success or failure • Adaptive Management applied to adjust or change actions as neccessary	** Monitoring and evaluation, adaptive management	All species	All species	Hatchery production performance, Natural production performance	• All of above

** Extension or improvement of existing actions-may require additional funding*
*** New action-will likely require additional funding*

5.6 Harvest

Fisheries are both an impact that reduces fish numbers and an objective of recovery. The long-term vision is to restore healthy, harvestable natural salmonid populations in many areas of the lower Columbia basin. The near-term strategy involves reducing fishery impacts on natural populations to ameliorate extinction risks until a combination of actions can restore natural population productivity to levels where increased fishing may resume. The regional strategy for interim reductions in fishery impacts involves: 1) elimination of directed fisheries on natural populations, 2) regulation of mixed stock fisheries for healthy hatchery and natural populations to limit and minimize indirect impacts on natural populations, 3) scaling of allowable indirect impacts for consistency with recovery, 4) annual abundance-based management to provide added protection in years of low abundance while allowing greater fishing opportunity consistent with recovery in years with much higher abundance, and 5) mass marking of hatchery fish for identification and selective fisheries.

Actions to address harvest impacts are generally focused at a regional level to cover fishery impacts accrued to lower Columbia salmon as they migrate along the Pacific Coast and through the mainstem Columbia River. Fisheries are no longer directed at weak natural populations but incidentally catch these fish while targeting healthy wild and hatchery stocks. Subbasin fisheries affecting natural populations have been largely eliminated. Fishery management has shifted from a focus on maximum sustainable harvest of the strong stocks to ensuring protection of the weak stocks. Weak stock protections often preclude access to large numbers of otherwise harvestable fish in strong stocks.

Fishery impact limits to protect ESA-listed weak populations are generally based on risk assessments that identify points where fisheries do not pose jeopardy to the continued persistence of a listed group of fish. In many cases, these assessments identify the point where additional fishery reductions provide little reduction in extinction risks. A population may continue to be at significant risk of extinction but those risks are no longer substantially affected by the specified fishing levels. Often, no level of fishery reduction will be adequate to meet naturally-spawning population escapement goals related to population viability. The elimination of harvest will not in itself lead to the recovery of a population. However, prudent and careful management of harvest can help close the gap in a coordinated effort to achieve recovery.

Fishery actions specific to the subbasins are addressed through the Washington State Fish and Wildlife sport fishing regulatory process. This public process includes an annual review focused on emergency type regulatory changes and a comprehensive review of sport fishing regulations which occurs every two years. This regulatory process includes development of fishing rules through the Washington Administrative Code (WAC) which are focused on protecting weak stock populations while providing appropriate access to harvestable populations. The actions consider the specific circumstances in each area of each subbasin and respond with rules that fit the relative risk to the weak populations in a given time and area of the subbasin. Following is a general summary of the fishery actions specific to the lower Cowlitz (Table 21). More complete details can be found in the WDFW Sport Fishing Rules Pamphlet.

Table 21. Summary of regulatory and protective fishery actions in the lower Cowlitz basin

Species	General Fishing Actions	Explanation	Other Protective Fishing Actions	Explanation
Fall Chinook	Open for fall Chinook	Hatchery fish are produced for harvest. Hatchery fish are not mass marked	Night closures, gear restrictions, and closure near Barrier Dam	Protects fall Chinook in areas of high concentration
Spring Chinook	Retain only adipose fin-clipped Chinook	Selective fishery for hatchery Chinook, unmarked wild spring Chinook must be released	Minimum size restrictions and closure near Barrier Dam	Closure protects spring Chinook in areas of high concentration and minimum size protects juveniles
chum	Closed to retention	Protects natural chum. Hatchery chum are not produced for harvest		
coho	Retain only adipose fin-clip marked coho	Selective fishery for hatchery coho, unmarked wild coho must be released	Small Lower Cowlitz tributaries closed to salmon fishing	Protects wild spawners in tributary creeks. Hatchery coho are released in the lower mainstem Cowlitz
Winter steelhead	Retain only adipose fin-clip marked steelhead	Selective fishery for hatchery steelhead, unmarked wild steelhead must be released	Steelhead and trout fishing closed in the spring and minimum size restrictions in affect	Spring closure Protects adult wild steelhead during spawning and minimum size protects juvenile steelhead

Regional actions cover species from multiple watersheds which share the same migration routes and timing, resulting in similar fishery exposure. Regional strategies and actions for harvest are detailed in the Regional Recovery and Subbasin Plan Volume I. A number of regional strategies for harvest involve implementation of actions within specific subbasins. In-basin fishery management is generally applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest actions with significant application to the Lower Cowlitz Subbasin populations are summarized in Table 22.

Table 22. Regional harvest actions from Volume I, Chapter 7 with significant application to the Lower Cowlitz Subbasin populations.

Action	Description	Responsible Parties	Programs	Comments
**F.A12	Monitor chum handle rate in winter steelhead and late coho tributary sport fisheries.	WDFW	Columbia Compact	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
**F.A8	Consider developing a mass marking plan for hatchery tule Chinook for tributary harvest management and for naturally-spawning escapement monitoring.	WDFW, NOAA, USFWS, Col. Tribes	U.S. Congress, Washington Fish and Wildlife Commission	Provides the opportunity to implement selective tributary sport fishing regulations in the Cowlitz watershed. This program is not federally funded and therefore is not subject to the Congressional mandate to mass mark federally funded hatchery production.
*F.A13	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Includes monitoring of naturally-spawning steelhead encounter rates in fisheries and refinement of long-term catch and release handling mortality estimates. Would include assessment of the current monitoring programs and determine their adequacy in formulating naturally-spawning steelhead incidental mortality estimates.
*F.A14	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Regulatory agencies should continue to refine gear, handle and release methods, and seasonal options to minimize mortality of naturally-spawning steelhead in commercial and sport fisheries.
*F.A20	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	WDFW, NOAA, ODFW, USFWS	PFMC, Columbia Compact, BPA Fish and Wildlife Program, WDFW Creel	Mass marking of lower Columbia River coho and steelhead has enabled successful ocean and freshwater selective fisheries to be implemented since 1998. Marking programs should be continued and fisheries monitored to provide improved estimates of naturally-spawning salmon and steelhead release mortality.

* Extension or improvement of existing action
** New action

5.7 Hydropower

. The three hydro-electric dams on the Cowlitz River are considered to be located in the upper Cowlitz basin. However, lower Cowlitz River species, in particular fall Chinook, are affected by flow regimes from Cowlitz River hydro operations which effect spawning and rearing habitat in the lower Cowlitz. The quantity and quality of fall Chinook habitat in the lower Cowlitz River can be addressed by; maintaining a flow regime, including minimum flow requirements, that enhance the spawning and rearing habitats for natural salmonid populations downstream of the Cowlitz hydrosystem. In addition, mainstem Columbia hydro operations and flow regimes affect habitat utilized by lower Lewis species in migration corridors and in the estuary. Key regional strategies applying to the lower Cowlitz populations are displayed in the following table.

Table 23. Regional hydropower measure from Volume I, Chapter 7 with significant application to lower Cowlitz Subbasin populations

Measure	Description	Comments
D.M4	Operate the tributary hydrosystems to provide appropriate flows for salmon spawning and rearing habitat in the areas downstream of the hydrosystem.	The quantity and quality of spawning and rearing habitat for salmon, in particular fall Chinook in the lower Cowlitz is affected by the water flow discharged at Mayfield Dam. The operational plans for the Cowlitz hydrosystem, in conjunction with fish management plans, should include flow regimes, including minimum flow and ramping rate requirements, which enhance the lower river habitat for fall Chinook.

5.8 Mainstem and Estuary Habitat

Lower Cowlitz River anadromous fish populations will also benefit from regional recovery strategies and measures identified to address habitat conditions and threats in the Columbia River mainstem and estuary. Regional recovery plan strategies involve: 1) avoiding large scale habitat changes where risks are known or uncertain, 2) mitigating small-scale local habitat impacts to ensure no net loss, 3) protecting functioning habitats while restoring impaired habitats to functional conditions, 4) striving to understand, protect, and restore habitat-forming processes, 5) moving habitat conditions in the direction of the historical template which is presumed to be more consistent with restoring viable populations, and 6) improving understanding of salmonid habitat use in the Columbia River mainstem and estuary and their response to habitat changes. A series of specific measures are detailed in the regional plan for each of these strategies.

5.9 Ecological Interactions

For the purposes of this plan, ecological interactions refer to the relationships of salmon anadromous steelhead with other elements of the ecosystem. Regional strategies and measures pertaining to exotic or non-native species, effects of salmon on system productivity, and native predators of salmon are detailed and discussed at length in the Regional Recovery and Subbasin Plan Volume I and are not reprised at length in each subbasin plan. Strategies include 1) avoiding, eliminating introductions of new exotic species and managing effects of existing exotic species, 2) recognizing the significance of salmon to the productivity of other species and the salmon themselves, and 3) managing predation by selected species while also maintaining a viable balance of predator populations. A series of specific measures are detailed in the regional plan for each of these strategies. Implementation will occur at the regional and subbasin scale.

5.10 Monitoring, Research, & Evaluation

Biological status monitoring quantifies progress toward ESU recovery objectives and also establishes a baseline for evaluating causal relationships between limiting factors and a population response. Status monitoring involves routine and intensive efforts. Routine monitoring of biological data consists of adult spawning escapement estimates, whereas routine monitoring for habitat data consists of a suite of water quality and quantity measurements.

Intensive monitoring supplements routine monitoring for populations and basins requiring additional information. Intensive monitoring for biological data consists of life-cycle population assessments, juvenile and adult abundance estimates and adult run-reconstruction. Intensive monitoring for habitat data includes stream/riparian surveys, and continuous stream flow assessment. The need for additional water quality sampling may be identified. Rather than prescribing one monitoring strategy, three scenarios are proposed ranging in level of effort and cost from high to low (Level 1-3 respectively). Given the fact that routine monitoring is ongoing, only intensive monitoring varies between each level.

An in-depth discussion of the monitoring, research and evaluation (M, R & E) approach for the Lower Columbia Region is presented in the Regional Recovery and Management Plan. It includes site selection rationale, cost considerations and potential funding sources. The following tables summarize the biological and habitat monitoring efforts specific to the lower Cowlitz subbasin.

Table 24. Summary of the biological monitoring plan for lower Cowlitz River populations.

Lower Cowlitz: Lower Columbia Biological Monitoring Plan					
Monitoring Type	**Fall Chinook**	**Chum**	**Coho**	**Winter Steelhead**	**Spring Chinook**
Routine	AA	AA	AA	AA	AA
Intensive					
Level 1			✓		
Level 2			✓		
Level 3					

AA Annual adult abundance estimates
✓ Adult and juvenile intensive biological monitoring occurs periodically on a rotation schedule (every 9 years for 3-year duration)
× Adult and juvenile intensive biological monitoring occurs annually

Table 25. Summary of the habitat monitoring plan for lower Cowlitz River populations.

Lower Cowlitz : Lower Columbia Habitat Monitoring Plan				
Monitoring Type	**Watershed**	**Existing stream / riparian habitat**	**Water quantity[3] (level of coverage)**	**Water quality [2] (level of coverage)**
Routine 1 (level of coverage)	Baseline complete	Poor	Stream Gage-Good IFA-Good	WDOE-Good USGS-Good Temperature-Poor
Intensive				
Level 1		✓		
Level 2				
Level 3				

IFAComprehensive Instream Flow Assessment (i.e. Instream Flow Incremental Methodology)
[1] Routine surveys for habitat data do not imply ongoing monitoring
[2] Intensive monitoring for water quality to be determined
[3] Water quantity monitoring may include stream gauge installation, IFA or low flow surveys

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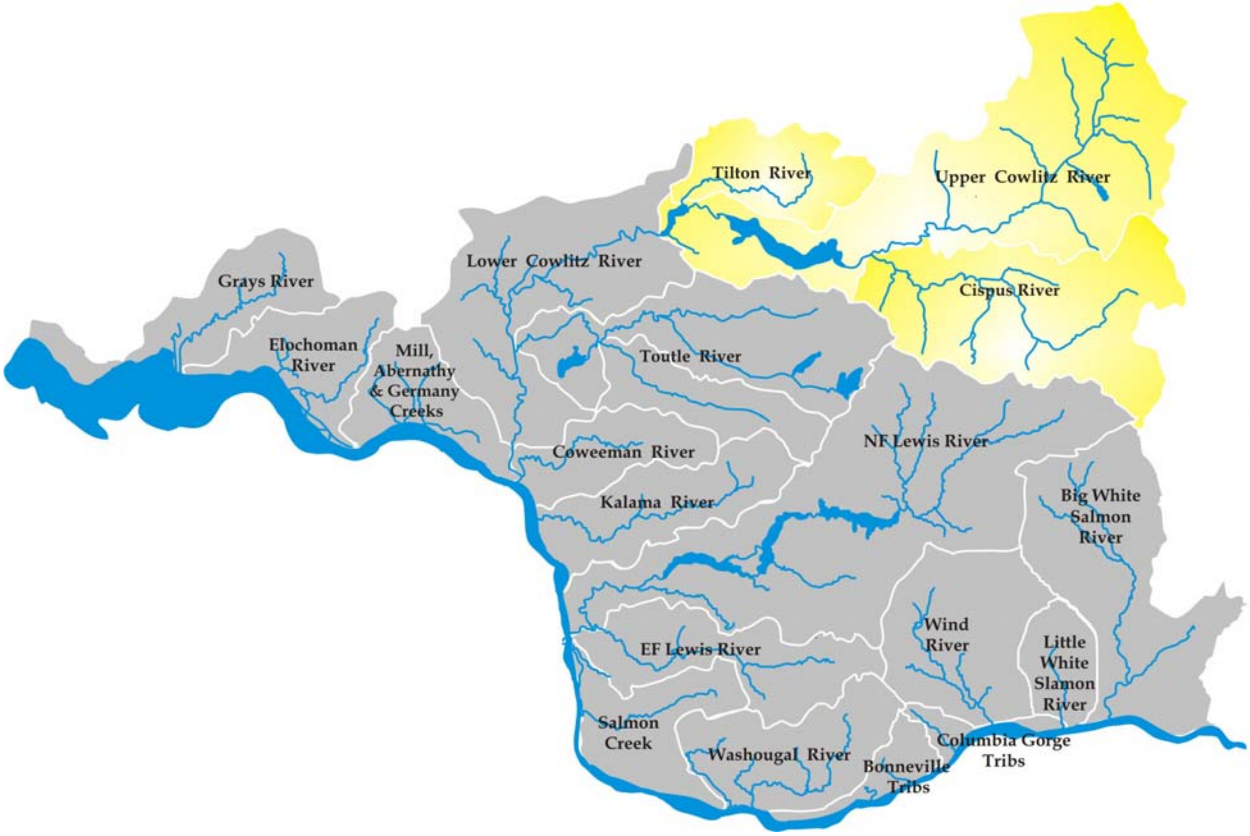
Subbasin Plan Vol. II.E.
Cowlitz Subbasin – Upper Cowlitz



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1.0 Upper Cowlitz – Executive Summary

This plan describes a vision, strategy, and actions for recovery of listed salmon, steelhead, and trout species to healthy and harvestable levels, and mitigation of the effects of the Columbia River Hydro system in Washington lower Columbia River subbasins. Recovery of listed species and hydropower mitigation is accomplished at a regional scale. This plan for the Upper Cowlitz Basin describes implementation of the regional approach within this basin, as well as assessments of local fish populations, limiting factors, and ongoing activities that underlie local recovery or mitigation actions. The plan was developed in a partnership between the Lower Columbia Fish Recovery Board (Board), Northwest Power and Conservation Council, federal agencies, state agencies, tribal nations, local governments, and others.

The Cowlitz River Basin is one of eleven major subbasins in the Washington portion of the Lower Columbia Region. The upper portion of the subbasin (above Mayfield Dam) historically supported thousands of fall Chinook, spring Chinook, coho, and winter steelhead. Today, numbers of naturally spawning salmon and steelhead are limited to the adult returns associated with a program to reintroduce natural spawning salmon and steelhead above the hydrosystem. Chinook, chum, and steelhead have been listed as Threatened under the Endangered Species Act and coho is proposed for listing. The decline has occurred over decades and the reasons are many. Hydropower development and operation have altered flows, habitat, and blocked passage of salmon and steelhead to their historical habitats. Passage of salmon and steelhead around the dams and reservoirs in the Upper Cowlitz Basin will need to be sufficiently adequate to ensure viability levels that meet regional recovery objectives. This means that the populations are productive, abundant, exhibit multiple life history strategies, and utilize significant portions of the basin. In portions of the basin, habitat quality has been reduced by residential development, agriculture, and forestry practices. Key habitats have been isolated or eliminated by channel modifications and through diking, filling, and draining of floodplains and wetlands. Altered habitat conditions have increased predation. Competition and interbreeding with domesticated or nonlocal hatchery fish has reduced productivity. Fish are harvested in fresh and saltwater fisheries.

In recent years, agencies, local governments, and other entities have actively addressed the various threats to salmon and steelhead, but much remains to be done. One thing is clear: no single threat is responsible for the decline in these populations. All threats and limiting factors must be reduced if recovery is to be achieved. An effective recovery plan must also reflect a realistic balance within physical, technical, social, cultural and economic constraints. The decisions that govern how this balance is attained will shape the region’s future in terms of watershed health, economic vitality, and quality of life.

This plan represents the current best estimation of necessary actions for recovery and mitigation based on thorough research and analysis of the various threats and limiting factors that impact Upper Cowlitz River fish populations. Specific strategies, measures, actions and priorities have been developed to address these threats and limiting factors. The specified strategies identify the best long term and short term avenues for achieving fish restoration and mitigation goals. While it is understood that data, models, and theories have their limitations and growing knowledge will certainly spawn new strategies, the Board is confident that by implementation of the recommended actions in this plan, the population goals in the Upper Cowlitz River Basin can be achieved. Success will depend on implementation of these strategies at the program and project level. It remains uncertain what level of effort will need to be invested in each area of impact to ensure the desired result. The answer to the question of precisely how much is enough is currently beyond our understanding of the species and ecosystems and can only be answered through ongoing monitoring and adaptive management against the backdrop of what is socially possible.

1.1 Key Priorities

Many actions, programs, and projects will make necessary contributions to recovery and mitigation in the Upper Cowlitz Basin. The following list identifies the most immediate priorities.

1. Provide Upstream and Downstream Passage Through the Cowlitz Basin Hydrosystem

The system of dams on the mainstem Cowlitz River, beginning with Mayfield Dam at River Mile 52, block all volitional access to the upper basin, consisting of up to 300 or more miles of habitat for anadromous species. Juvenile and adult fish are currently trucked around the system of dams and reservoirs. Tacoma Power and Lewis County PUD currently operate the facilities in accordance with licenses with the Federal Energy Regulatory Commission (FERC), which rely on an adaptive management approach to implementing passage improvements. Partners in the relicensing process must ensure that adequate measures are taken to restore self-sustaining natural production of ESA-listed salmonids in the Upper Cowlitz Basin.

2. Protect Intact Forests in Headwater Basins

The Cispus Basin, Upper Mainstem Cowlitz Basin, and many headwater tributaries are in National Forest Lands, with a portion of the northern basin lying within Mount Rainier National Park. These lands are heavily forested with relatively intact landscape conditions that support functioning watershed processes. Streams are unaltered, road densities are low, and riparian areas and uplands are characterized by mature forests. Existing legal designations and management policy are expected to continue to offer protection to these lands.

3. Manage Forest Lands to Protect and Restore Watershed Processes

Much of the Tilton, reservoir tributary basins, and the lower portion of the Upper Mainstem Basin are managed for commercial timber production and have experienced intensive past forest practices activities. Proper forest management is critical to fish recovery. Past forest practices have reduced fish habitat quantity and quality by altering stream flow, increasing sediment, and reducing riparian zones. In addition, forest road culverts have blocked fish passage in small tributary streams. Effective implementation of new forest practices through the Department of Natural Resources' Habitat Conservation Plan, State Forest Practices Rules, and the Northwest Forest Plan are expected to dramatically improve conditions by restoring passage, protecting riparian conditions, reducing sediment inputs, lowering water temperatures, improving flows, and restoring habitat diversity. Improvements will benefit all species, particularly winter steelhead and coho.

4. Manage Growth and Development to Protect Watershed Processes and Habitat Conditions

The human population in the basin is relatively low, but it is projected to grow by at least twenty percent in the next twenty years. Population growth will primarily occur in lower river valleys and along the major stream corridors. This growth will result in the conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions. These changes will provide a variety of risks and opportunities for preserving the rural character and local economic base while also protecting and restoring natural fish populations and habitats.

5. Restore Valley Floodplain Function and Stream Habitat Diversity

Much of the mainstem Cowlitz (between Lake Scanewa and Packwood) and the Tilton River (near Morton, WA) are used for agriculture and residential development. Dike building and bank stabilization have heavily impacted fish habitat in these areas. Removing or modifying channel control and containment structures to reconnect the stream and its floodplain where this is feasible and can be done without increasing risks of substantial flood damage will restore normal habitat-forming processes to reestablish habitat complexity, off-channel habitats, and conditions favorable to fish spawning and rearing. These improvements will be particularly beneficial to spring Chinook and coho. Partially restoring normal floodplain functions will also help control catastrophic flooding and maintain wetland and riparian habitats critical to other fish, wildlife, and plant species. Existing floodplain function and habitats will be protected through local land use ordinances, partnerships with landowners, and the acquisition of land, where appropriate. Restoration will be achieved by working with willing landowners, non-governmental organizations, conservation districts, and state and federal agencies.

6. Hatchery Priorities are Consistent with Conservation Objectives

Hatcheries throughout the Columbia basin historically focused on producing fish for fisheries as mitigation for hydropower development and widespread habitat degradation. Emphasis of hatchery production without regard for natural populations can pose risks to natural population viability. Hatchery priorities must be aligned to conserve natural populations, enhance natural fish recovery, and avoid impeding progress toward recovery while continuing to provide fishery mitigation benefits. The Cowlitz hatchery program will produce and/or acclimate spring Chinook, coho and winter steelhead for use in the Upper Cowlitz Basin. Hatchery fish will be used to supplement natural production in appropriate areas of the basin and adjacent tributary streams, develop a local broodstock to reestablish historical diversity and life history characteristics, and also to provide fishery mitigation in a manner that does not pose significant risk to natural population rebuilding efforts. Fall Chinook releases in the upper Cowlitz have been discontinued as not to interfere with spring Chinook re-introduction efforts

7. Manage Fishery Impacts so they do not Impede Progress Toward Recovery

This near-term strategy involves limiting fishery impacts on natural populations to ameliorate extinction risks until a combination of measures can restore fishable natural populations. There is no directed Columbia River or tributary harvest of ESA-listed Cowlitz River salmon and steelhead. This practice will continue until the populations are sufficiently recovered to withstand such pressure and remain self-sustaining. Some upper Cowlitz River salmon and steelhead are incidentally taken in mainstem Columbia River and ocean mixed stock fisheries for strong wild and hatchery runs of fall Chinook and coho. These fisheries will be managed with strict limits to ensure this incidental take does not threaten the recovery of wild populations including those from the Upper Cowlitz Basin. Steelhead will continue to be protected from significant fishery impacts in the Columbia River and are not subject to ocean fisheries. Selective fisheries for marked hatchery steelhead and coho (and fall Chinook after mass marking occurs) will be a critical tool for limiting wild fish impacts. State and federal legislative bodies will be encouraged to develop funding necessary to implement mass-marking of fall Chinook, thus enabling a selective fishery with lower impacts on wild fish. State and federal fisheries managers will better incorporate Lower Columbia indicator populations into fisheries impact models.

8. Reduce Out-of-Subbasin Impacts so that the Benefits of In-Basin Actions can be Realized

Upper Cowlitz River salmon and steelhead are exposed to a variety of human and natural threats in migrations outside of the subbasin. Human impacts include drastic habitat changes in the Columbia River estuary, effects of Columbia Basin hydropower operation on mainstem, estuary, and nearshore ocean conditions, interactions with introduced animal and plant species, and altered natural predation patterns by northern pikeminnow, birds, seals, and sea lions. A variety of restoration and management actions are needed to reduce these out-of-basin effects so that the benefits of in-basin actions can be realized. To ensure equivalent sharing of the recovery and mitigation burden, impacts in each area of effect (habitat, hydropower, etc.) should be reduced in proportion to their significance to species of interest.

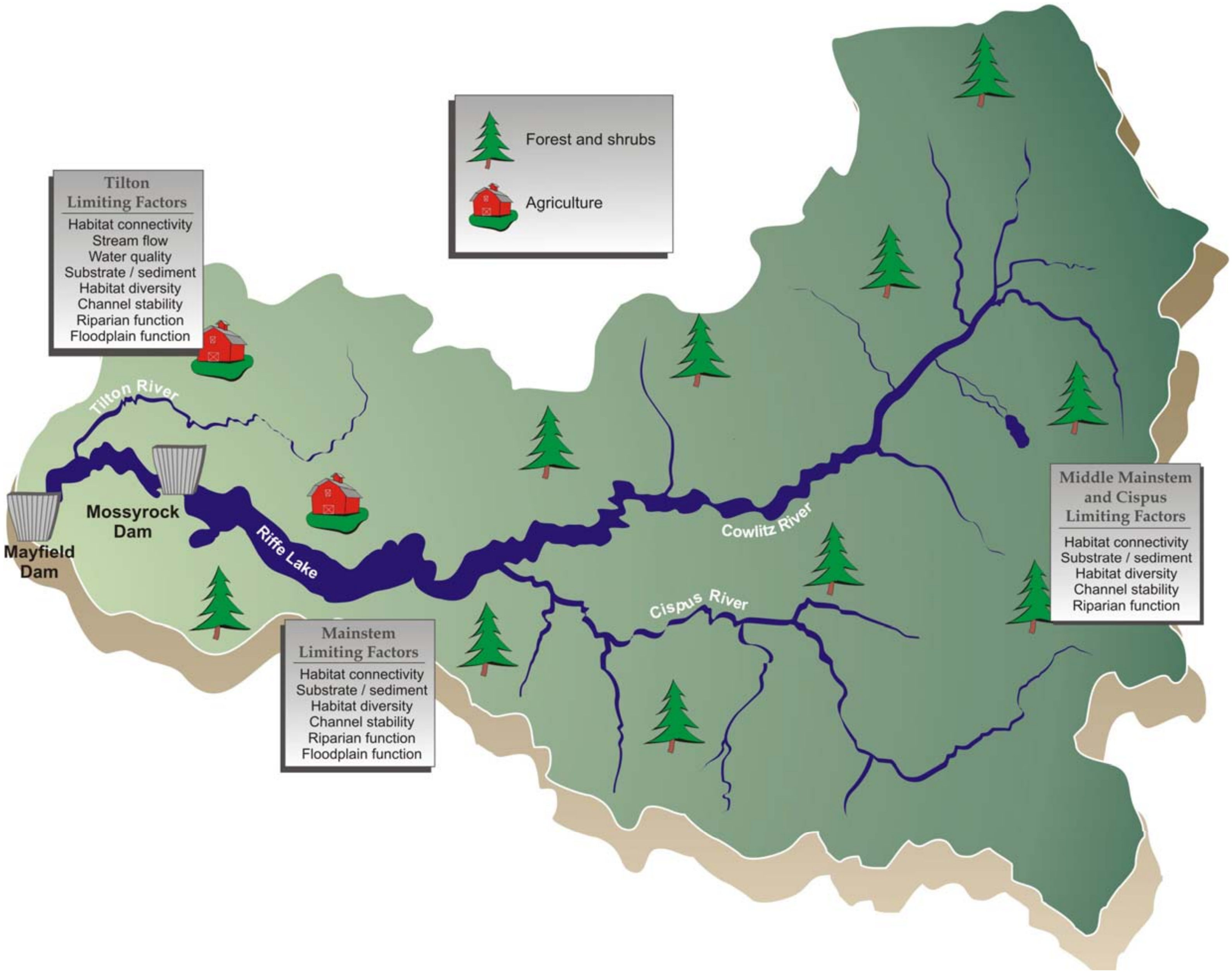

Forest and shrubs
Agriculture
Tilton
Limiting Factors
Habitat connectivity
Stream flow
Water quality
Substrate / sediment
Habitat diversity
Channel stability
Riparian function
Floodplain function
Tilton River
Mossyrock
Dam
Mayfield
Dam
Riffe Lake
Cowlitz River
Cispus River
Mainstem
Limiting Factors
Habitat connectivity
Substrate / sediment
Habitat diversity
Channel stability
Riparian function
Floodplain function
Middle Mainstem
and Cispus
Limiting Factors
Habitat connectivity
Substrate / sediment
Habitat diversity
Channel stability
Riparian function

Figure 1. Key features of the Upper Cowlitz Subbsin including a summary of limiting fish habitat factors in different areas and the status and relative distribution of focal salmonid species.

2.0 Background

This plan describes a vision and framework for rebuilding salmon and steelhead populations in Washington's Upper Cowlitz River Subbasin. The plan addresses subbasin elements of a regional recovery plan for Chinook salmon, chum salmon, coho salmon, steelhead, and bull trout listed or under consideration for listing as Threatened under the federal Endangered Species Act (ESA). The plan also serves as the subbasin plan for the Northwest Power and Conservation Council (NPCC) Fish and Wildlife Program to address effects of construction and operation of the Federal Columbia River Power System.

Development of this plan was led and coordinated by the Washington Lower Columbia River Fish Recovery Board (LCFRB). The Board was established by state statue (RCW 77.85.200) in 1998 to oversee and coordinate salmon and steelhead recovery efforts in the lower Columbia region of Washington. It is comprised of representatives from the state legislature, city and county governments, the Cowlitz Tribe, private property owners, hydro project operators, the environmental community, and concerned citizens. A variety of partners representing federal agencies, Tribal Governments, Washington state agencies, regional organizations, and local governments participated in the process through involvement on the LCFRB, a Recovery Planning Steering Committee, planning working groups, public outreach, and other coordinated efforts.

The planning process integrated four interrelated initiatives to produce a single Recovery/Subbasin Plan for Washington subbasins of the lower Columbia:

- Endangered Species Act recovery planning for listed salmon and trout.
- Northwest Power and Conservation Council (NPCC) fish and wildlife subbasin planning for eight full and three partial subbasins.
- Watershed planning pursuant to the Washington Watershed Management Act, RCW 90-82.
- Habitat protection and restoration pursuant to the Washington Salmon Recovery Act, RCW 77.85.

This integrated approach ensures consistency and compatibility of goals, objectives, strategies, priorities and actions; eliminates redundancy in the collection and analysis of data; and establishes the framework for a partnership of federal, state, tribal and local governments under which agencies can effectively and efficiently coordinate planning and implement efforts.

The plan includes an assessment of limiting factors and threats to key fish species, an inventory of related projects and programs, and a management plan to guide actions to address specific factors and threats. The assessment includes a description of the subbasin, focal fish species, current conditions, and evaluations of factors affecting focal fish species inside and outside the subbasin. This assessment forms the scientific and technical foundation for developing a subbasin vision, objectives, strategies, and measures. The inventory summarizes current and planned fish and habitat protection, restoration, and artificial production activities and programs. This inventory illustrates current management direction and existing tools for plan implementation. The management plan details biological objectives, strategies, measures, actions, and expected effects consistent with the planning process goals and the corresponding subbasin vision.

3.0 Assessment

3.1 Subbasin Description

3.1.1 *Topography & Geology*

For the purposes of this assessment, the Upper Cowlitz basin is the watershed area contributing to Mayfield Dam. The basin encompasses 1,390 square miles in portions of Lewis, Skamania, Pierce, and Yakima Counties. The basin is within WRIA 26 of Washington State. Major tributaries include the Cispus, Clear Fork, Ohanapecosh, and Tilton.

Headwater streams consist of high gradient canyons in the steep, heavily timbered mountainous areas surrounding Mounts Rainier, Adams, St. Helens, and the Goat Rocks Wilderness. The high point in the basin is the summit of Mt. Rainier at 14,410 feet. An upper alluvial valley extends from the junction of the Muddy Fork and the Ohanapecosh Rivers (near Packwood, Washington) to Cowlitz Falls Reservoir (RM 99.5).

Cowlitz Falls Dam (RM 88.5) was constructed in 1994, creating a long, narrow 11-mile reservoir. Below the Cowlitz Falls Dam, the river enters Riffe Lake, a 23.5 mile long reservoir created by the 606-foot high Mossyrock Dam (RM 66), completed in 1968. Riffe Lake is operated as a storage reservoir by Tacoma Power for flood control and hydropower production. Due to characteristics of the dam and reservoir, no fish passage facilities have been constructed at Mossyrock Dam. A few miles below the dam, the river enters Mayfield Lake, a 13.5 mile long reservoir created by the construction of Mayfield Dam (RM 52) in 1962. Historically, the portion of the stream inundated by the three reservoirs was made up of a series of deep canyons. The salmon hatchery Barrier Dam (RM 49.5) located below Mayfield Dam is a collection facility for trapping and hauling fish into the upper basin, a practice that has been in effect since 1969.

The geology of the headwater streams consists of volcanic rocks of the Cascade Mountains. The upper basin is made up of andesite and basalt flows. The most common forest soils are Haplohumults (reddish brown lateritic soils) and the most common grassland soils are Argixerolls (prairie soils) (WDW 1990).

3.1.2 *Climate*

The basin has a typical northwest maritime climate. Summers are dry and warm and winters are cool, wet, and cloudy. Mean monthly precipitation ranges from 1.9 inches (July) to 19 inches (November) at Paradise on Mt. Rainier and from 1.1 inches (July) to 8.8 inches (November) at Mayfield Dam. Mean annual precipitation ranges from 56 inches at Mayfield Dam to over 116 inches at Paradise (WRCC 2003). Most precipitation occurs between October-March. Snow and freezing temperatures are common in the upper basin while rain predominates in the middle and lower elevations.

3.1.3 *Land Use, Ownership, and Cover*

Forestry is the dominant land use in the basin, with over 70% of the land managed as public and private commercial forestland. The Upper Cowlitz also has a substantial amount of land in non-commercial forest and reserved forest, owing primarily to the large public land holdings (Gifford Pinchot National Forest and Mt. Rainier National Park) in the basin. Much of the private land in the river valleys is agricultural and residential, with substantial impacts to riparian and floodplain areas in places. Population centers in the subbasin consist primarily of small rural towns including Morton, Randle, and Packwood, WA. Projected population change from 2000 to 2020 for unincorporated areas in WRIA 26 is 22% (LCFRB 2001). The State of

Washington owns, and the Washington State Department of Natural Resources (DNR) manages the beds of all navigable waters within the subbasin. Any proposed use of those lands must be approved in advance by the DNR. A breakdown of land ownership is presented in Figure 2. Figure 3 displays the pattern of landownership for the basin

Forests above 3,500 feet are mostly Pacific silver fir, with Douglas fir, western hemlock, mountain hemlock, and lodgepole pine as associates. Below 3,500 feet, climax species are western hemlock, Douglas fir, and western red cedar. Alder, cottonwood, maple, and willow dominate the larger stream riparian areas (WDW 1990). A breakdown of land cover is presented in Figure 2. Figure 3 displays the pattern of land cover / land-use.

3.1.4 *Development Trends*

Population centers in the subbasin consist primarily of small rural towns including Morton, Randle, and Packwood, WA. Projected population change from 2000 to 2020 for unincorporated areas in WRIA 26 is 22% (LCFRB 2001). Population growth will primarily occur in lower river valleys and along the major stream corridors. This growth will result in the conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions.

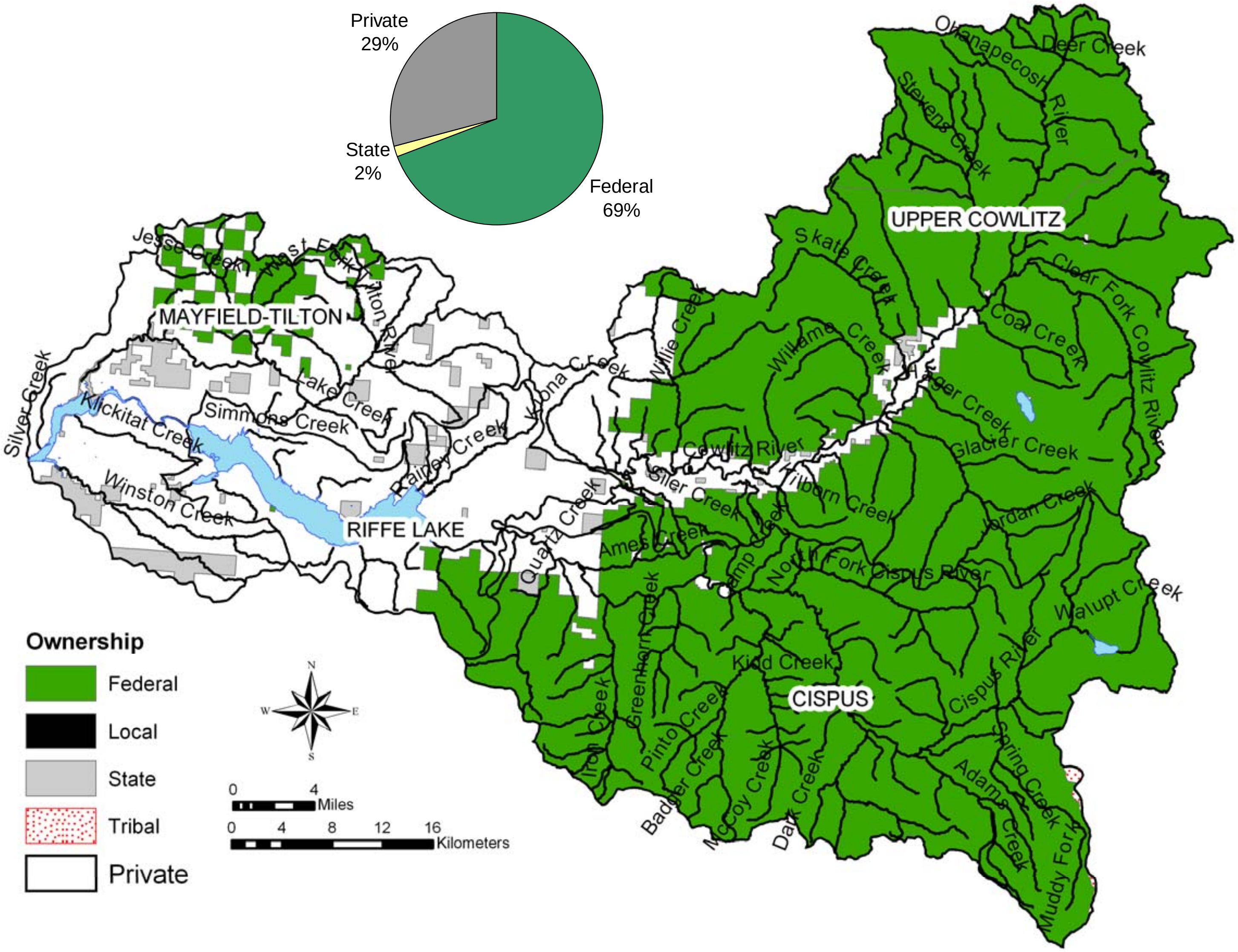


Figure 2. Landownership within the Upper Cowlitz basin. Data is WDNR data that was obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

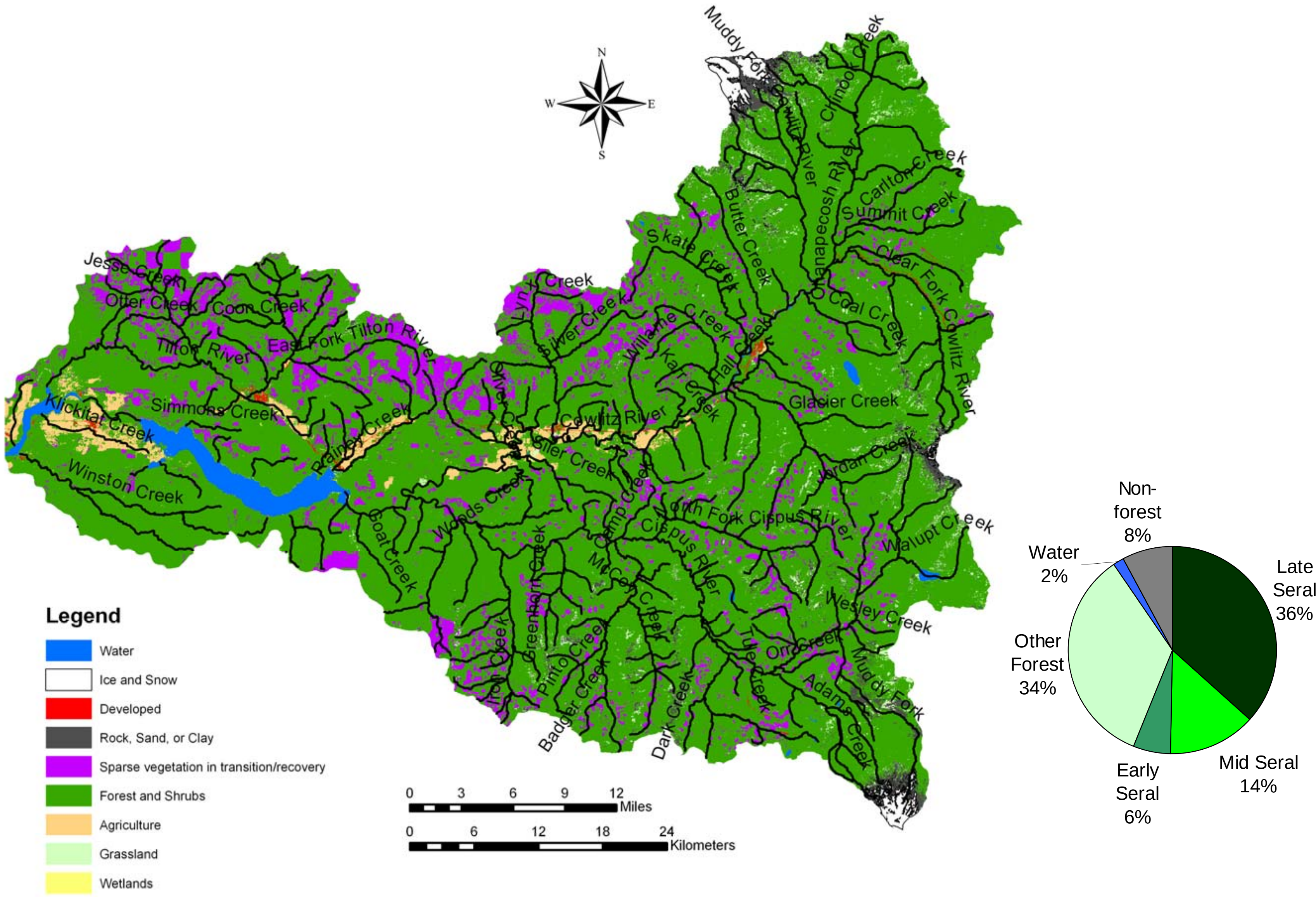


Figure 3. Land cover within the Upper Cowlitz basin. Vegetation cover (pie chart) derived from Landsat data based on method in Lunetta et al. 1997. Mapped data was obtained from the USGS National Land Cover Dataset (NLCD).

3.2 Focal and Other Species of Interest

Listed salmon, steelhead, and trout species are focal species of this planning effort for the Upper Cowlitz Basin. Other species of interest were also identified as appropriate. Species were selected because they are listed or under consideration for listing under the U.S. Endangered Species Act or because viability or use is significantly affected by hydropower development. The upper Cowlitz ecosystem supports and depends on a wide variety of fish and wildlife in addition to designated species. A comprehensive ecosystem-based approach to salmon and steelhead recovery will provide significant benefits to other native species through restoration of landscape-level processes and habitat conditions. Other fish and wildlife species not directly addressed by this plan are subject to a variety of other Federal, State, and local planning or management activities.

Focal salmonid species in upper Cowlitz River watersheds include fall Chinook, spring Chinook, coho and winter steelhead. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 1). Extinction risks are significant for all focal species – the current health or viability of ranges from very low for fall Chinook and coho to low for spring Chinook and winter steelhead. Spring chinook, coho, and winter steelhead have been reintroduced into the upper Cowlitz habitats in recent years in an effort to reestablish natural salmon and steelhead production. Returns of spring Chinook, coho and winter steelhead include both natural and hatchery produced fish.

Table 1. Status of focal salmond and steelhead populations in theLower Cowlitz River subbasin.

Focal Species	ESA Status	Hatchery Component[1]	Historical numbers[2]	Recent numbers[3]	Current viability[4]	Extinction risk[5]
Fall Chinook	Threatened	Yes	24,000-28,000	None	Very Low	70%
Spring Chinook	Threatened	Yes	35,000-60,000	NA	Low	60%
Coho	Proposed	Yes	20,000-70,000	NA	Very Low	90%
Winter Steelhead	Threatened	Yes	2,000-17,000	NA	Low	60-70%[6]

[1] *Significant numbers of hatchery fish are released in the subbasin.*

[2] *Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NOAA rough calculations.*

[3] *Approximate current annual range in number of naturally-produced fish returning to the subbasin.*

[4] *Prospects for long term persistence based on criteria developed by the NOAA Technical Recovery Team.*

[5] *Probability of extinction within 100 years corresponding to estimated viability.*

[6] *60% in the Upper Cowlitz and Cispus, and 70% in the Tilton.*

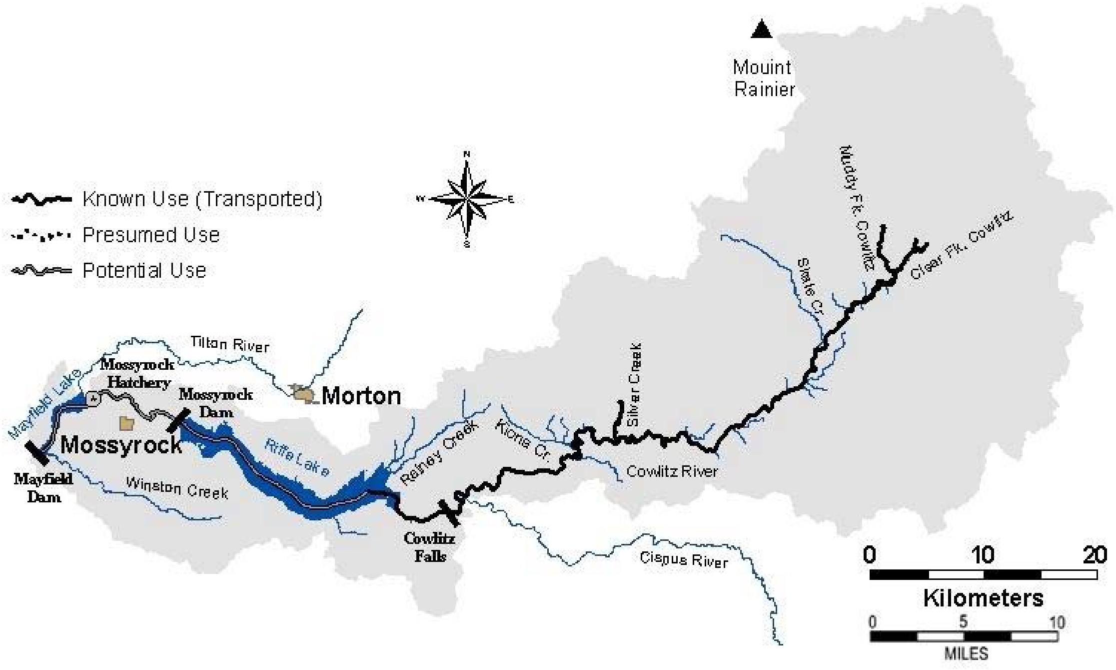
Other species of interest in the Upper Cowlitz Basin include coastal cutthroat trout and Pacific lamprey. These species have been affected by many of the same habitat factors that have reduced numbers of anadromous salmonids.

Brief summaries of the population characteristics and status follow. Additional information on life history, population characteristics, and status assessments may be found in Appendix A (focal species) and B (other species).

3.2.1 *Fall Chinook—Cowlitz Subbasin (Cowlitz)*

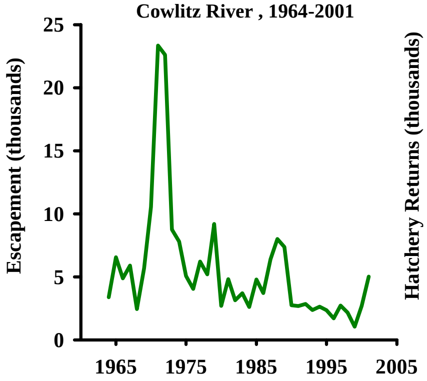
ESA: Threatened 1999	SASSI: Depressed 2002

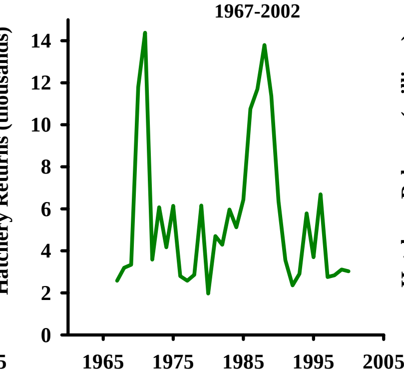
The historical upper Cowlitz adult population is estimated from 24,000-28,000 fish, where they were distributed throughout the upper basin. The natural return was blocked by Mayfield Dam in 1962. Salmon and steelhead were passed over the dam from 1962-66 and hauled to the Tilton and upper Cowlitz from 1967-80, and again beginning in 1994. Fall Chinook are not currently being hauled to the upper Cowlitz to avoid conflict with reintroduction of spring Chinook. Recovery efforts for fall Chinook are currently focused on the lower Cowlitz population.

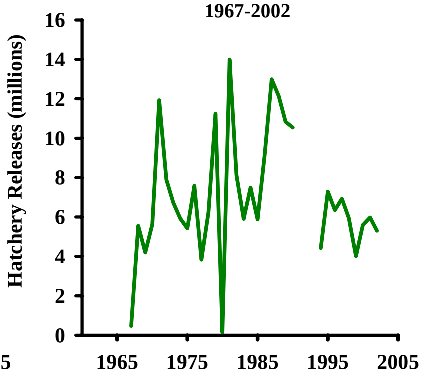


Distribution

- In the Cowlitz River, spawning occurs in the mainstem between the Cowlitz River Salmon Hatchery and the Kelso Bridge (~45 miles), but is concentrated in the area between the Cowlitz Salmon and Trout Hatcheries (RM 52 and 41.3)
- Historically, Cowlitz River fall Chinook were distributed from the mouth to upper tributaries such as the Ohanapecosh and Tilton Rivers and throughout the upper basin
- Completion of Mayfield Dam in 1962 blocked access above the dam (RM 52); all fish were passed over the dam from 1962–66; from 1967–80, small numbers of fall Chinook were hauled to the Tilton and upper Cowlitz
- An adult trap and haul program began again in 1994 where fish were collected below Mayfield Dam and released above Cowlitz Falls Dam; fall Chinook are currently released in the upper Cowlitz and Cispus Rivers


Spawner escapement estimates for the Cowlitz River , 1964-2001


Cowlitz Salmon Hatchery rack counts, 1967-2002


Cowlitz Salmon Hatchery release data, 1967-2002

Life History

- Fall Chinook enter the Cowlitz River from early September to late November
- Natural spawning in the Cowlitz River occurs between September and November, over a broader time period than most fall Chinook; the peak is usually around the first week of November
- Age ranges from 2-year-old jacks to 6-year-old adults, with dominant adult age of 3, 4, and 5 (averages are 16.49%, 58.05%, and 19.31%, respectively)
- Fry emerge around March/April, depending on time of egg deposition and water temperature; fall Chinook fry spend the spring in fresh water, and emigrate in the summer as sub-yearlings
- Cowlitz fall Chinook display life history characteristics (spawn timing, migration patterns) that fall between tules and Lewis River late spawning wild fall Chinook

Diversity

- The Cowlitz fall Chinook stock is designated based on distinct spawning timing and distribution
- Genetic analysis of Cowlitz River Hatchery fall Chinook from 1981, 1982, and 1988 determined they were similar to, but distinct from, Kalama Hatchery fall Chinook and distinct from other Washington Chinook stocks

Abundance

- Historical abundance of natural spawning fall Chinook in the Cowlitz River is estimated to have once been 100,000 adults, declining to about 18,000 adults in the 1950s, 12,000 in the 1960s, and recently to less than 2,000
- In 1948, WDF and WDG estimated that the Cowlitz River produced 63,612 adult fall Chinook; escapement above the Mayfield Dam site was at least 14,000 fish
- Fall Chinook escapement estimates in 1951 were 10,900 in the Cowlitz and minor tributaries, 8,100 in the Cispus, and 500 in the Tilton
- From 1961–66, an average of 8,535 fall Chinook were counted annually at Mayfield Dam
- Cowlitz River spawning escapement from 1964-2001 ranged from 1,045 to 23,345 (average 5,522)
- Currently hatchery production accounts for most fall Chinook returning to the Cowlitz River
- Natural spawning escapement goal is 3,000 fish; the goal was not met from 1990-2000

Productivity & Persistence

- NMFS Status Assessment for the Cowlitz River indicated a 0.15 risk of 90% decline in 25 years and a 0.33 risk of 90% decline in 50 years; the risk of extinction in 50 years was 0
- Two adult production potential estimates have been reported for the upper Cowlitz: 63,818 and 93,015
- Smolt density model predicted natural production potential for the Cowlitz River below Mayfield Dam of 2,183,000 smolts; above Mayfield Dam the model predicts production potential of 357,000 smolts from the Tilton River and 4,058,000 smolts above Cowlitz Falls
- Current juvenile production from natural spawning is presumed to be low

Hatchery

- Cowlitz River Salmon Hatchery is located about 2 miles downstream of Mayfield Dam; hatchery was completed in 1967; broodstock is primarily native Cowlitz fall Chinook
- Hatchery releases of fall Chinook in the Cowlitz River began in 1952; hatchery release data are displayed for 1967-2002
- The current hatchery program goal is 5 million fall Chinook juveniles released annually

Harvest

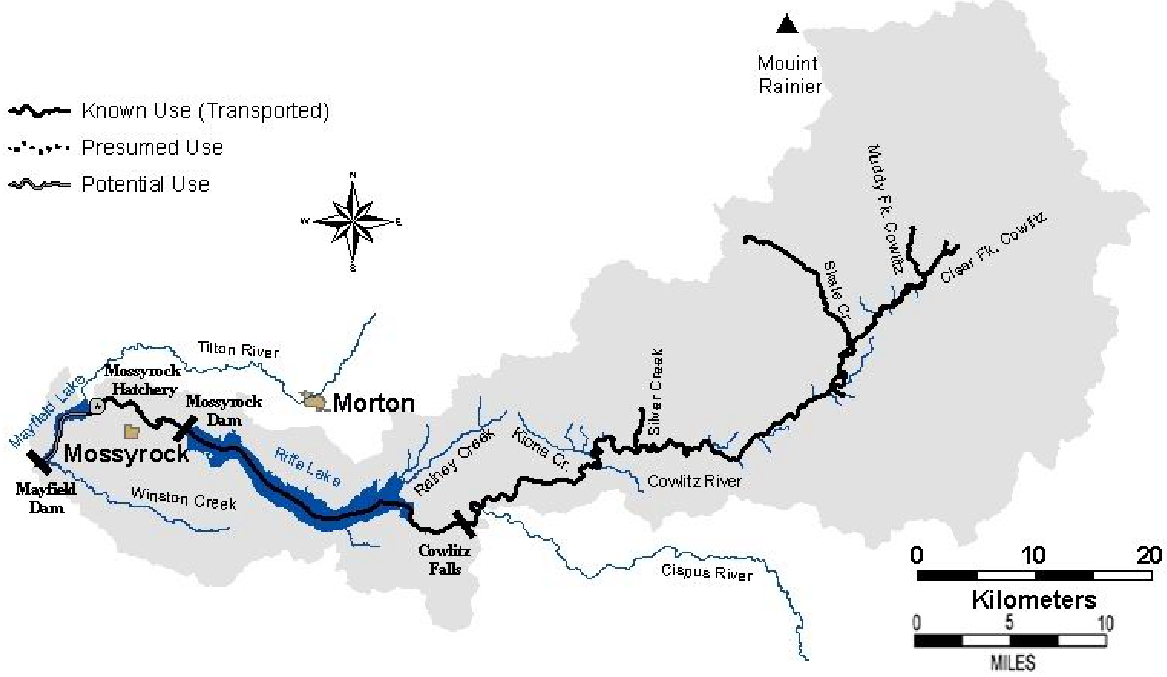
- Fall Chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, and in Columbia River commercial and sport fisheries
- Ocean and mainstem Columbia River fisheries are managed for Snake and Coweeman River wild fall Chinook ESA harvest rate limits which limits the harvest of Cowlitz fall Chinook
- Cowlitz fall Chinook are important contributors to Washington ocean sport and troll fisheries and to the Columbia River estuary sport (Buoy 10) fishery
- CWT data analysis of the 1989–94 brood years indicates a total Cowlitz Hatchery fall Chinook harvest rate of 33% with 67% accounted for in escapement
- The majority of fishery CWT recoveries of 1989–94 brood Cowlitz Hatchery fall Chinook were distributed between Washington ocean (30%), British Columbia (21%), Alaska (15%), Cowlitz River (11%), and Columbia River (8%) sampling areas
- Annual harvest is variable depending on management response to annual abundance in PSC (US/Canada), PFMC (US ocean), and Columbia River Compact Forums
- Sport harvest in the Cowlitz River averaged 2,672 fall Chinook annually from 1977–86

  Freshwater sport fisheries in the Cowlitz River are managed to achieve adult fall Chinook hatchery escapement goals

3.2.2 *Spring Chinook—Cowlitz Subbasin (Upper)*

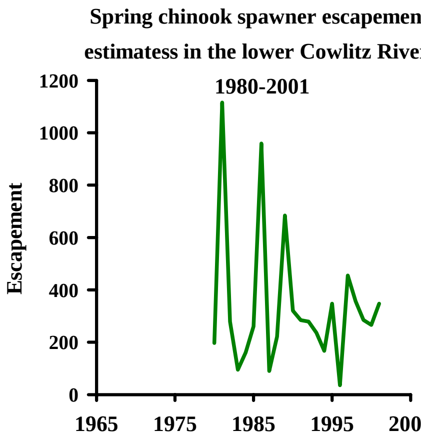
ESA: Threatened 1999	**SASSI: Depressed 2002**

The historical upper Cowlitz adult population is estimated from 35,000-60,000 fish. Current natural spawning returns are part of an upper Cowlitz and Cispus River reintroduction program. Cowlitz origin hatchery produced spring Chinook are utilized for supplementation of natural spring Chinook. Spawning primarily occurs in the mainstem upper Cowlitz above Packwood and in the Cispus River between Iron and East Canyon creeks. Natural spawning occurs between late August and early October. Juveniles typically spend a full rear rearing in the upper Cowlitz and Cispus before migrating. Juveniles are captured at the Cowlitz Falls collection facility, acclimated at Cowlitz Salmon Hatchery and released into the lower Cowlitz.

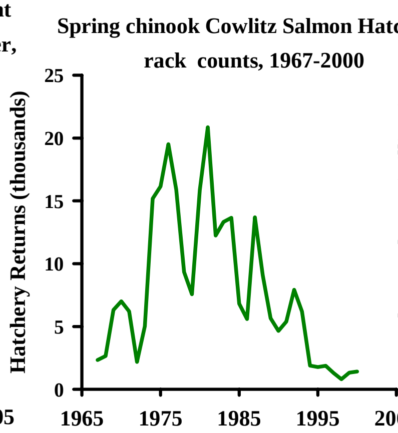


Distribution

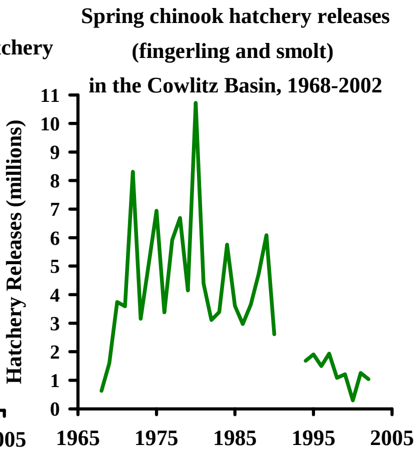
- Historically, all spawning in the Cowlitz River occurred above the Mayfield Dam site, particularly in the mainstem Cowlitz River above Packwood and in the Cispus River between Iron and East Canyon Creeks (spring Chinook were thought to have also spawned in the Tilton River, but confirmation and distribution of spawning is unknown)
- Completion of Mayfield Dam in 1962 blocked access above the dam (RM 52); fish were passed over the dam from 1962-66; from 1974-80, an average of 2,838 spring Chinook were hauled to the Tilton and upper Cowlitz
- An adult trap and haul program began again in 1994 where fish were collected below Mayfield Dam and released above Cowlitz Falls Dam; spring Chinook are now released in the upper Cowlitz and Cispus rivers
- A collection facility is currently operating at the Cowlitz Falls Dam to collect emigrating spring Chinook smolts produced from adults released in the upper Cowlitz and Cispus rivers
- Natural spawning below Mayfield Dam is concentrated on the mainstem Cowlitz between the Cowlitz Salmon and Trout Hatcheries (~8.0 miles)



Spring chinook spawner escapement estimatess in the lower Cowlitz River, 1980-2001



Spring chinook Cowlitz Salmon Hatchery rack counts, 1967-2000



Spring chinook hatchery releases (fingerling and smolt) in the Cowlitz Basin, 1968-2002

Life History

- Spring Chinook enter the Cowlitz River from March through June
- Natural spawning in the Cowlitz River occurs between late August and early October; the peak is usually around mid-September
- Age ranges from 2 year-old jacks to 6 year-old adults, with 4 year-olds the dominant age class (average is 43.76%)
- Fry emerge between November and March, depending on time of egg deposition and water temperature; spring Chinook fry spend one full year in fresh water, and emigrate in their second spring as age-2 smolts

Diversity

- One of four spring Chinook populations in the Columbia River Evolutionarily Significant Unit (ESU)
- The Cowlitz spring Chinook stock was designated based on distinct spawning distribution and early spawning timing
- Genetic analyses of Cowlitz River Hatchery spring Chinook from 1982 and 1987 determined they were genetically similar to, but distinct from, Kalama Hatchery and Lewis River wild spring Chinook and significantly different from other Columbia River spring Chinook stocks

Abundance

- In 1948, WDF and WDG estimated that the Cowlitz River produced 32,490 adult spring Chinook
- Spring Chinook escapement estimates in 1951 were 10,400 in the Cowlitz basin, with 8,100 in the Cispus, 1,700 in the upper Cowlitz, 400 in the upper Toutle, and 200 in the Tilton
- From 1962-1966, an average of 9,928 spring Chinook were counted annually at Mayfield Dam
- From 1978-1985 (excluding 1984), an average of 3,894 spring Chinook were counted annually at Mayfield Dam
- Cowlitz River below Mayfield Dam spawning escapements from 1980-2001 ranged from 36-1,116 (average 338)
- Hatchery strays account for most spring Chinook currently returning to the Cowlitz River

Productivity & Persistence

- NMFS Status Assessment for the Cowlitz River indicated a 0.03 risk of 90% decline in 25 years and a 0.25 risk of 90% decline in 50 years; the risk of extinction in 50 years was 0
- Smolt density model predicted natural production potential for the Cowlitz River below Mayfield Dam of 329,400 smolts and 788,400 smolts for the Toutle River; above Mayfield Dam the model predicts production potential of 1,600,000 smolts
- Juvenile production from natural spawning is presumed to be low in the lower Cowlitz River

Hatchery

- Cowlitz River Salmon Hatchery is located about 2 miles downstream of Mayfield Dam; the hatchery was completed in 1967
- Hatchery releases of spring Chinook in the Cowlitz began in the 1940s; releases from the Salmon Hatchery into the Cowlitz River averaged 3,495,517 from 1968-1990, releases into the Toutle averaged 651,369 from 1972-1984
- In 2002, the Cowlitz Salmon and Trout Hatcheries reared and released 1,131,000 spring Chinook smolts: 929,000 into the lower Cowlitz, 106,600 into the Toutle and 95,900 to Deep River
- There are an additional 300,000 sub-yearling spring Chinook released above Cowlitz Falls Dam into the upper Cowlitz and Cispus rivers as part of the reintroduction program.

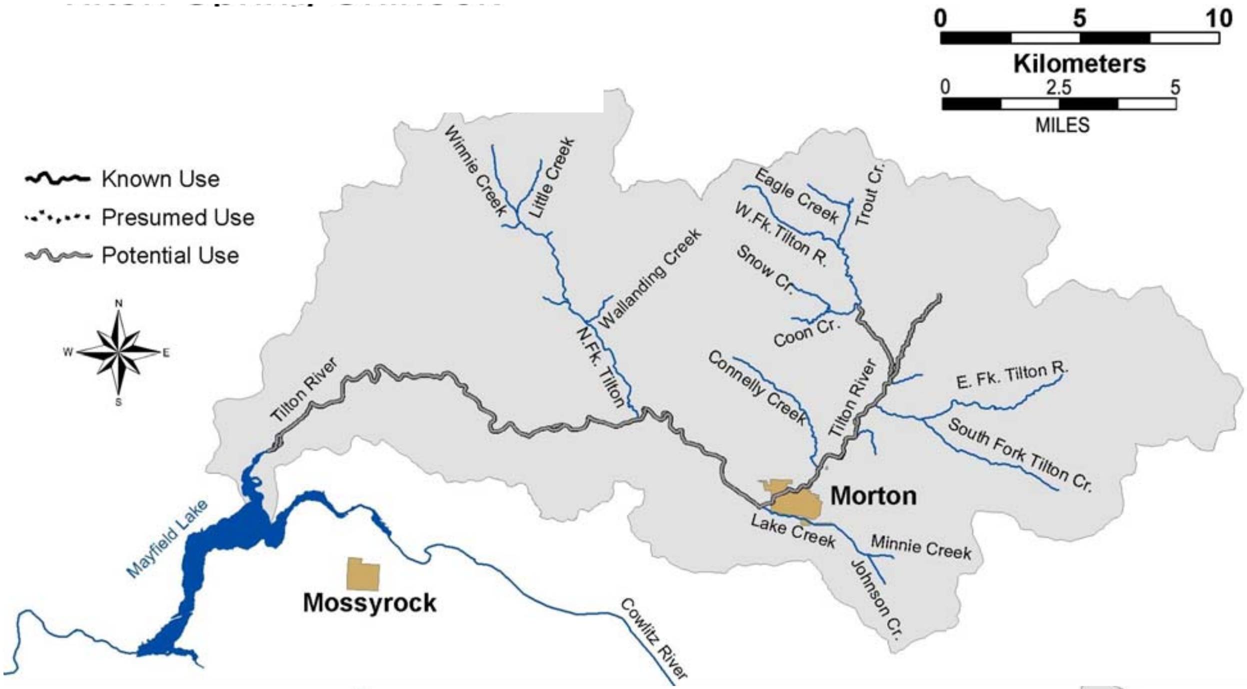
Harvest

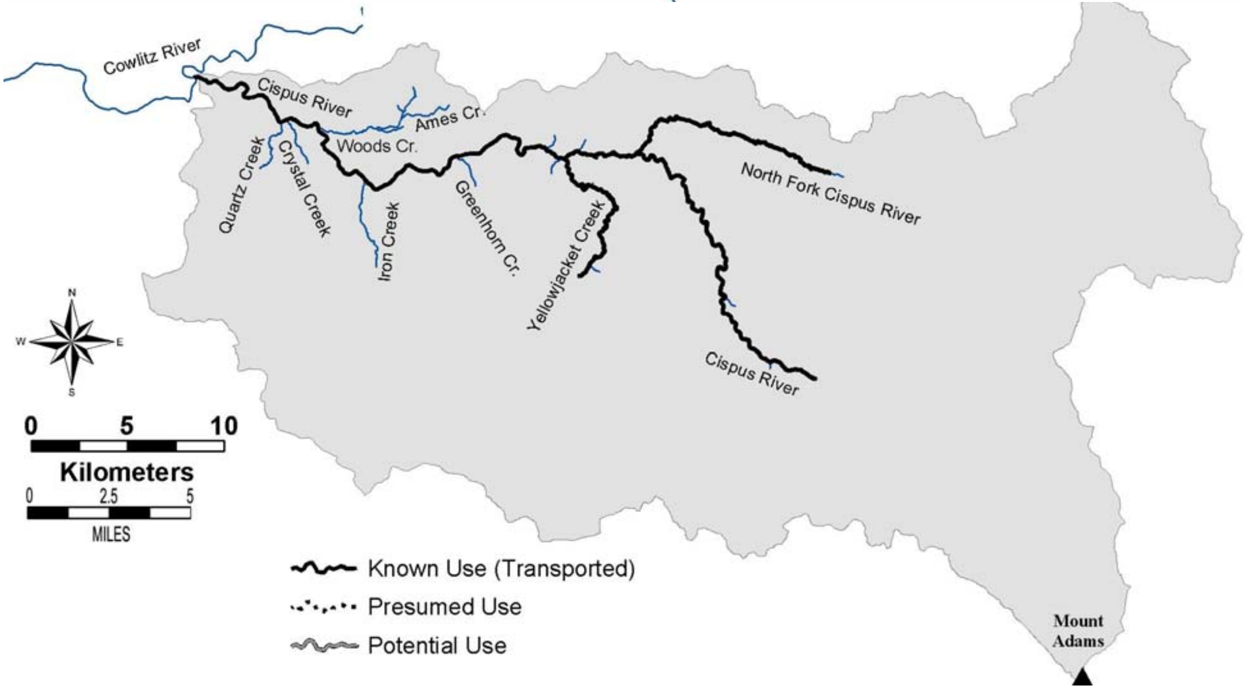
- Cowlitz spring Chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, in addition to Columbia River commercial and sport fisheries
- Coded-wire tag (CWT) data analysis of the 1989-1994 brood years indicates that 40% of the Cowlitz spring Chinook were harvested and 60% escaped to spawn
- Fishery recoveries of the 1989-1994 brook Cowlitz River Hatchery spring Chinook: Cowlitz sport (35%), British Columbia (29%), Washington Coast (22%), Columbia River (6%), Oregon coast (5%) and Alaska (3%)
- Mainstem Columbia River Harvest of Cowlitz spring Chinook was substantially reduced and after 1977 when April and May spring Chinook seasons were eliminated to protect upper Columbia and Snake wild spring Chinook.
- Mainstem Columbia harvest of Cowlitz River Hatchery spring Chinook increased in 2001-2002 when selective fisheries for adipose marked hatchery fish enabled mainstem spring fishing in April (and in May, 2002) again
- Sport harvest in the Cowlitz River averaged 7,100 spring Chinook annually from 1980-1984, but reduced to 2,100 from 1985–94 and to only 200 from 1995–2002.
- Tributary harvest is managed to attain the Cowlitz Hatchery adult broodstock escapement goal

3.2.3 *Spring Chinook—Cowlitz Subbasin (Tilton & Cispus)*

ESA: Threatened	**SASSI Depressed 2002**

The historical upper Cowlitz adult population is estimated from 35,000-60,000 fish. Current natural spawning returns are part of an upper Cowlitz and Cispus River reintroduction program. Cowlitz origin hatchery produced spring Chinook are utilized for supplementation of natural spring Chinook. Spawning primarily occurs in the mainstem upper Cowlitz above Packwood and in the Cispus River between Iron and East Canyon creeks. Natural spawning occurs between late August and early October. Juveniles typically spend a full rear rearing in the upper Cowlitz and Cispus before migrating. Juveniles are captured at the Cowlitz Falls collection facility, acclimated at Cowlitz Salmon Hatchery and released into the lower Cowlitz





Distribution

- Historically, all spawning in the Cowlitz River occurred above the Mayfield Dam site, particularly in the mainstem Cowlitz above Packwood and in the Cispus River between Iron and East Canyon Creeks (spring Chinook were thought to also have spawned in the Tilton River, but confirmation and distribution of spawning is unknown)
- Completion of Mayfield Dam in 1962 blocked access above the dam (RM 52); fish were passed over the dam from 1962-66; from 1974-80, an average of 2,838 spring Chinook were hauled to the Tilton and upper Cowlitz
- An adult trap and haul program began again in 1994 where fish were collected below Mayfield Dam and released above Cowlitz Falls Dam; spring Chinook are released in the upper Cowlitz and Cispus
- A collection facility is currently operating at the Cowlitz Falls Dam to collect emigrating spring Chinook smolts produced from adults released in the upper Cowlitz and Cispus Rivers
- Natural spawning in the Cowlitz River below Mayfield Dam is concentrated in the mainstem between the Cowlitz Salmon and Trout Hatcheries (~8.0 miles)

Life History

- Spring Chinook enter the Cowlitz River from March through June
- Natural spawning in the Cowlitz River occurs between late August and early October; the peak is usually around mid-September
- Age ranges from 2-year-old jacks to 6-year-old adults, with 4-year-olds the dominant age class (average is 43.76%)
- Fry emerge between November and March, depending on time of egg deposition and water temperature; spring Chinook fry spend one full year in fresh water, and emigrate in their second spring as age-2 smolts

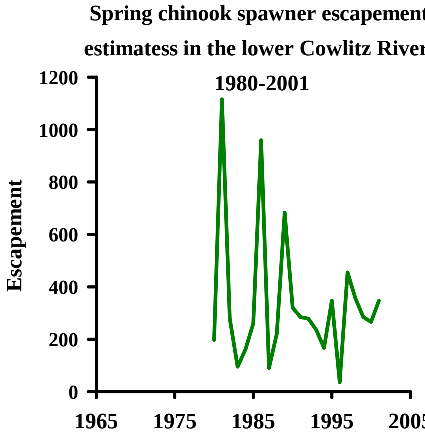
Diversity

- One of four spring Chinook populations in the Columbia River Evolutionarily Significant Unit (ESU)
- The Cowlitz spring Chinook stock was designated based on distinct spawning distribution and early spawning timing
- Genetic analyses of Cowlitz River Hatchery spring Chinook from 1982 and 1987 determined they were genetically similar to, but distinct from, Kalama Hatchery and Lewis River wild spring Chinook and significantly different from other Columbia River spring Chinook stocks

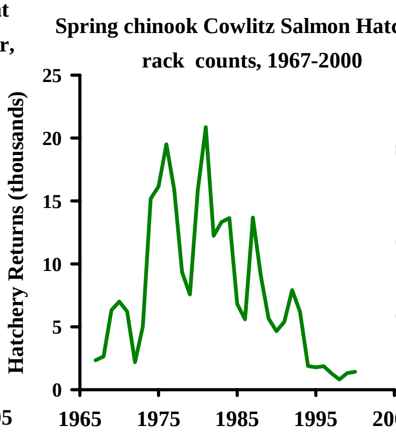
Abundance

- In 1948, WDF and WDG estimated that the Cowlitz River produced 32,490 adult spring Chinook
- Spring Chinook escapement estimates in 1951 were 10,400 in the Cowlitz basin, with 8,100 in the Cispus, 1,700 in the upper Cowlitz, 400 in the upper Toutle, and 200 in the Tilton
- From 1962-1966, an average of 9,928 spring Chinook were counted annually at Mayfield Dam
- From 1978-1985 (excluding 1984), an average of 3,894 spring Chinook were counted annually at Mayfield Dam
- Cowlitz River below Mayfield Dam spawning escapements from 1980-2001 ranged from 36 to 1,116 (average 338)

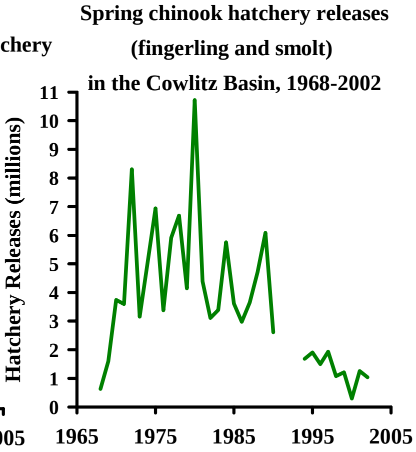
- Hatchery strays account for most spring Chinook returning to the Cowlitz River



Spring chinook spawner escapement estimatess in the lower Cowlitz River, 1980-2001



Spring chinook Cowlitz Salmon Hatchery rack counts, 1967-2000



Spring chinook hatchery releases (fingerling and smolt) in the Cowlitz Basin, 1968-2002

Productivity & Persistence

- NMFS Status Assessment for the Cowlitz River indicated a 0.03 risk of 90% decline in 25 years and a 0.25 risk of 90% decline in 50 years; the risk of extinction in 50 years was 0
- Smolt density model predicted natural production potential for the Cowlitz River below Mayfield Dam of 329,400 smolts and 788,400 smolts for the Toutle River; above Mayfield Dam the model predicts production potential of 1,600,000 smolts
- Juvenile production from natural spawning is presumed to be low

Hatchery

- Cowlitz Salmon Hatchery is located about 2 miles downstream of Mayfield Dam; hatchery was completed in 1967
- Hatchery releases of spring Chinook in the Cowlitz began in the 1940s; releases from the salmon hatchery into the Cowlitz River averaged 3,495,517 from 1968-1990, releases into the Toutle River averaged 651,369 from 1972-1984
- There are 300,000 sub-yearling spring Chinook released annually above Cowlitz Falls Dam as part of a reintroduction program

Harvest

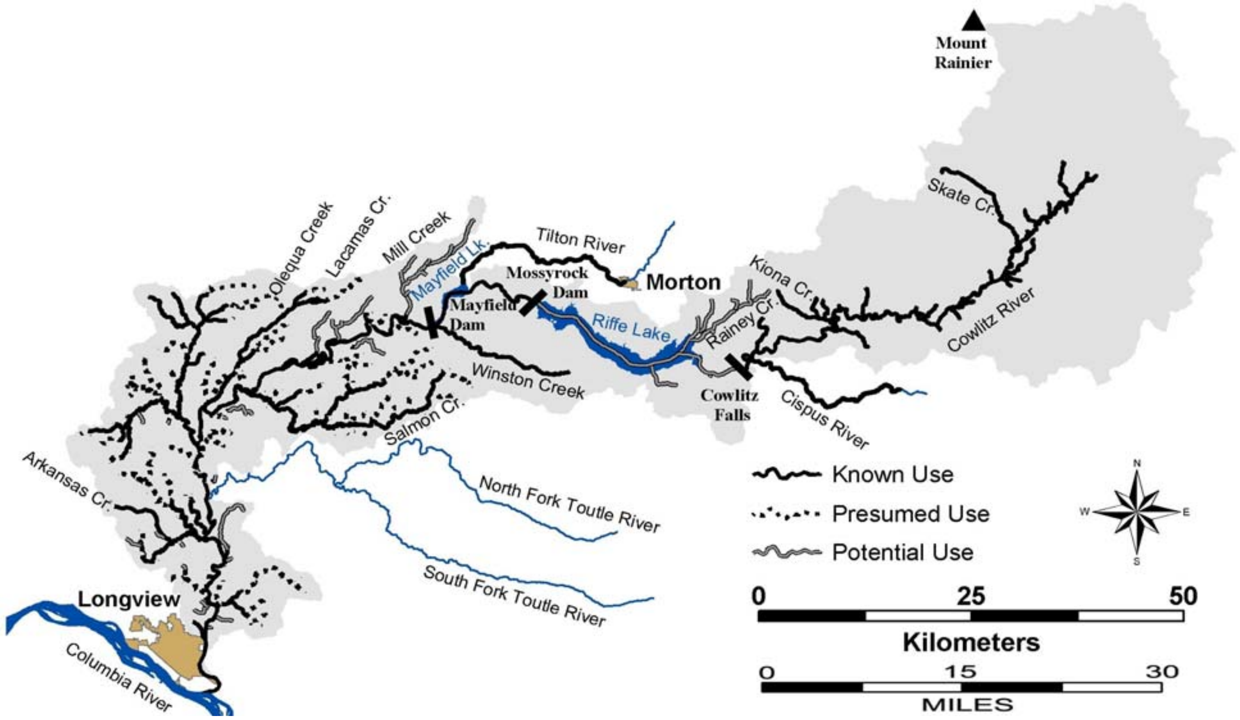
- Cowlitz spring Chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, in addition to Columbia River commercial and sport fisheries
- Coded-wire tag (CWT) data analysis of the 1989-1994 brood years indicates that 40% of the Cowlitz spring Chinook were harvested and 60% escaped to spawn
- Fishery recoveries of the 1989-1994 brood Cowlitz River Hatchery spring Chinook: Cowlitz sport (35%), British Columbia (29%), Washington Coast (22%), Columbia River (6%), Oregon coast (5%) and Alaska (3%)
- Mainstem Columbia River harvest of Cowlitz River spring Chinook was substantially reduced after 1977 when April and May spring Chinook seasons were eliminated to protect upper Columbia and Snake wild spring Chinook.
- Mainstem Columbia River harvest of Cowlitz River Hatchery spring Chinook increased in 2001-2002 when selective fisheries for adipose marked hatchery fish enabled mainstem spring fishing in April (and in May, 2002) again

- Sport harvest in the Cowlitz River averaged 7,100 spring Chinook annually from 1980-1984, but reduced to 2,100 from 1985-1994 and only 200 from 1995-2002.
- Tributary harvest is managed to attain the Cowlitz River hatchery adult broodstock escapement goal

3.2.4 *Coho—Cowlitz Subbasin*

ESA: Candidate 1995 **SASSI: Cowlitz—Depressed 2002;**

The historical upper Cowlitz adult population is estimated from 20,000-70,000 fish with the majority of returns being late stock which spawn from late November to March.. Current natural spawning returns are part of an upper Cowlitz and Cispus River reintroduction program. Cowlitz origin hatchery coho are utilized for supplementation of natural coho. Natural spawning occurs in the mainstem and tributaries of the upper Cowlitz, Cispus, and Tilton rivers. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the Cowlitz Basin before migrating as yearlings in the spring. Juveniles are captured at the Cowlitz Falls Dam collection facility, acclimated at Cowlitz Salmon Hatchery and released into the lower Cowlitz.



Distribution

- Managers refer to early stock coho as Type S due to their ocean distribution generally south of the Columbia River and late stock coho as Type N due to their ocean distribution generally north of the Columbia River
- Natural spawning is thought to occur in most areas accessible to coho, including the Toutle, SF Toutle, Coweeman, and Green Rivers and all accessible tributaries
- Natural spawning in lower Cowlitz tributaries occurs primarily in Olequa, Lacamas, Brights, Ostrander, Blue, Otter, Mill, Arkansas, Foster, Stillwater, Campbell, and Hill Creeks
- Natural spawning in the Coweeman River basin is primarily in tributaries downstream of the confluence of Mulholland Creek
- The post Mt. St. Helens eruption Toutle River system includes tributaries at various stages of recovery and some tributaries (primarily on the Green and South Toutle) with minor effects of the eruption. Bear, Hoffstadt, Johnson, Alder, Devils, and Herrington Creeks are examples of tributaries important to coho; coho adults are collected and passed to tributaries above the North Toutle Sediment Retention Dam

- Completion of Mayfield Dam in 1962 blocked access above the dam; a returning adult trap and haul program began in 1994 where fish were collected below Mayfield Dam and released above Cowlitz Falls Dam, restoring some access to the upper watershed.

Life History

- Adults enter the Columbia River from August through January (early stock primarily from mid-August through September and late stock primarily from late September to October)
- Peak spawning occurs in late October for early stock and December to early January for late stock
- Adults return as 2-year-old jacks (age 1.1) or 3-year-old adults (age 1.2)
- Fry emerge from January through April on the Cowlitz, depending on water temperature
- Coho spend one year in fresh water, and emigrate as age-1 smolts in the spring

Diversity

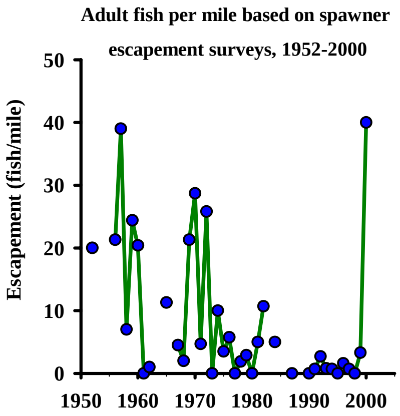
- Late stock (or Type-N) coho are informally considered synonymous with Cowlitz River stock
- Early stock (or Type-S) coho are informally considered synonymous with Toutle River stock
- Columbia River early and late stock coho produced from Washington hatcheries are genetically similar

Abundance

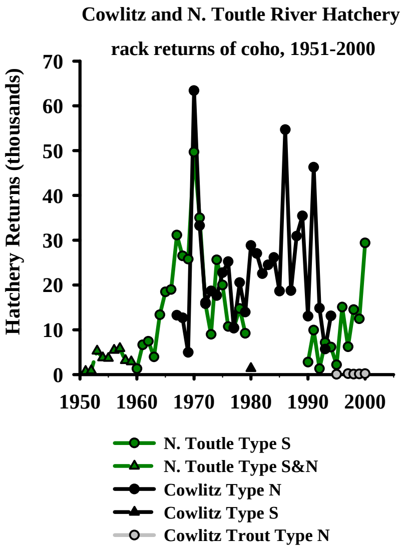
- Cowlitz River wild coho run is a fraction of its historical size
- In 1948, WDF estimated coho escapement to the basin was 77,000; in the early 1950s, escapement to the basin was estimated as 32,500 coho
- Escapement surveys on Olequa Creek from 1952-1990 established a range of 0-40 fish/mile
- Average total escapement of natural coho to the Toutle River was estimated as 1,743 for the years 1972-1979, prior to the 1980 eruption of Mt. St. Helens
- In 1985, an estimated 5,229 coho naturally spawned in lower Cowlitz River tributaries (excluding the Coweeman and Toutle systems), but the majority of spawners were fish originating from the Cowlitz Hatchery
- Hatchery production accounts for most coho returning to the Cowlitz River

Productivity & Persistence

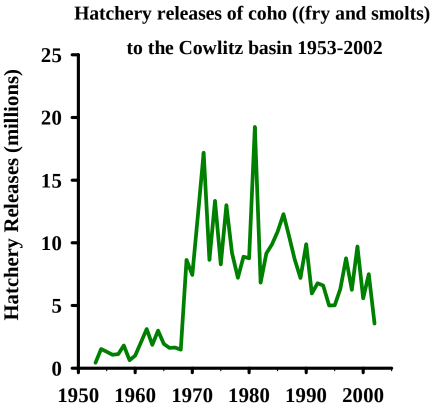
- Natural coho production is presumed to be very low in the lower Cowlitz basin with Olequa Creek the most productive
- The Toutle River system likely provided the most productive habitat in the basin in the 1960s and 1970s, but was greatly reduced after the 1980 Mt. St. Helens eruption
- Reintroduction efforts in the upper Cowlitz River basin have demonstrated good production capabilities in tributaries above the dams, but efforts are challenged in passing juvenile production through the system
- Smolt density model natural production potential estimates were made on various sections of the Cowlitz River basin: 123,123 smolts for the lower Cowlitz River, 131,318 smolts for the Tilton River and Winston Creek, 155,018 smolts above Cowlitz Falls, 142,234 smolts for the Toutle River, and 37,797 smolts for the Coweeman River



Adult fish per mile based on spawner escapement surveys, 1952-2000



Cowlitz and N. Toutle River Hatchery rack returns of coho, 1951-2000



Hatchery releases of coho ((fry and smolts) to the Cowlitz basin 1953-2002

Hatchery

- The Tilton River Hatchery released coho in the Cowlitz basin from 1915-1921
- A salmon hatchery operated in the upper Cowlitz River near the mouth of the Clear Fork until 1949
- The Cowlitz Salmon Hatchery is located about 2 miles downstream of Mayfield Dam; hatchery was completed in 1967; the hatchery is programmed for an annual release of 4.2 million late coho smolts
- Cowlitz Hatchery coho are important to the reintroduction effort in the upper basin. Adult coho are released upstream of the dams to spawn naturally in the upper Cowlitz, Cispus, and Tilton rivers.
- The North Toutle Hatchery is located on the Green River less than a mile upstream of the confluence with the North Fork Toutle River; the hatchery is programmed for an annual release of 1 million early coho smolts

Harvest

- Until recent years, natural produced coho were managed like hatchery fish and subjected to similar harvest rates; ocean and Columbia River combined harvest of Columbia produced coho ranged from 70% to over 90% from 1970-83
- Ocean fisheries were reduced in the mid 1980s to protect several Puget Sound and Washington coastal wild coho stocks
- Columbia River commercial coho fisheries in November were eliminated in the 1990s to reduce harvest of late Clackamas River wild coho
- Since 1999, Columbia River hatchery fish have been mass marked with an adipose fin clip to enable fisheries to selectively harvest hatchery coho and release wild coho
- Natural produced lower Columbia River coho are beneficiaries of harvest limits aimed at Federal ESA listed Oregon Coastal coho and Oregon State listed Clackamas and Sandy River coho
- During 1999-2002, fisheries harvest of ESA listed coho was less than 15% each year
- Hatchery coho can contribute significantly to the lower Columbia River gill net fishery; commercial harvest of early coho is constrained by fall chinook and Sandy River coho

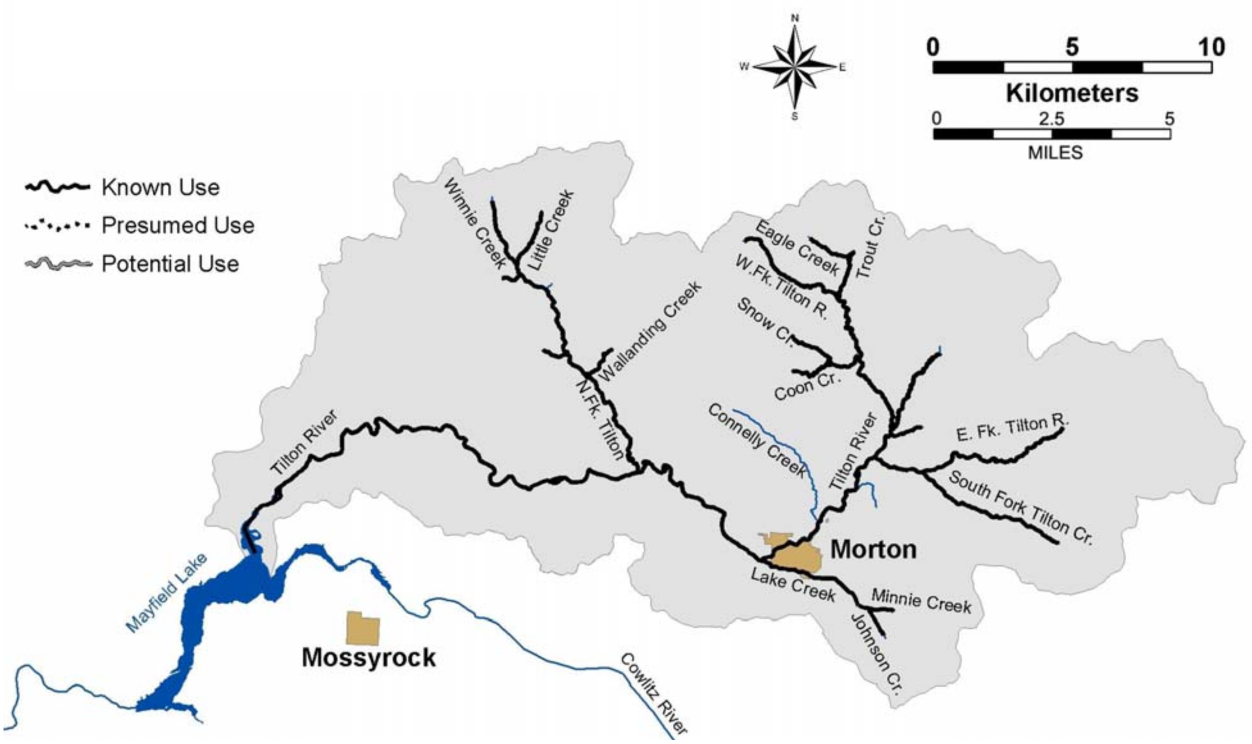
management; commercial harvest of late coho is focused in October during the peak abundance of hatchery late coho

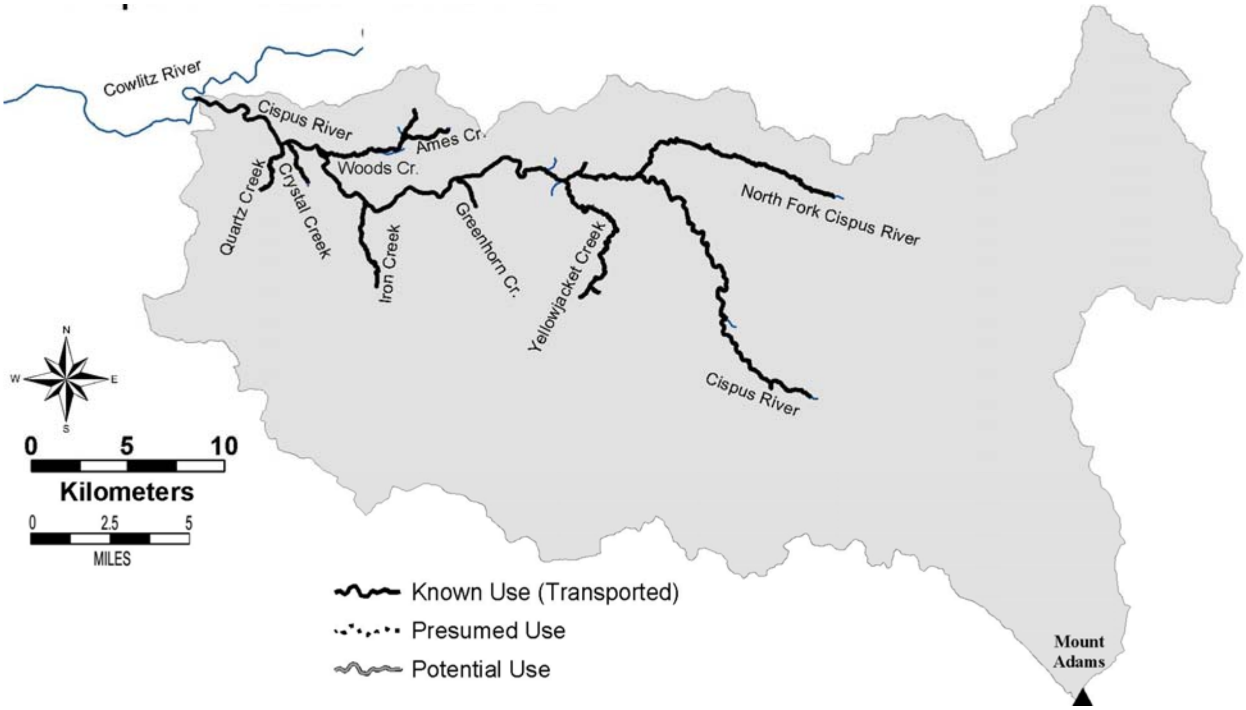
- A substantial estuary sport fishery exists between Buoy 10 and the Astoria-Megler Bridge; majority of the catch is early hatchery coho, but late coho harvest can also be substantial
- An average of 1,494 coho (1986-1990) were harvested annually in the Cowlitz River sport fishery
- The Toutle River sport fishery was closed in 1982 after the eruption of Mt. St. Helens; the Green River sport fishery was closed from 1981 to 1988 after the eruption of Mt. St. Helens and was reopened in 1989
- CWT data analysis of the 1995-97 North Toutle Hatchery early coho indicates 34% were captured in fisheries and 66% were accounted for in escapement
- CWT data analysis of the 1994 and 1997 brood Cowlitz Hatchery late coho indicates 64% were captured in fisheries and 36% were accounted for in escapement
- Fishery CWT recoveries of 1995-97 Toutle coho were distributed between Columbia River (47%), Washington ocean (37%), and Oregon ocean (15%) sampling areas
- Fishery CWT recoveries of 1994 and 1997 brood Cowlitz coho were distributed between Columbia River (55%), Washington ocean (30%), and Oregon ocean (15%) sampling areas

3.2.5 *Winter Steelhead—Cowlitz Subbasin (Tilton and Cispus)*

ESA: Threatened 1998	SASSI: Unknown 2002

The historical upper Cowlitz adult population is estimated from 2,000-17,000 fish. Current natural spawning returns are part of an upper Cowlitz and Cispus River reintroduction program. Cowlitz origin hatchery produced late spawning winter steelhead are utilized for supplementation of natural winter steelhead. Spawning in the Upper Cowlitz Basin primarily occurs in the mainstem upper Cowlitz near the Muddy Fork and Clear Fork and the Ohanapecosh River, Cispus River, and Tilton River. Spawning time is generally March to June Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Cowlitz Basin in the spring. Juveniles are captured at the Cowlitz Falls Dam collection facility, acclimated at Cowlitz Salmon Hatchery and released into the lower Cowlitz.



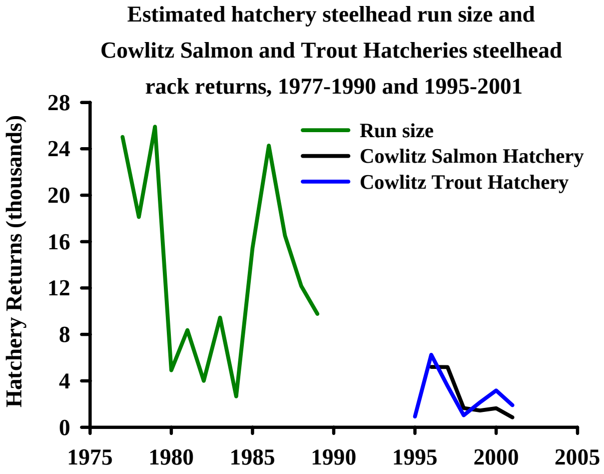


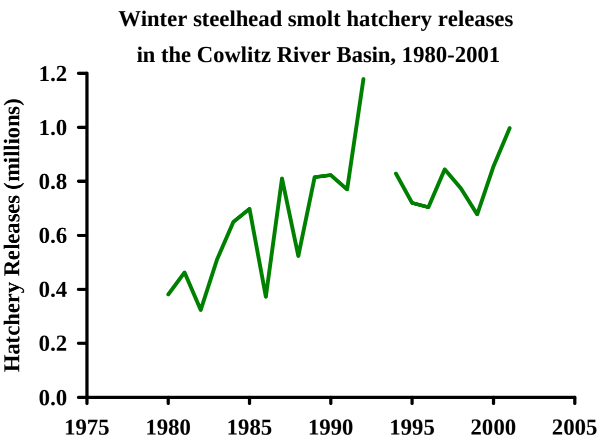
Distribution

- Winter steelhead are distributed throughout the mainstem Cowlitz River below Mayfield Dam; natural spawning occurs in Olequa, Ostrander, Salmon, Arkansas, Delameter, Stillwater and Whittle Creeks
- Historically, winter steelhead were distributed throughout the upper Cowlitz, Cispus, and Tilton Rivers; known spawning areas include the mainstem Cowlitz near Riffle and the reach between the Muddy Fork and the Clear Fork and the lower Ohanapecosh River
- Construction of Mayfield Dam in 1963 blocked winter steelhead access to the upper watershed; approximately 80% of the spawning and rearing habitat are not accessible
- In 1994, a trap and haul program began to reintroduce anadromous salmonids to the watershed above Cowlitz Falls Dam; adult winter steelhead are collected at the Cowlitz hatcheries and released in the upper Cowlitz, Cispus, and Tilton basins; smolts resulting from natural production in the upper watershed are collected at the Cowlitz Falls Fish Collection Facility, acclimated at the Cowlitz Salmon Hatchery, and released in the mainstem Cowlitz

Life History

- Adult migration timing for Cowliltz winter steelhead is from December through April
- Spawning timing on the Cowlitz is generally from early March to early June
- Limited age composition data for Cowlitz River winter steelhead indicate that the dominant age classes are 2.2 and 2.3 (54.2% and 32.2 %, respectively)
- Wild steelhead fry emerge from March through May; juveniles generally rear in fresh water for two years; juvenile emigration occurs from April to May, with peak migration in early May


Estimated hatchery steelhead run size and Cowlitz Salmon and Trout Hatcheries steelhead rack returns, 1977-1990 and 1995-2001


Winter steelhead smolt hatchery releases in the Cowlitz River Basin, 1980-2001

Diversity

- Cowlitz winter steelhead stock designated based on distinct spawning distribution
- Concern with wild stock interbreeding with hatchery brood stock from Chambers Creek and the Cowlitz River (Cowlitz and late Cowlitz stock)
- Allele frequency analysis of Cowlitz Hatchery late winter steelhead in 1996 was unable to determine the distinctiveness of the stock compared to other lower Columbia steelhead stocks

Abundance

- Historically, annual wild winter steelhead runs to the Cowlitz River were estimated at 20,000 fish; escapement was estimated as 11,000 fish
- In 1936, steelhead were observed in the Cispus River and reported in the Tilton River during escapement surveys
- Between 1961 and 1966, an average of 11,081 adult steelhead were collected annually at the Mayfield Dam Fish Passage Facility
- In the late 1970s and 1980s, wild winter steelhead annual average run size in the Cowlitz River was estimated to be 309 fish
- From 1983–95, the annual escapement of Cowlitz River winter steelhead ranged from 4,067-30,200 (average 16,240)

Productivity & Persistence

- In the late 1970s and 1980s, wild winter steelhead contribution to the annual winter steelhead return was estimated to be 1.7%
- Estimated potential winter steelhead smolt production for the Cowlitz River is 63,399

Hatchery

- The Cowlitz Trout Hatchery, located on the mainstem Cowlitz at RM 42, is the only hatchery in the Cowlitz basin producing winter steelhead
- Hatchery winter steelhead have been planted in the Cowlitz River basin since 1957; broodstock from the Cowlitz River and Chambers Creek have been used; an annual average of 180,000 hatchery winter steelhead smolts were released in the Cowlitz River from 1967–94; smolt release data are displayed from 1980–2001
- Hatchery fish account for the majority of the winter steelhead run to the Cowlitz River basin

- There are 100,000 late stock winter steelhead juveniles planted in the Tilton and 287,500 late stock winter steelhead juveniles planted in the upper Cowlitz as part of the reintroduction program.

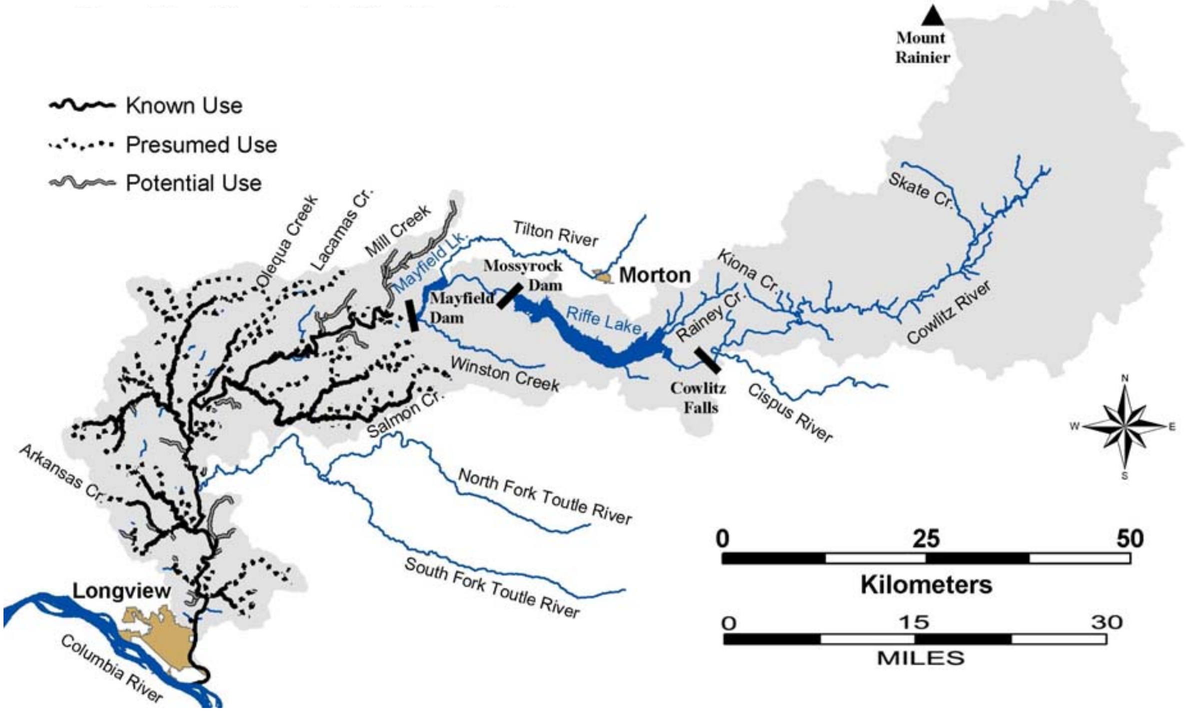
Harvest

- No directed commercial or tribal fisheries target Cowlitz winter steelhead; incidental mortality currently occurs during the lower Columbia River spring chinook tangle net fisheries
- Steelhead sport fisheries in the Columbia must release wild winter steelhead which are not marked with an adipose fin clip
- ESA limits fishery impact of wild winter steelhead in the mainstem Columbia and in the Cowlitz basin as per the Fishery Management and Evaluation Plan submitted by WDFW to NOAA Fisheries in 2003.
- Approximately 6.2% of returning Cowlitz River steelhead are harvested in the Columbia River sport fishery
- Wild winter steelhead sport harvest in the Cowlitz River from in the late 1970s and early 1980s ranged from 102-336; wild winter steelhead contribution to the total annual sport harvest was less than 2%
- The Cowlitz River may be the most intensely-fished basin in the Washington sport fisheries; the Cowlitz has been the top winter steelhead river in Washington

3.2.6 *Cutthroat Trout—Cowlitz River Subbasin*

ESA: Not Listed	**SASSI: Depressed 2000**

Anadromous cutthroat counts at Mayfield Dam from 1962-96 ranged from 5,500-12,300. Outmigrant counts at the Mayfield migrant trap show a long-term declining trend. The anadromous population is considered depressed. Adfluvial forms are present in Mayfield, Riffe, and Scanewa reservoirs and resident forms are present throughout the upper Cowlitz basin. Cutthroat trout are present throughout the basin. Anadromous cutthroat enter the Cowlitz from July-October and spawn from January to April. The hatchery cutthroat spawn from November-February. Most juveniles rear 2-3 years before migrating from their natal stream.

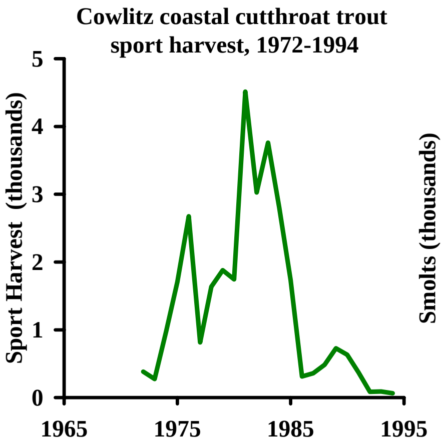


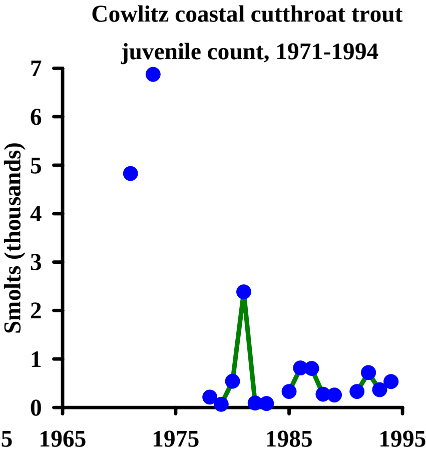
Distribution

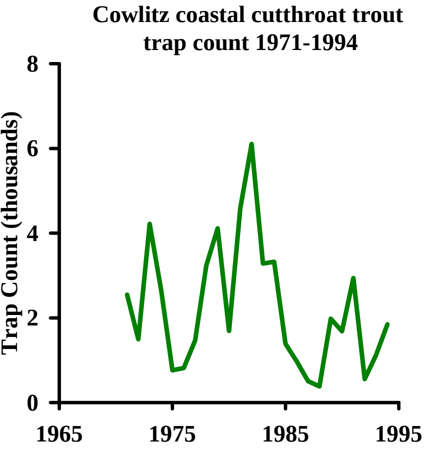
- Anadromous forms were historically present throughout the watershed, but are now limited to the area downstream of Mayfield Dam, which block passage
- Adfluvial forms are present in Mayfield, Riffe, and Scanewa Reservoirs
- Resident forms are documented throughout the system and are the only form present upstream of Mayfield Dam

Life History

- Anadromous, adfluvial, fluvial and resident forms are present
- Anadromous river entry is from July through October, with peak entry in August and September
- Anadromous spawning occurs from January through mid-April
- Fluvial and resident spawn timing is not documented but is believed to be similar to anadromous timing
- Spawn timing at higher elevations is likely later, and may occur as late as June
- Hatchery cutthroat spawn from November to February, due to artificial selection for early spawn timing
- Smolt migration occurs in the spring after juveniles have spend 2 to 3 years in fresh water


Cowlitz coastal cutthroat trout sport harvest, 1972-1994


Cowlitz coastal cutthroat trout juvenile count, 1971-1994


Cowlitz coastal cutthroat trout trap count 1971-1994

Diversity

- Distinct stock based on geographic distribution of spawning areas
- Genetic sampling of ten groups within the Cowlitz system showed little difference among the groups
- Cowlitz collections were significantly different from other lower Columbia samples, except for Elochoman/Skamakowa Creek.

Abundance

- Anadromous counts at Mayfield Dam from 1962 to 1996 ranged from 5458 to 12,324 fish, and averaged 8698
- Outmigrant trapping at Mayfield migrant trap shows a long term declining trend
- Recent years' counts average about 10% of outmigrant counts when sampling began in the early 60s
- Smolt counts have been under 1000 every year since 1978, with the exception of 1982
- No population size data for resident forms

Hatchery

- Cowlitz Trout Hatchery began producing anadromous cutthroat in 1968
- The goal is 115,000 smolts larger than 210 mm to produce a return to the hatchery of 5000 adults

Harvest

- Not harvested in ocean commercial or recreational fisheries
- Angler harvest for adipose fin clipped hatchery fish occurs in mainstem Columbia River summer fisheries downstream of the Cowlitz River
- Cowlitz River sport harvest for hatchery cutthroat can be significant in year of large adult returns.
- Wild cutthroat (unmarked fish) must be released

3.2.7 *Other Species*

Pacific lamprey – Information on lamprey abundance is limited and does not exist for the upper Cowlitz population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have also declined in the upper Cowlitz. The adult lamprey return from the ocean to spawn in the spring and summer. Spawning likely occurs in the small to mid-size streams of the basins. Juveniles rear in freshwater up to 6 years before migrating to the ocean.

3.3 Subbasin Habitat Conditions

This section describes the current condition of aquatic and terrestrial habitats within the subbasin. Descriptions are included for habitat features of particular significance to focal salmonid species including watershed hydrology, passage obstructions, water quality, key habitat availability, substrate and sediment, woody debris, channel stability, riparian function, and floodplain function. These descriptions will form the basis for subsequent assessments of the effects of habitat conditions on focal salmonids and opportunities for improvement.

3.3.1 *Watershed Hydrology*

Runoff is predominantly generated by rainfall, with a portion of spring flows coming from snowmelt in the upper elevations and occasional winter peaks related to rain-on-snow events. A few upper tributaries drain glaciers and contribute meltwater during dry summer months. Most of the lower elevation streamflows are controlled by winter rainfall.

Flow in the mainstem is regulated in large part by the hydropower system. See Figure 4 for a comparison of flows upstream and downstream of the reservoirs:

- Cowlitz Falls Dam is the uppermost hydropower project (RM 88.5). It is owned and operated by Lewis County Public Utility District (PUD) No. 1 and is a run-of-the-river facility (no significant storage) that creates daily fluctuations related to power production.
- Mossyrock Dam (RM 66) is operated by Tacoma Power and provides 1,686,000 acre-feet of storage in Riffe Lake. The lake’s levels are raised in the spring and drawn down in the fall in preparation for winter flows.
- Mayfield Dam (RM 52) is also operated by Tacoma Power and has a relatively small 133,764 acre-foot capacity. Behind Mayfield Dam, Mayfield Lake provides little flood storage capacity and flows from Mayfield Dam are largely in response to the regulation of flows through Mossyrock Dam.

The Barrier Dam and salmon hatchery at RM 49.5 also are operated by Tacoma Power.

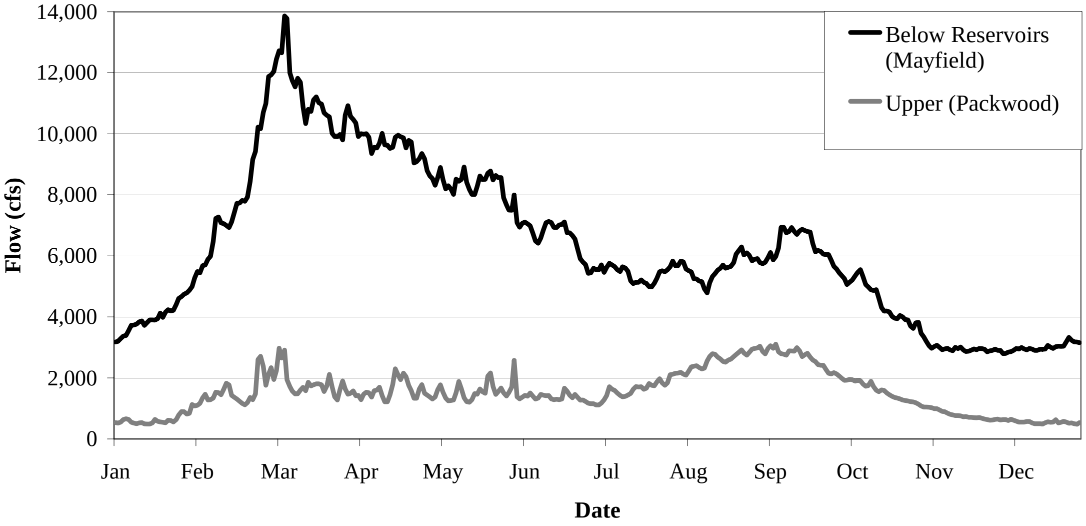


Figure 4. Cowlitz River hydrographs (mean daily flows 1972-2001). Both stations exhibit winter peaks due to rain and rain-on-snow events. There is a rise in flows in the fall in the Cowlitz near Packwood due to late summer snowmelt from snowfield and glacial melt. The rise in flows below the reservoirs is due partly to snowmelt flows and partly to flow releases at the dams in preparation for winter rains. USGS Gage #14238000; Cowlitz River below Mayfield Dam, Wash, and USGS Gage #14226500; Cowlitz River at Packwood, Wash.

Runoff conditions may be impaired in portions of the basin as a result of forest and road conditions. The Integrated Watershed Assessment (IWA), which is presented in greater detail later in this chapter, indicates that approximately 30% of the upper Cowlitz basin is ‘impaired’ with regards to runoff properties. These impaired areas are located primarily in subwatersheds in the Tilton, Mayfield Lake, Rainey Creek, and the upper Cowlitz mainstem just above the reservoirs; areas with high road densities, immature forest vegetation, and developed land. About 27% of the basin is rated as ‘moderately impaired’. These areas are located primarily in the northern portion of the upper Cowlitz mainstem watershed, the lower Cispus watershed, and scattered subwatersheds throughout the basin. Approximately 43% of the basin is rated as ‘functional’ according to the IWA. Hydrologically functional subwatersheds have mature forest cover and low road densities and are located primarily in the upper elevation areas in the upper Cowlitz mainstem and Cispus watersheds.

Impaired runoff conditions identified by the IWA in the Tilton and Mayfield Lake basins are supported by reports of extreme high and low flows in Mayfield Lake tributaries, which are believed to be the result of extensive timber harvesting (Mobrand Biometrics 1999, Wade 2000). Elevated winter peaks in the Tilton risk flushing out juveniles and scouring spawning gravels (Wade 2000). Average peak flow increases of 10%, 22%, 20%, and 17% were estimated for Tilton tributaries Connelly Creek, Lake Creek, EF Tilton, and SF Tilton, respectively (Murray Pacific 1994 and 1996a). Landslides causing dam break floods are very damaging in Connelly Creek and are associated with logging roads and clearcuts (Murray Pacific 1993). Low flows degrade habitat in the NF, SF, EF, and WF Tilton (Harza 1997).

Peak flow analyses by the USFS in the Cispus basin revealed that 14 out of 24 subbasins had a significant risk of increased peak flows as a result of impacts to vegetation structure (USFS 1996a, 1996b, and 1995). Similar analyses in the upper Cowlitz revealed that 9 out of 24 subbasins had a significant risk of increased peak flows, roughly corresponding to the IWA results.

Low and subsurface flows are a concern in many of the upper Cowlitz tributaries, generally due to excessive in-channel sediment aggradation. Flow regulation at Mossyrock Dam affects Riffe Lake levels, which can affect low flow habitat in the alluvial fan through which Riffe Lake tributaries Rainey, Stiltner, and Philips Creek flow. Low flow in this area can cause increased temperature and vulnerability to predation. There may also be low flow issues related to a private hatchery that has water rights to 50% of the flow of Rainey Creek and 100% of the flow of an unnamed tributary (Murray Pacific 1996b).

The projected 20 year increase in combined surface and groundwater demand in the upper Cowlitz basin ranges from 0.5% (Cispus) to 36.4% (Tilton). However, the presence of Mayfield and Riffe Lakes, combined with the low population of the subbasin, suggests that the impact from current or projected water withdrawals on stream flow rates will be minimal (LCFRB 2001).

3.3.2 *Passage Obstructions*

The hydropower system is the primary factor for decline in the upper Cowlitz basin. Historically, spawning grounds in the upper basin produced 20% of the fall Chinook and 38% of the steelhead in the Cowlitz basin (Mobrand Biometrics 1999). The hydropower facilities impede volitional access to upstream habitats. Furthermore, over 48 miles of stream habitat was flooded by the Mayfield, Mossyrock, and Cowlitz Falls Dams.

The Barrier Dam and Mayfield Dam prevent all volitional passage of anadromous fish above RM 52. A facililty at the Barrier Dam (RM 49) collects coho, winter steelhead, and coastal cutthroat, which are hauled upstream of the Cowlitz Falls Dam. Outmigrating smolts are collected at the Cowlitz Falls Fish Collection Facility (CFFCF) above Cowlitz Falls Dam and are hauled below the Barrier Dam. Some fish may avoid collection at the CFFCF and pass through the Cowlitz Falls Dam turbines or through the dam spill. Passage of juvenile migrants through Riffe Lake is a major problem for maintaining sustainable anadromous fish runs in the upper basin. A 1999 study revealed that only 63% of radio tagged steelhead smolts traveled successfully from the Cowlitz Falls Dam tailrace to a collection facility at Mossyrock Dam. None of the tagged coho and chinook were detected at Mossyrock. This study revealed potential problems with migration through the reservoir as well as problems with smolt collection at Mossyrock Dam (Harza 2000). Currently, there is no regular juvenile collection at Mossyrock Dam. Regular collection of downstream migrants was discontinued in 1974. The 606 foot tall Mossyrock Dam prevents access to several Riffe Lake tributaries, including Rainey Creek, which is believed to have a substantial amount of potentially productive habitat (Wade 2000). Radio-telemetry studies of coho and steelhead revealed a low (<50%) survival rate of juvenile migrants negotiating Mayfield Lake. Results could be due to predation, water quality, flow, or monitoring error (Harza 1999 as cited in Wade 2000).

Apart from the mainstem Cowlitz dams, passage problems in the Mayfield Lake basin include numerous culverts and road crossings in the Winston Creek, Connelly Creek, East Fork Tilton, South Fork Tilton, and West Fork Tilton basins. A full description is given in Wade (2000). Passage problems in the Cispus include subsurface flows in Copper Creek, Crystal Creek, and Camp Creek. A culvert in Woods Creek blocks approximately 1 mile of potential anadromous habitat. Subsurface and/or low flow conditions related to excessive sediment aggradation are believed to create passage problems in some areas of the upper Cowlitz basin. Ten such barriers are identified by the USFS (1997a and 1997b). The USFS has also identified several artificial barriers including culverts and other features.

3.3.3 *Water Quality*

Elevated water temperatures (>18ºC) in the Tilton basin have been found in Winston Creek, the mainstem Tilton, Connelly Creek, Slam Creek (EF Tilton basin), the WF Tilton, and Coon Creek (WF Tilton basin). High temperatures are attributed to low stream shade levels and low summer flows (Murray Pacific 1998 and 1994). High turbidity and low dissolved oxygen levels have been measured in Mayfield Lake and the Tilton (Wade 2000).

High temperatures in Riffe Lake have been recorded as deep as 20 meters (Harza 2000). Temperatures above state standards measured in the Rainey Creek basin were believed to be related to low canopy cover (Murray Pacific 1996b). High turbidity levels have also been measured in Rainey Creek (Harza 2000).

In the Cispus basin, the mainstem Cispus above Quartz Creek, Woods Creek, Chambers Creek, and East Canyon Creeks have exceeded the state temperature standard of 16ºC (USFS 1995). Four stream segments in the Cispus basin, including two on the mainstem, one on the North Fork, and one on Baird Creek were included on the State's 1998 303(d) list for temperature exceedances (WDOE 1998). High turbidity was measured in Quartz Creek following the St. Helens eruption (354 NTU in 1981 and 64 NTU in 1983). High (240 NTU) turbidity was measured in the lower Cispus during the December 1995 flood, attributable to streambank erosion, road failures, and road surface erosion (USFS 1996a).

In upper mainstem Cowlitz tributaries, Silver Creek and Willame Creek were listed on the 1996 and 1998 WA State 303(d) list for exceedances of temperature standards (WDOE 1996 and 1998). State temperature standards (16ºC) have also been exceeded on Kiona Creek and tributaries (Murray Pacific 1995) and Lake Creek (USFS 1997b). Miller Creek may have water quality issues associated with sewage and garbage disposal into the creek at Randle (USFS 1997a).

Nutrient levels in all streams above the dams are assumed to be lower than in historical times due to lower current numbers of anadromous fish (Wade 2000).

3.3.4 *Key Habitat Availability*

The three dams inundated a significant amount of pool and side channel habitat in the mainstem and in the lower reaches of tributaries. Riffe Lake may provide some refuge for fish displaced from tributaries during high flows, but in general, the reservoir does not provide favorable habitat (Murray Pacific 1996b).

Pool frequency and quality in the Mayfield Lake basin is low. This is largely attributed to low LWD concentrations. Streams containing LWD had 15 times the amount of pools than streams without LWD (EA 1998). Of 5 creeks surveyed (Tilton, EF Tilton, SF Tilton, Lake Creek, Winston Creek), 4 of them had low (<35% pool area) pool frequency (Harza 1997). In the WF Tilton, mass wasting between 1974 and 1996 reduced pool frequency and quality (Murray Pacific 1998). Pool frequency was generally low in reaches surveyed in the Rainey Creek (Riffe Lake tributary) basin. Fifty percent of the pools were associated with LWD.

Pool frequency and quality in the Cispus basin is low due in part to channel widening, sediment aggradation, and low LWD quantities (USFS 1995). The Cispus mainstem has a low amount of pool habitat in places but conditions are expected to improve as forest practices improve. Pools in Crystal Creek are of poor quality but are also expected to improve (USFS 1996a). Side channel habitat in the Cispus basin is assumed to be lacking due to roads and other activities that have blocked historical flood channels and have disconnected floodplains, however, a few decent off-channel habitats conducive to coho rearing are available in some places (USFS 1995).

Pool frequency and quality in the upper Cowlitz mainstem basin is low. Width-to-depth ratios are high, sediment pulses often fill existing pools, and pools lack adequate cover (USFS 1997a and 1997b). Excessive sediment deposits and lack of LWD are thought to be responsible for poor pool quality and frequency in most of the smaller tributaries (Wade 2000). The channel between RM 100 and RM 115 on the Cowlitz may have experienced side channel loss due to downcutting following the 1996 flood (USFS 1997b). Side channel habitats have been lost on the lower reaches of most of the smaller tributaries due to residential, agricultural, and industrial development (Wade 2000).

3.3.5 *Substrate & Sediment*

A 1996 study found that over half of the surveyed habitat units in the SF Tilton, Lake Creek, and Winston Creek basins had greater than 35% embeddedness (Harza 1997). Connelly Creek has experienced an increase in fines (7% in 1993 to 18% in 1996) due to mass wasting associated with large storms and logging activities on steep slopes (Murray Pacific 1996a). Fines are a problem in the WF Tilton from the Coon Creek confluence to the mouth. Mass wasting is a concern due to high harvest levels in this basin (Murray Pacific 1998). There are also concerns with mass wasting and fine sediment input between Nineteen Creek and the falls on the mainstem Tilton. A lack of good spawning sized substrate may be due to transport capacity exceeding input in the EF Tilton and in Coal Creek (Murray Pacific 1994). Poor gravel quality due to excessive fines (>20% fine sediment) was identified for 3 of 7 survey locations in the Rainey Creek basin (Murray Pacific 1996b).

Excessive stream sedimentation occurs in the Cispus basin due to mass wasting and erosion from roads, concentrated overland runoff, and harvest-related mass wasting (USFS 1995). Excessive fine sediments are considered a major problem in the upper mainstem Cowlitz. Increased sediment delivery from floodplain development, riparian impacts, channelization, and lack of LWD has increased channel migration, raised width-to-depth ratios, and reduced pool quality (USFS 1997b, Lanigan et al. 1998). Erosion and sedimentation in many of the upper Cowlitz tributaries are believed to be impacting fish production. In some cases, sediment accumulations have created subsurface flow conditions, eliminating anadromous habitat (USFS 1997a).

Sediment supply conditions from hillslopes were evaluated as part of the IWA watershed process modeling, which is presented later in this chapter. The results indicate that only 4 of 131 subwatershed are ‘impaired’ with regards to sediment supply, however, 95 of the 131 (73%) subwatersheds were rated as ‘moderately impaired’. The remainder, which are located primarily in the upper Cispus and upper Cowlitz mainstem basins, were rated as ‘functional’. Sediment supply impairments are related to the high number of forest roads and unstable slopes in some areas.

Sediment production from private forest roads is expected to decline over the next 15 years as roads are updated to meet the new forest practices standards, which include ditchline disconnect from streams and culvert upgrades. The frequency of mass wasting events should also decline due to the new regulations, which require geotechnical review and mitigation measures to minimize the impact of forest practices activities on unstable slopes.

3.3.6 *Woody Debris*

LWD levels in the Tilton watershed have been reduced since historical times due to channel cleaning, timber harvest in riparian zones, debris torrents, dam-break floods, and increased peak flows (EA 1998). It is believed that large wood was present in channels throughout the watershed in historical times (Mobrand Biometrics 1999). Low LWD levels also exist in Winston Creek (Wade 2000). Approximately 97% of the fish-bearing streams in the Rainey Creek basin contain below target levels of LWD. Near term recruitment of LWD is considered “high” on only 3% of the fish-bearing streams (Murray Pacific 1996b).

Adequate LWD is lacking in the Cispus basin due to channel clearing and timber harvest. Lower Iron Creek and the NF Cispus have particularly low levels of instream LWD (USFS 1996a). The upper Cowlitz mainstem historically had abundant LWD but now has very little (Mobrand Biometrics 1999, USFS 1997a). LWD was removed from the floodplains and harvested from riparian areas. Low LWD levels in nearly all of the tributary streams have been attributed to debris flows, riparian cleaning, active removal, loss of recruitment, natural decay, and attrition (Murray Pacific 1995).

3.3.7 *Channel Stability*

There are bank stability concerns in the lower NF Tilton due to glacial till parent material. There are also bank stability concerns in the lower mainstem Tilton, Winston Creek, WF Tilton, and Otter and Tumble Creeks (NF Tilton tributaries) (EA 1998).

A total of 210 slides have occurred in the Rainey Creek basin between 1937 and 1996; an estimated 80% are associated with forestry activities. Major debris torrents and channel avulsions occurred on Rainey and Stiltner Creeks during floods in 1995 and 1996. Other areas of bank instability are related to logging and grazing impacts on riparian vegetation (Murray Pacific 1996b).

Increased sediment deposition, combined with increased peak flow associated with upslope vegetation removal, has contributed to channel widening and bank erosion in the Cispus basin. Numerous incidences of bank instability and channel widening are described in the limiting factors analysis (Wade 2000).

Bank instability is a problem in the upper mainstem Cowlitz due to excessive sediment accumulations causing channel widening. Bank stability has also been compromised as a result of farming and grazing practices (USFS 1997b). Specific bank stability problem areas are identified in Wade (2000).

3.3.8 *Riparian Function*

According to IWA watershed process modeling, which is presented in greater detail later in this chapter, riparian conditions are ‘impaired’ in 6 of the 131 upper Cowlitz subwatersheds (5%) , ‘moderately impaired’ in 85 of the 131 subwatersheds (65%), and ‘functional’ in 40 of the subwatersheds (30%). The greatest impairments are in the Mayfield Lake and Rainey Creek basins. Functional riparian conditions are located primarily along higher elevation streams in the upper Cispus and upper Cowlitz mainstem basins.

These results are supported by an analysis by Lewis County GIS (2000), which revealed that over 87% of riparian corridors in the Mayfield / Tilton basin are clearly lacking vegetation or have early-seral riparian conditions. Stream surveys revealed that the mainstem Tilton, EF Tilton, SF Tilton, and Lake Creek all had greater than 60% of surveyed habitat units with only 0-

20% canopy cover (Harza 1997). Wade (2000), however, identifies several areas where good riparian conditions exist in the Tilton basin.

Small and medium-sized hardwoods make up 68% of riparian areas along fish bearing streams in the Rainey Creek basin. This is attributed to soil types, conversion to agriculture, and logging (Murray Pacific 1996b). In the entire Riffe Lake basin only 17.4% of the basin has riparian areas with greater than 70% mature coniferous cover (Lewis County GIS 2000).

In the Cispus basin, areas of concern for poor riparian conditions include upper Quartz Creek (Mount St. Helens eruption impacts), Crystal Creek, Iron Creek, Camp Creek, McCoy Creek, East Canyon Creek, and private lands on the mainstem Cispus. Lower Quartz Creek and the NF Cispus have some of the best conditions (USFS 1996a, and 1995). Throughout the entire Cispus basin, 70% of riparian areas are in early seral structural stages (Lewis County GIS 2000, Wade 2000).

The bulk of the mature riparian forest cover on the upper mainstem Cowlitz and on the lower reaches of most upper mainstem tributaries has been removed by agriculture, timber harvest, and development (Harza 1997). Kiona Creek in particular is in bad shape, with 100% of the riparian areas in either grass/pole or small tree (9” to 20.9” diameter) vegetation structures (USFS 1997a). In the entire upper Cowlitz basin, over 72% of the riparian areas are either in early-seral stand structures or are clearly lacking vegetation (Lewis County GIS 2000, Wade 2000).

Riparian function is expected to improve over time on private forestlands. This is due to the requirements under the Washington State Forest Practices Rules (Washington Administrative Code Chapter 222). Riparian protection has increased dramatically today compared to past regulations and practices.

3.3.9 *Floodplain Function*

The 23.5 miles of stream inundated by Mossyrock Dam was historically a braided, alluvial channel that provided abundant salmon habitat (Mobrand Biometrics 1999). Cowlitz Falls Dam inundated approximately 11 miles of stream also in an unconfined alluvial valley bottom.

Most of the smaller streams in the Mayfield Lake basin have little potential for floodplain habitat. Many of the floodplains that do exist are likely affected by roads since 33% of anadromous streams in the basin have stream-adjacent roads (Lewis County GIS 2000). The WRIA 26 Limiting Factors Analysis (Wade 2000) describes several areas where stream-adjacent roads, railroads, and road crossings impact floodplain function. Channelization has occurred along the Rainey Creek (Riffe Lake tributary) alluvial fan due to diking and at the mouths of several Rainey Creek tributaries (Murray Pacific 1996b).

Wetlands and floodplains have been altered in the Cispus basin due to roads and manipulation of channel locations (USFS 1996b). Twenty-one percent of anadromous streams in the Cispus basin have stream-adjacent roads (Lewis County GIS 2000). Floodplains along the mainstem Cispus, Iron Creek, Camp Creek, and Yellowjacket Creek have all been affected by channelization, roads, or timber salvage (USFS 1996a and 1996b).

The mainstem Cowlitz above Scanewa Lake (created by Cowlitz Falls Dam) has lost floodplain habitat due to encroachment of agricultural uses. Most tributaries to the upper Cowlitz mainstem have been affected by diking, dredging, bank hardening, straightening, road building, and/or floodplain structures associated with residential, commercial, and industrial development (Wade 2000).

3.4 Stream Habitat Limitations

A systematic link between habitat conditions and salmonid population performance is needed to identify the net effect of habitat changes, specific stream sections where problems occur, and specific habitat conditions that account for the problems in each stream reach. In order to help identify the links between fish and habitat conditions, the Ecosystem Diagnosis and Treatment (EDT) model was applied to Lower Cowlitz River fall Chinook, coho, and steelhead. A thorough description of the EDT model, and its application to lower Columbia salmonid populations, can be found in Appendix E.

Three general categories of EDT output are discussed in this section: population analysis, reach analysis, and habitat factor analysis. Population analysis has the broadest scope of all model outputs. It is useful for evaluating the reasonableness of results, assessing broad trends in population performance, comparing among populations, and for comparing past, present, and desired conditions against recovery planning objectives. Reach analysis provides a greater level of detail. Reach analysis rates specific reaches according to how degradation or restoration within the reach affects overall population performance. This level of output is useful for identifying general categories of management (i.e. preservation and/or restoration), and for focusing recovery strategies in appropriate portions of a subbasin. The habitat factor analysis section provides the greatest level of detail. Reach specific habitat attributes are rated according to their relative degree of impact on population performance. This level of output is most useful for practitioners who will be developing and implementing specific recovery actions.

3.4.1 *Population Analysis*

Population assessments under different habitat conditions are useful for comparing fish trends and establishing recovery goals. Fish population levels under current and potential habitat conditions were inferred using the EDT model based on habitat characteristics of each stream reach and a synthesis of habitat effects on fish life cycle processes.

Cowlitz and Cispus Basins

Habitat-based assessments were completed for fall Chinook, spring Chinook, coho, and winter steelhead in the upper Cowlitz and Cispus basins. Model results indicate adult productivity in the upper Cowlitz has been reduced to 15-30% of historical levels for all species (Table 2). Adult abundance of both spring Chinook and fall Chinook has declined by more than 80% from historical levels, while winter steelhead and coho abundance has declined by 57% and 37%, respectively (Figure 5). Diversity (as measured by the diversity index) is estimated to have declined by 40%, 60%, and 38% for fall Chinook, spring Chinook, and coho, respectively (Table 2). Diversity for winter steelhead has remained more stable, decreasing by an estimated 16% (Table 2).

Smolt productivity has also decreased sharply for all species in the upper Cowlitz basin. Smolt productivity for fall Chinook and winter steelhead has declined by 54% and 56%, respectively, while spring Chinook and coho smolt productivities have declined by 72% and 76%, respectively (Table 2). Smolt abundance levels have also declined for spring Chinook, fall

Chinook, and winter steelhead (Table 2). For coho, the model indicates a 16% increase in smolt abundance levels (Table 2).

Declines in adult productivity in the Cispus basin are similar to those in the upper Cowlitz. Adult productivity in the Cispus is estimated to have declined by 68-87% for all species (Table 3). Adult abundance of spring and fall Chinook has fallen to 10-15% of historical levels, and winter steelhead and coho runs are estimated at less than half of historical levels (Figure 6). Diversity of spring chinook, fall chinook, and coho has decreased by 50-75%, though winter steelhead diversity has only decreased by 13% (Table 3).

Smolt productivity in the Cispus basin has declined by 55-73% from historical levels for all species (Table 3). These declines have been greater for spring Chinook and coho than for fall Chinook and winter steelhead. Smolt abundance has been reduced for all species as well, however fall and spring Chinook have been impacted the most, with current abundance levels only 21% and 7% of the historical levels, respectively (Table 3). Coho have suffered the least impact with an abundance reduction of only 18% (Table 3).

Model results indicate that restoration of PFC conditions in both of the basins would produce substantial benefits. Adult returns to the upper Cowlitz and the Cispus would increase by 40-150%, with the greatest benefits for spring and fall Chinook (Table 2 and Table 3). Similarly, smolt abundance levels would increase by 30-260% with the spring Chinook gaining the most production in both the upper Cowlitz and Cispus (Table 2 and Table 3). Productivity and diversity would also increase with restoration to PFC conditions.

Tilton Basin

Habitat-based assessments were completed for fall Chinook, spring Chinook, coho, and winter steelhead in the Tilton watershed. Model results indicate that both adult productivity and adult abundance have been severely reduced. Current productivity estimates range from only 10-24% of historical levels (Table 4). Current abundance estimates range from only 4-22% of historical levels (Figure 7). Diversity (as measured by the diversity index) has also declined sharply (Table 4). Fall Chinook and coho diversity is estimated at only 39% and 36% of historical levels, respectively. Spring Chinook and winter steelhead diversity has declined by 78% and 79%, respectively.

Smolt productivity in the Tilton has also declined (Table 4), though losses have not been as great as for adult productivity, suggesting that out of basin factors may be contributing to losses in adult productivity. Relative declines in smolt abundance have been greatest for coho and winter steelhead, but similar losses have also occurred for spring Chinook and fall Chinook (Table 4).

Model results indicate that restoration of PFC conditions would produce substantial benefits for all species (Table 4). Adult abundance for coho would benefit the most, with runs increasing to approximately 12 times current levels. Similarly, returns of fall Chinook, spring Chinook, and winter steelhead all would increase by 140- 400% (Table 4). Smolt abundance would also increase for all species (Table 4). Benefits to smolt abundance would range from a 92% increase for fall Chinook smolts to a 669% increase for coho smolts.

Table 2. Upper Cowlitz River - Population productivity, abundance, and diversity (of both smolts and adults) based on EDT analysis of current (P or patient), historical (T or template)[1], and properly functioning (PFC) habitat conditions.

	Adult Abundance			Adult Productivity			Diversity Index			Smolt Abundance			Smolt Productivity		
Species	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	T[1]
Fall Chinook	3,097	6,516	17,613	2.5	3.6	9.1	0.60	0.70	1.00	465,080	818,516	1,779,088	237	274	518
Spring Chinook	3,019	6,426	21,750	2.5	4.5	15.8	0.41	0.45	1.00	175,993	384,052	1,707,591	77	115	270
Coho	11,039	23,633	17,654	3.0	7.3	21.4	0.57	0.61	0.92	317,625	644,219	272,111	76	157	316
Winter Steelhead	855	1,402	1,973	4.8	9.3	15.1	0.72	0.78	0.86	17,196	25,080	28,802	94	163	213

[1] Estimate represents historical conditions in the basin and current conditions in the mainstem and estuary.

Table 3. Cispus River— Population productivity, abundance, and diversity (of both smolts and adults) based on EDT analysis of current (P or patient), historical (T or template), and properly functioning (PFC) habitat conditions.

	Adult Abundance			Adult Productivity			Diversity Index			Smolt Abundance			Smolt Productivity		
Species	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	T[1]
Fall Chinook	934	2,055	5,792	1.8	2.9	7.2	0.49	0.70	1.00	129,631	282,394	607,842	176	245	426
Spring Chinook	718	1,803	7,791	1.9	3.5	14.0	0.27	0.37	1.00	52,519	191,009	790,464	79	141	297
Coho	3,752	5,351	8,029	4.0	7.5	22.1	0.33	0.37	0.73	98,166	124,684	120,143	90	153	309
Winter Steelhead	624	1,001	1,504	4.2	7.4	13.1	0.85	0.94	0.98	12,576	18,112	22,084	83	131	185

[1] Estimate represents historical conditions in the basin and current conditions in the mainstem and estuary.

Table 4. Tilton River — Population productivity, abundance, and diversity (of both smolts and adults) based on EDT analysis of current (P or patient), historical (T or template), and properly functioning (PFC) habitat conditions.

	Adult Abundance			Adult Productivity			Diversity Index			Smolt Abundance			Smolt Productivity		
Species	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	T[1]
Fall Chinook	1,025	2,475	4,610	2.0	4.5	8.6	0.35	0.90	0.90	137,656	264,812	337,240	211	359	465
Spring Chinook	868	3,176	5,436	1.9	7.2	15.1	0.20	0.78	0.93	63,454	195,918	246,459	92	188	251
Coho	261	3,233	5,599	2.6	12.6	24.9	0.32	0.84	0.90	8,741	67,197	82,075	72	256	352
Winter Steelhead	219	1,093	1,741	2.3	9.7	16.5	0.21	0.91	1.00	4,484	19,991	26,042	44	170	234

[1] Estimate represents historical conditions in the basin and current conditions in the mainstem and estuary.

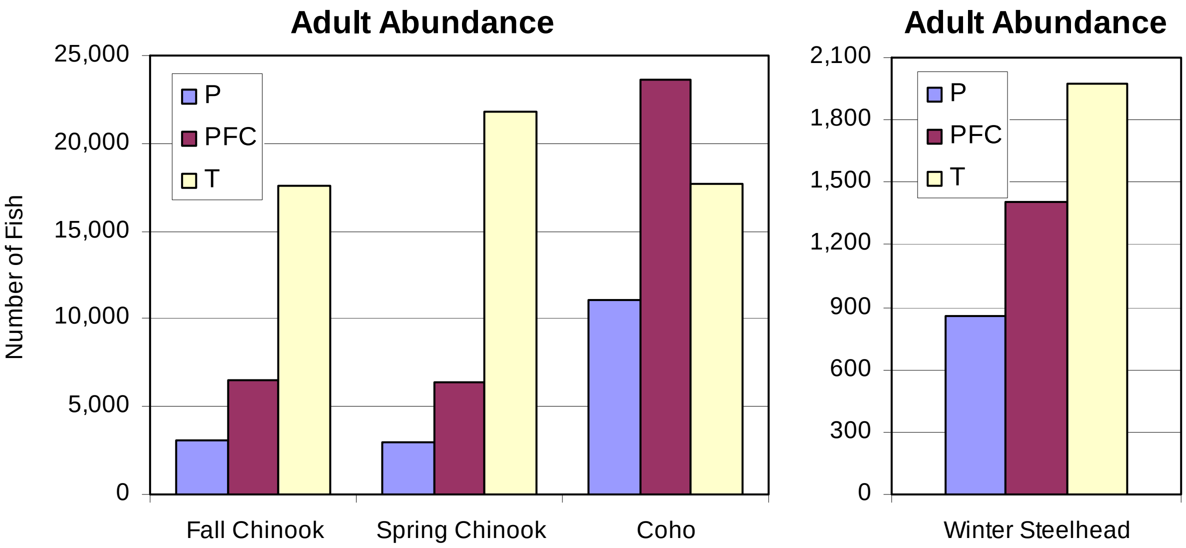


Figure 5. **Adult abundance of Upper Cowlitz fall chinook, spring chinook, coho and winter steelhead based on EDT analysis of current (P or patient), historical (T or template), and properly functioning (PFC) habitat conditions.**

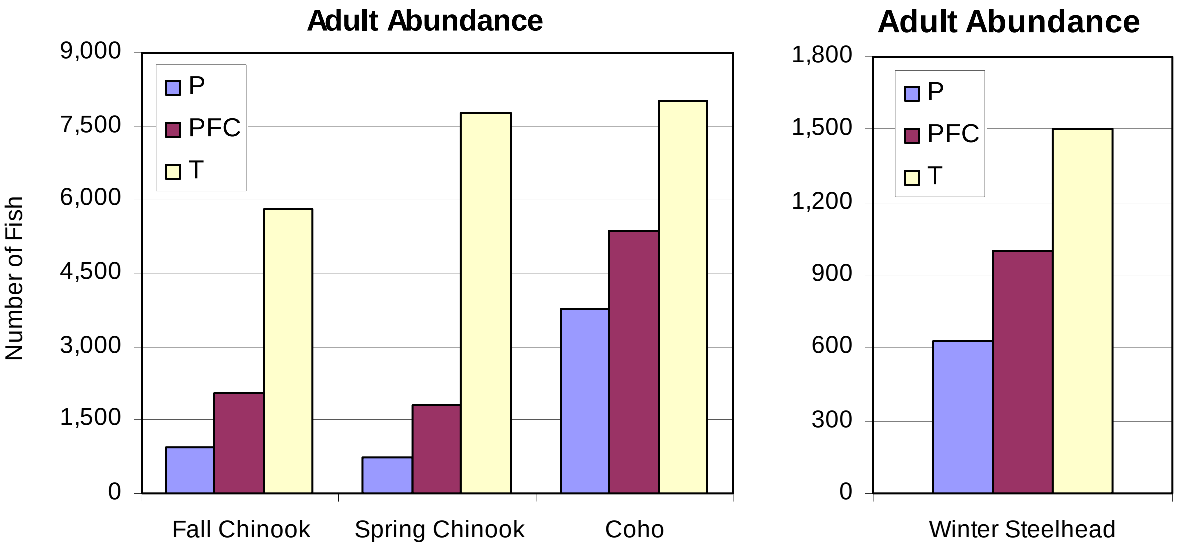


Figure 6. **Adult abundance of Cispus fall chinook, spring chinook, coho and winter steelhead based on EDT analysis of current (P or patient), historical (T or template), and properly functioning (PFC) habitat conditions.**

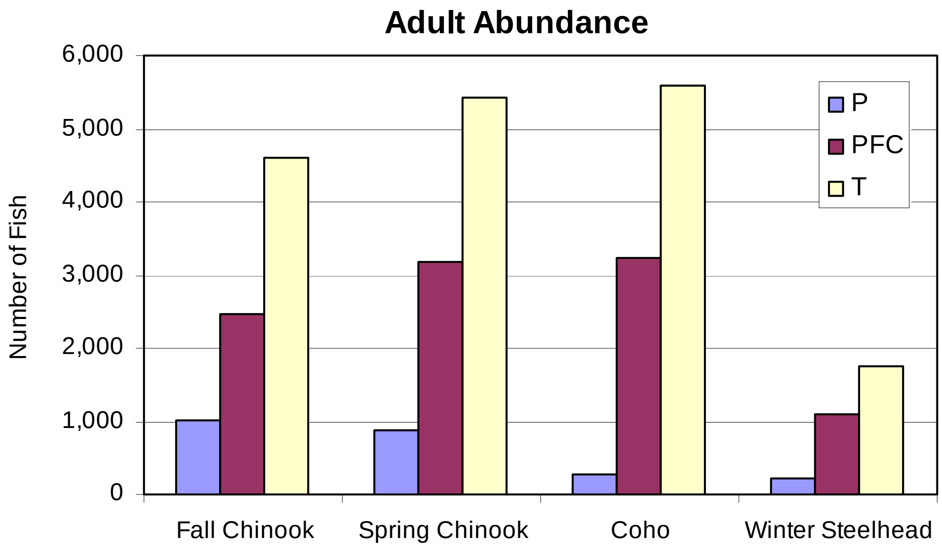


Figure 7. Adult abundance of Tilton River fall chinook, spring chinook, coho and winter steelhead based on EDT analysis of current (P or patient), historical (T or template), and properly functioning (PFC) habitat conditions.

3.4.2 *Stream Reach Analysis*

Habitat conditions and suitability for fish are better in some portions of a subbasin than in others. The reach analysis of the EDT model uses estimates of the difference in projected population performance between current/patient and historical/template habitat conditions to identify core and degraded fish production areas. Core production areas, where habitat degradation would have a large negative impact on the population, are assigned a high value for preservation. Likewise, currently degraded areas that provide significant potential for restoration are assigned a high value for restoration. Collectively, these values are used to prioritize the reaches within a given basin. For this reach analysis, the Upper Cowlitz and Cispus basins were combined for EDT modeling purposes. See Figure 8 for a map of EDT reaches within the Upper Cowlitz and Cispus basins and Figure 9 for a map of EDT reaches in the Tilton basin.

Upper Cowlitz and Cispus Basins

Winter steelhead, spring Chinook, and fall Chinook are transported above the hydropower system and make extensive use of mainstem habitat in the upper Cowlitz and Cispus basins. Winter steelhead and spring Chinook make use of mainstem tributaries to a greater degree than fall Chinook. Coho primarily use mainstem tributaries for spawning and rearing.

Important reaches in the Upper Cowlitz and Cispus for fall Chinook (Figure 10) include primarily the upper mainstem reaches of the Cowlitz (Upper Cowlitz 1A-1E, and Upper Cowlitz 1CC and 1CCC). Only one reach in the Cispus, Cispus 1C, was considered high priority for fall Chinook. The majority of these reaches show a preservation recovery emphasis (Figure 10). Only the reaches of Cispus 1C and Upper Cowlitz 1A and 1B show a combined preservation and restoration recovery emphasis. The reach Upper Cowlitz 1E shows the highest preservation rating of any fall Chinook reach.

For spring Chinook in the Upper Cowlitz and Cispus, high priority reaches are concentrated in the mainstem Cowlitz, with only one high priority reach located in the Cispus

(Figure 11). These reaches are split with regard to recovery emphasis (Figure 11). Three reaches, Upper Cowlitz 1AA and 1B, and Cispus 1C, show a combined preservation and restoration recovery emphasis. All other reaches show a preservation emphasis only. Reach Upper Cowlitz 1E shows the highest preservation rating of any spring Chinook reach.

High priority areas for coho in the Cowlitz include the reaches Upper Cowlitz 1A, 1AA, 1B and 1E (Figure 12). In the Cispus, the reaches Cispus 2 and 3 are considered high priority reaches (Figure 12). As with spring Chinook, these reaches are split with regard to recovery emphasis. Again, reach Upper Cowlitz 1E is ranked as the highest priority reach.

High priority areas for winter steelhead in the Upper Cowlitz and Cispus include the mainstem reaches Upper Cowlitz 1C, 1D, 1E and 1CC, as well as Cispus 2, 3, and 1F (Figure 13). The tributary reaches Yellowjacket 1, Silver Cr 1, and Johnson Cr 1 are also key areas. The majority of high priority reaces for winter steelhead show a combined preservation and restoration recovery emphasis (Figure 13). Silver Cr 1 is the only high priority reach with a restoration emphasis. Upper Cowlitz 1E shows the highest preservation rating of any winter steelhead reach.

Tilton Basin

High priority reaches are similar for fall Chinook (Figure 14) and spring Chinook (Figure 15), and include mainstem reaches from Bear Canyon to the EF Tilton and sections in the EF Tilton. In these reaches, as in the reaches for winter steelhead, all high and medium priority reaches show a restoration emphasis. Reaches Tilton 5 and Tilton 6 show one of the strongest restoration emphasis for both fall and spring Chinook in the Tilton.

Important sections for coho include mainstem reaches (Tilton1, 3, 5 and 6), the lower EF Tilton (Tilton EF1), and Lake Creek (Figure 8). Again, all reaches show a strong habitat restoration emphasis, with Tilton 5 having the most potential improvement due to restoration.

High priority reaches for winter steelhead include the lower sections of the EF Tilton (Tilton EF1 and Tilton EF2) as well as mainstem sections of the Tilton (Tilton 1, 3, 5 and 6) (Figure 9). All high and medium priority reaches for winter steelhead show a restoration emphasis.

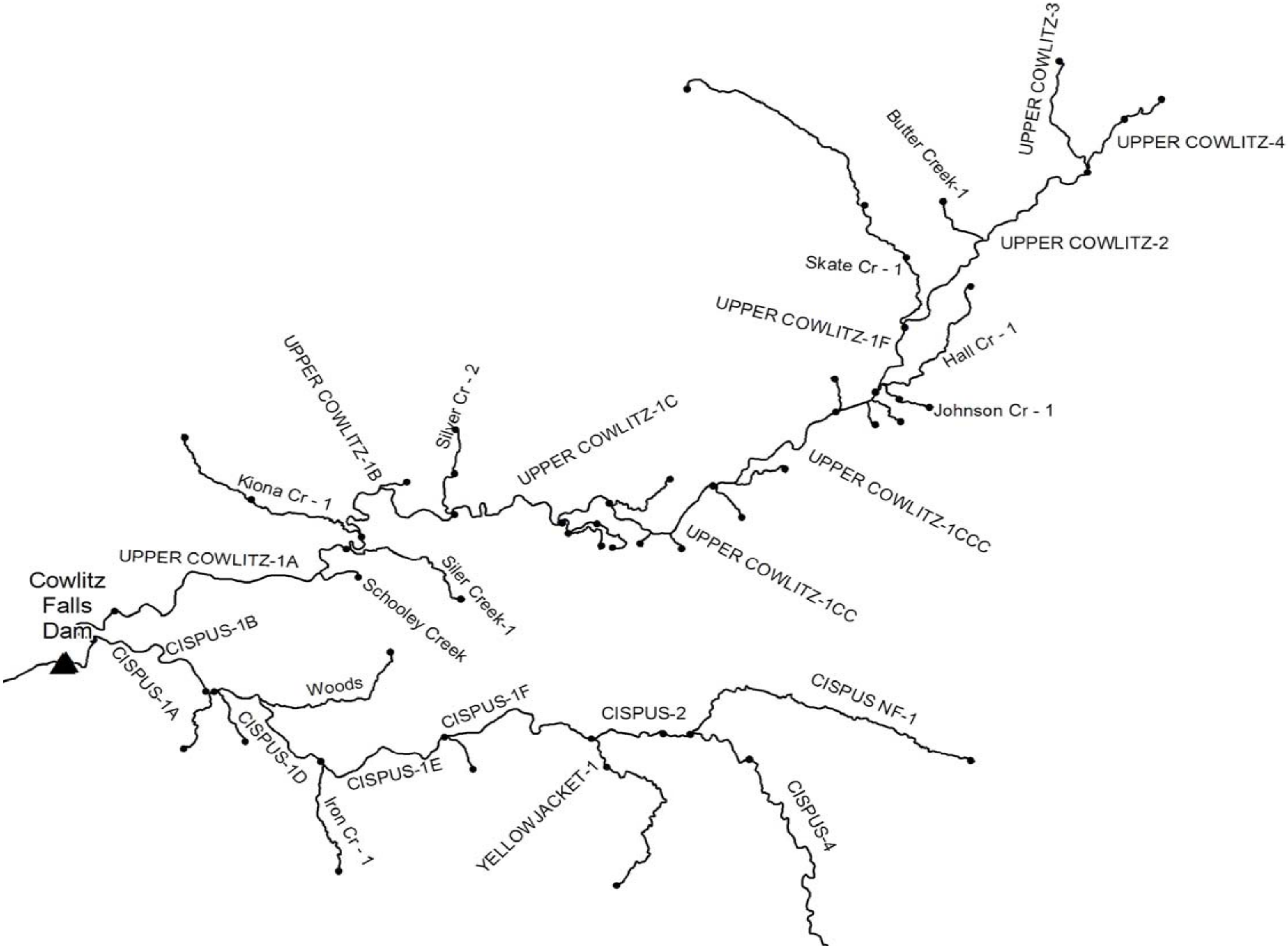


Figure 8. **Upper Cowlitz and Cispus rivers with EDT reaches identified. For readability, not all reaches are labeled.**

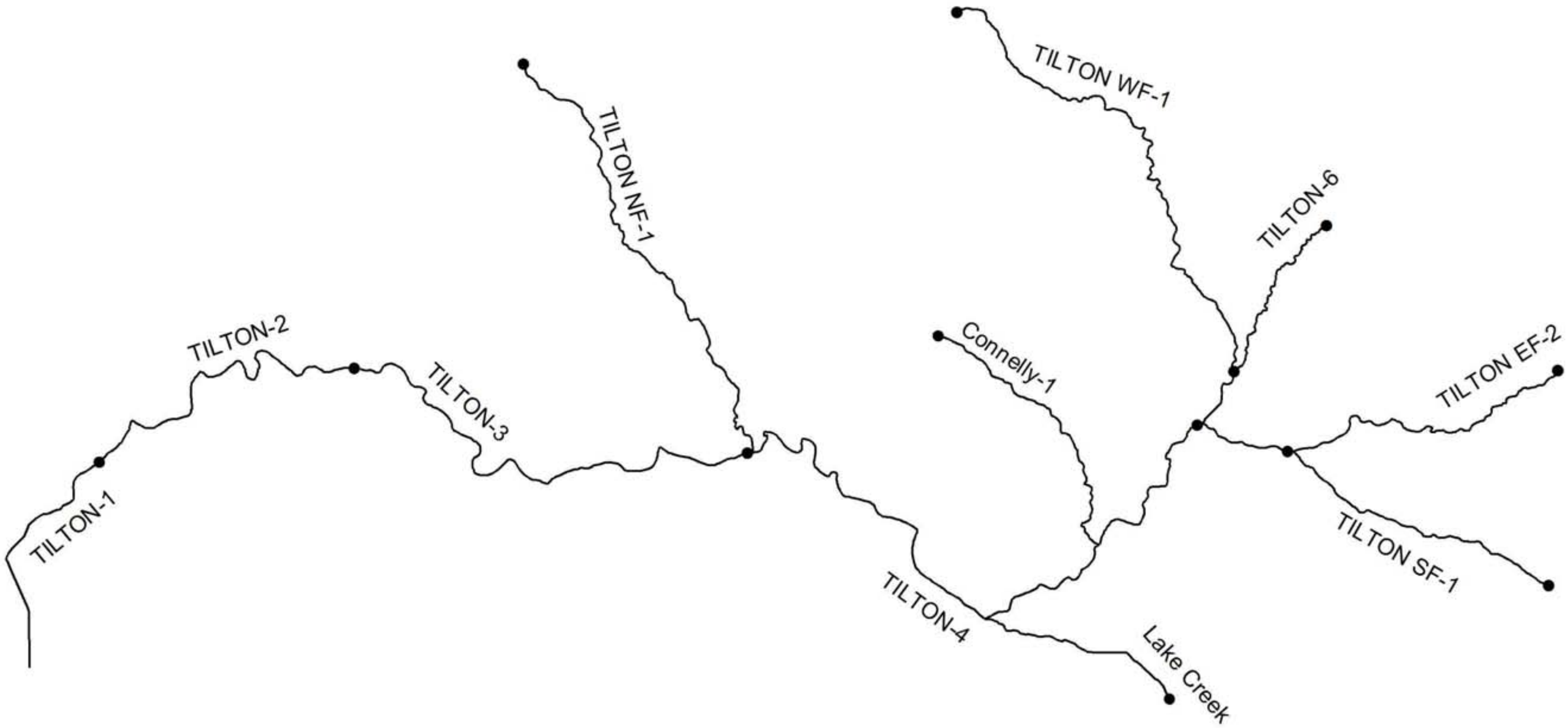
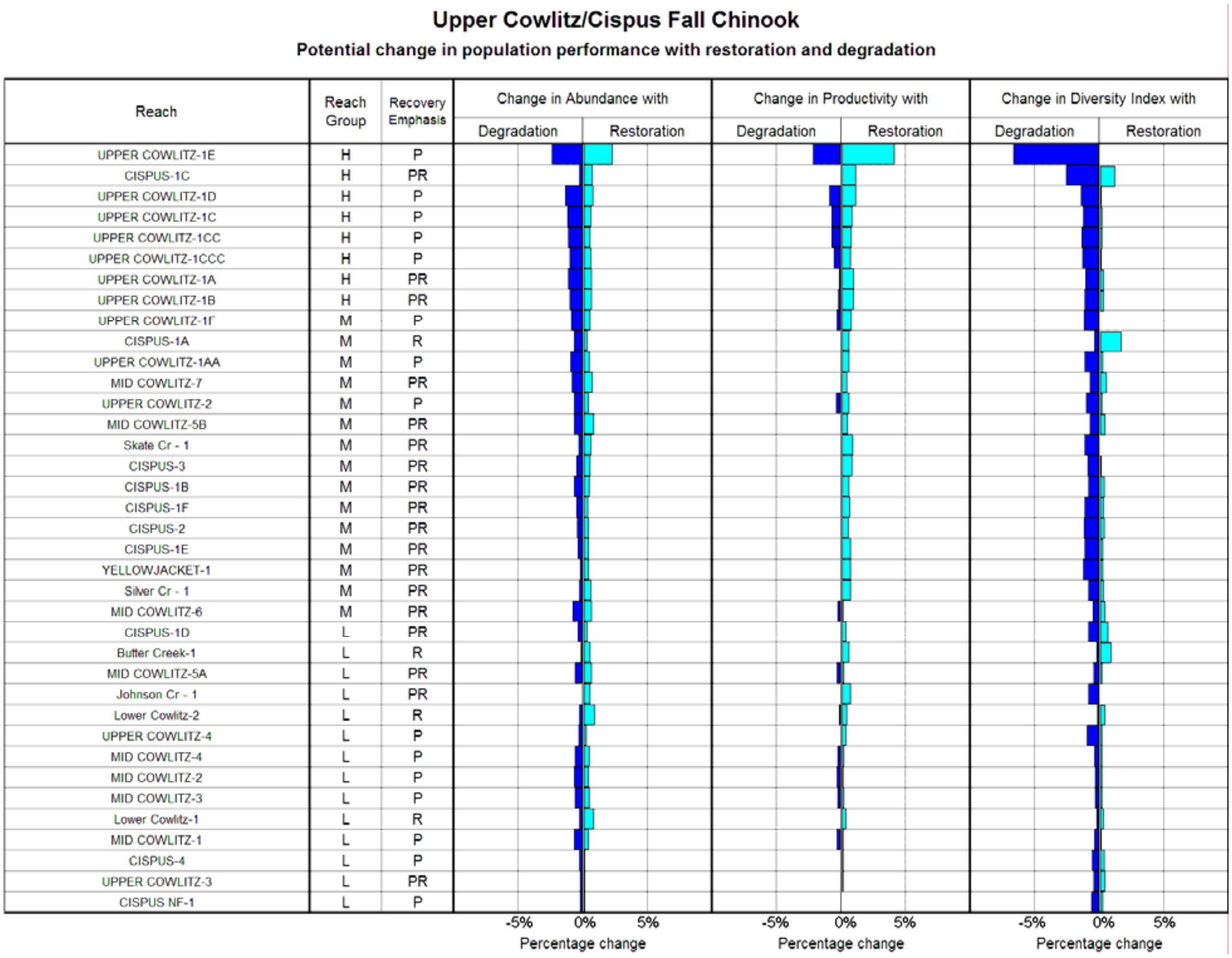
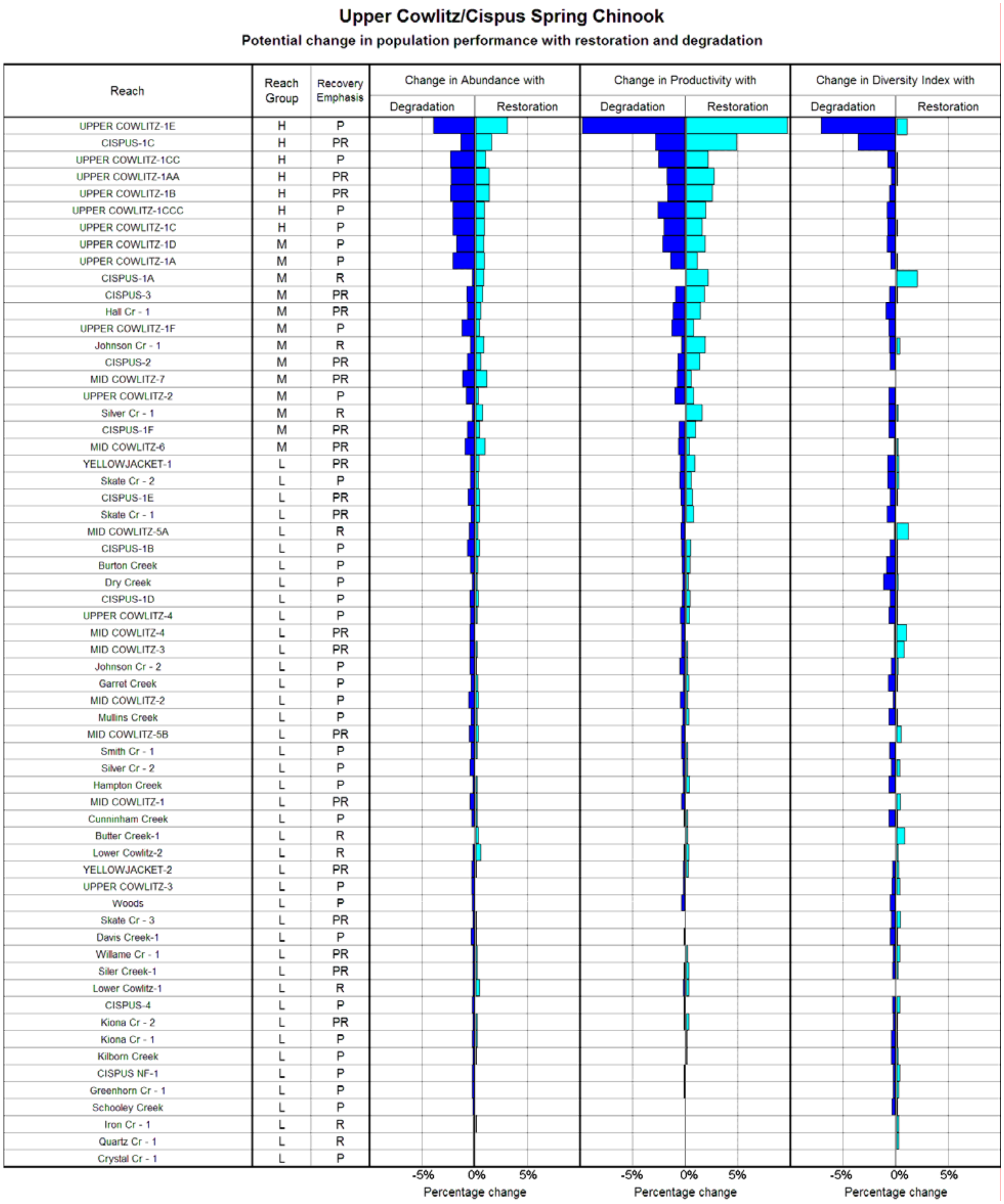


Figure 9.Tilton River basin EDT reaches. Some reaches are not labeled for clarity.



Reach	Reach Group	Recovery Emphasis
UPPER COWLITZ-1E	H	P
CISPUS-1C	H	PR
UPPER COWLITZ-1D	H	P
UPPER COWLITZ-1C	H	P
UPPER COWLITZ-1CC	H	P
UPPER COWLITZ-1CCC	H	P
UPPER COWLITZ-1A	H	PR
UPPER COWLITZ-1B	H	PR
UPPER COWLITZ-1F	M	P
CISPUS-1A	M	R
UPPER COWLITZ-1AA	M	P
MID COWLITZ-7	M	PR
UPPER COWLITZ-2	M	P
MID COWLITZ-5B	M	PR
Skate Cr - 1	M	PR
CISPUS-3	M	PR
CISPUS-1B	M	PR
CISPUS-1F	M	PR
CISPUS-2	M	PR
CISPUS-1E	M	PR
YELLOWJACKET-1	M	PR
Silver Cr - 1	M	PR
MID COWLITZ-6	M	PR
CISPUS-1D	L	PR
Butter Creek-1	L	R
MID COWLITZ-5A	L	PR
Johnson Cr - 1	L	PR
Lower Cowlitz-2	L	R
UPPER COWLITZ-4	L	P
MID COWLITZ-4	L	P
MID COWLITZ-2	L	P
MID COWLITZ-3	L	P
Lower Cowlitz-1	L	R
MID COWLITZ-1	L	P
CISPUS-4	L	P
UPPER COWLITZ-3	L	PR
CISPUS NF-1	L	P

Figure 10. Upper Cowlitz and Cispus fall Chinook ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphasis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams


Upper Cowlitz/Cispus Spring Chinook

Potential change in population performance with restoration and degradation

Reach	Reach Group	Recovery Emphasis
UPPER COWLITZ-1E	H	P
CISPUS-1C	H	PR
UPPER COWLITZ-1CC	H	P
UPPER COWLITZ-1AA	H	PR
UPPER COWLITZ-1B	H	PR
UPPER COWLITZ-1CCC	H	P
UPPER COWLITZ-1C	H	P
UPPER COWLITZ-1D	M	P
UPPER COWLITZ-1A	M	P
CISPUS-1A	M	R
CISPUS-3	M	PR
Hall Cr - 1	M	PR
UPPER COWLITZ-1F	M	P
Johnson Cr - 1	M	R
CISPUS-2	M	PR
MID COWLITZ-7	M	PR
UPPER COWLITZ-2	M	P
Silver Cr - 1	M	R
CISPUS-1F	M	PR
MID COWLITZ-6	M	PR
YELLOWJACKET-1	L	PR
Skate Cr - 2	L	P
CISPUS-1E	L	PR
Skate Cr - 1	L	PR
MID COWLITZ-5A	L	R
CISPUS-1B	L	P
Burton Creek	L	P
Dry Creek	L	P
CISPUS-1D	L	P
UPPER COWLITZ-4	L	P
MID COWLITZ-4	L	PR
MID COWLITZ-3	L	PR
Johnson Cr - 2	L	P
Garret Creek	L	P
MID COWLITZ-2	L	P
Mullins Creek	L	P
MID COWLITZ-5B	L	PR
Smith Cr - 1	L	P
Silver Cr - 2	L	P
Hampton Creek	L	P
MID COWLITZ-1	L	PR
Cunninham Creek	L	P
Butter Creek-1	L	R
Lower Cowlitz-2	L	R
YELLOWJACKET-2	L	PR
UPPER COWLITZ-3	L	P
Woods	L	P
Skate Cr - 3	L	PR
Davis Creek-1	L	P
Willame Cr - 1	L	PR
Siler Creek-1	L	PR
Lower Cowlitz-1	L	R
CISPUS-4	L	P
Kiona Cr - 2	L	PR
Kiona Cr - 1	L	P
Kilborn Creek	L	P
CISPUS NF-1	L	P
Greenhorn Cr - 1	L	P
Schooley Creek	L	P
Iron Cr - 1	L	R
Quartz Cr - 1	L	R
Crystal Cr - 1	L	P

Figure 11. Upper Cowlitz and Cispus spring Chinook ladder diagram.

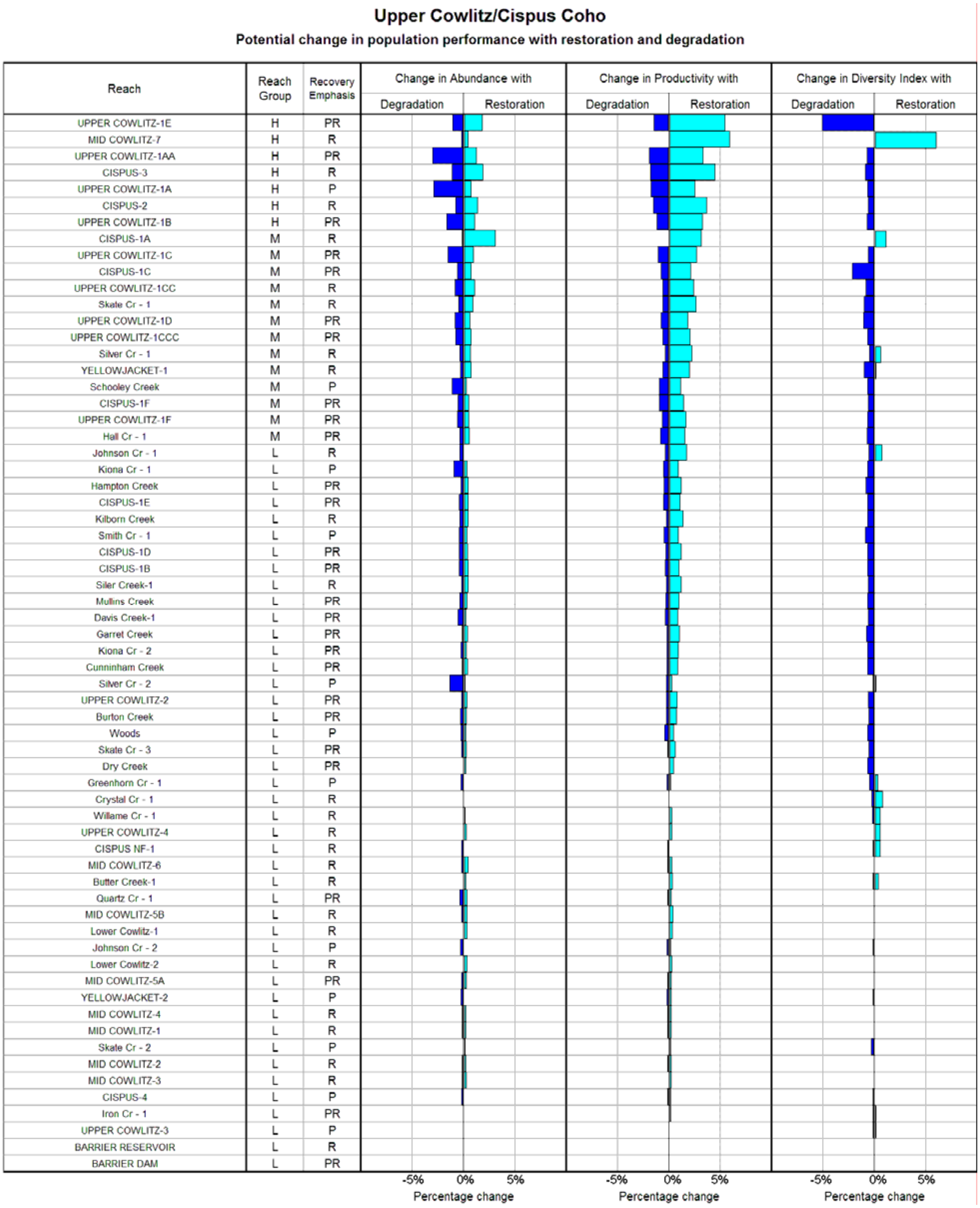


Figure 12. Upper Cowlitz and Cispus coho ladder diagram.

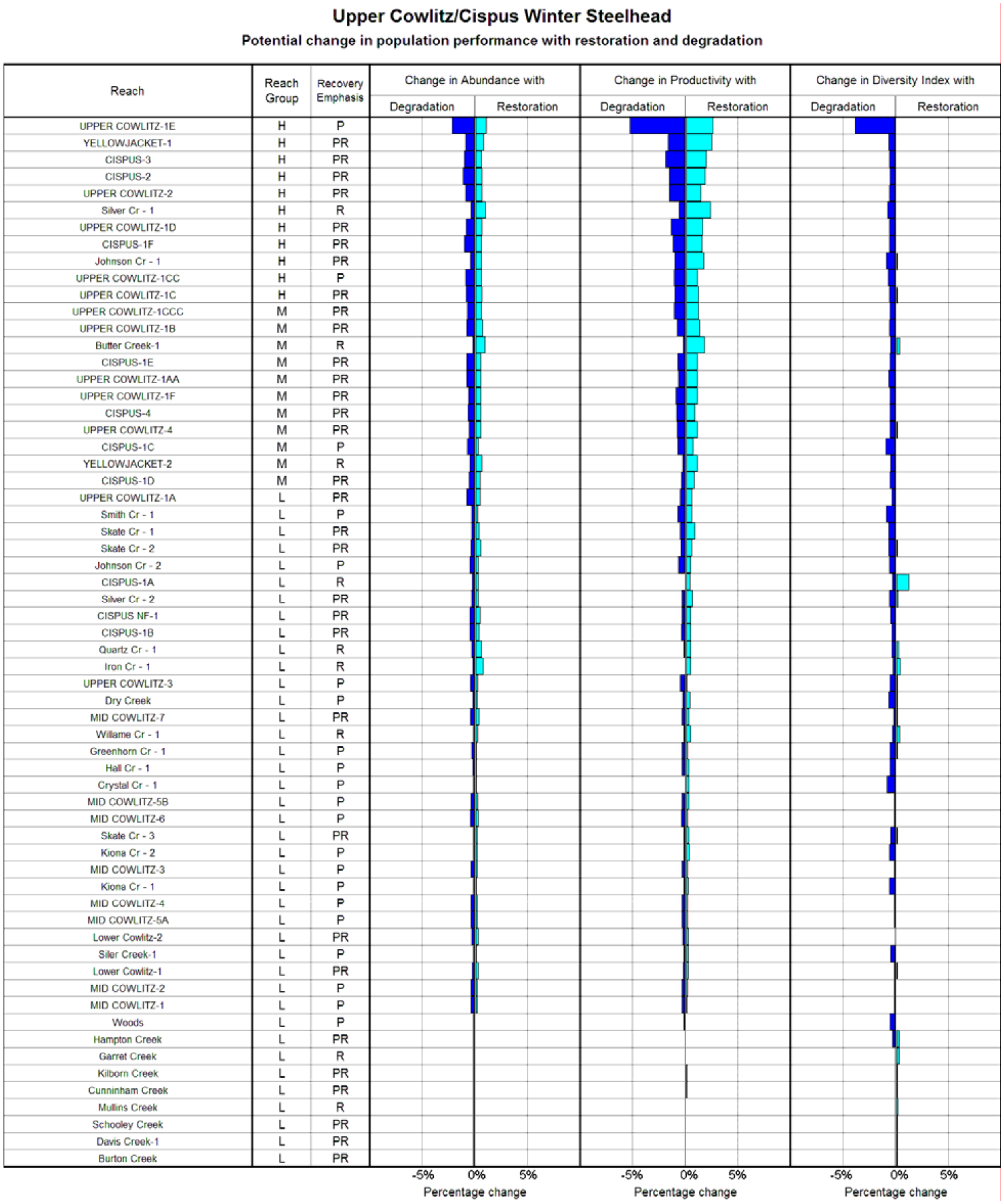


Figure 13. Upper Cowlitz and Cispus winter steelhead ladder diagram.

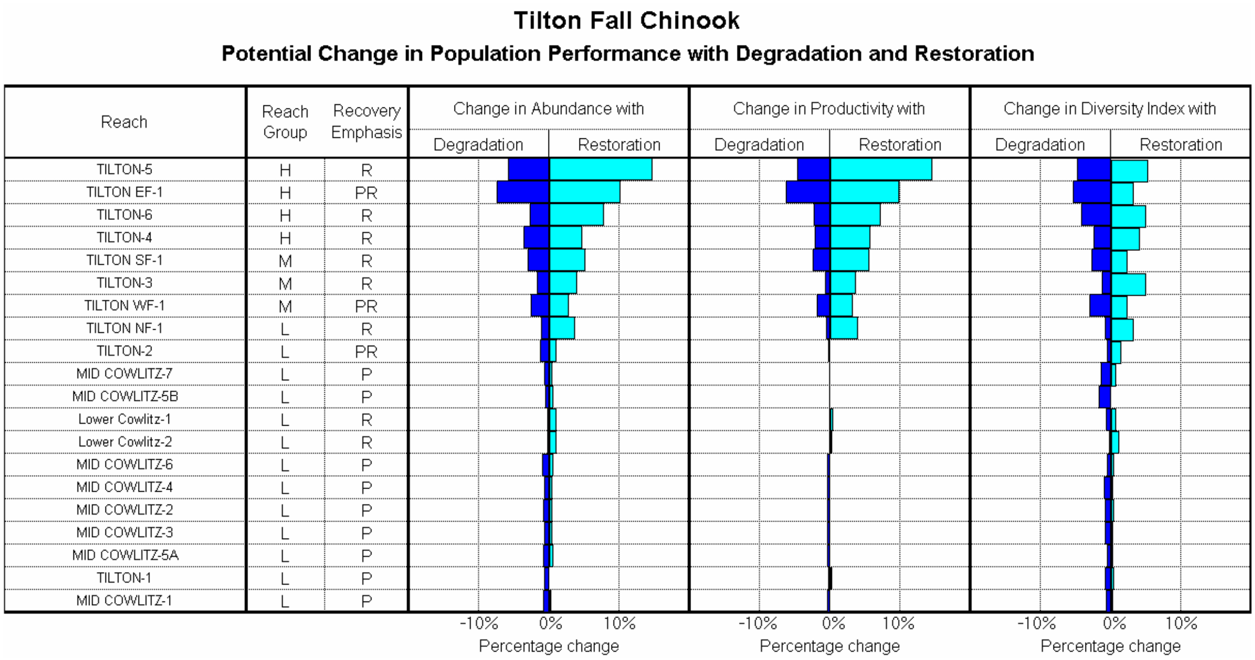


Figure 14.Tilton fall Chinook ladder diagram.

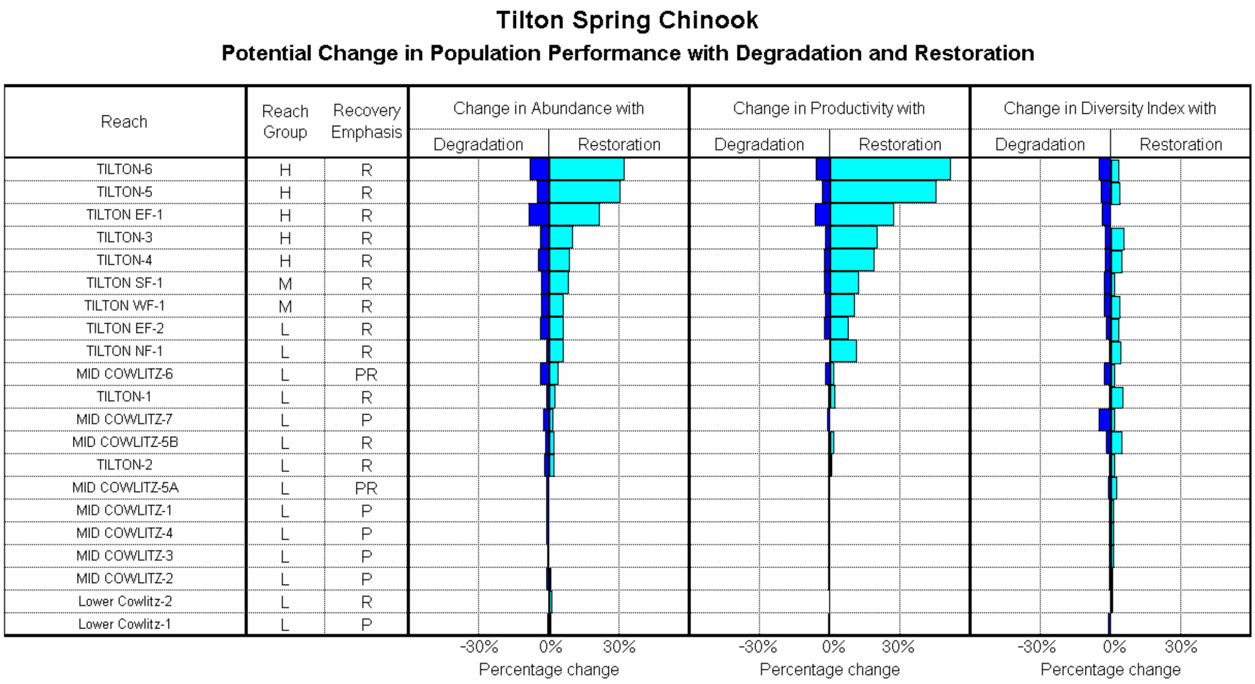


Figure 15. Tilton spring Chinook ladder diagram.

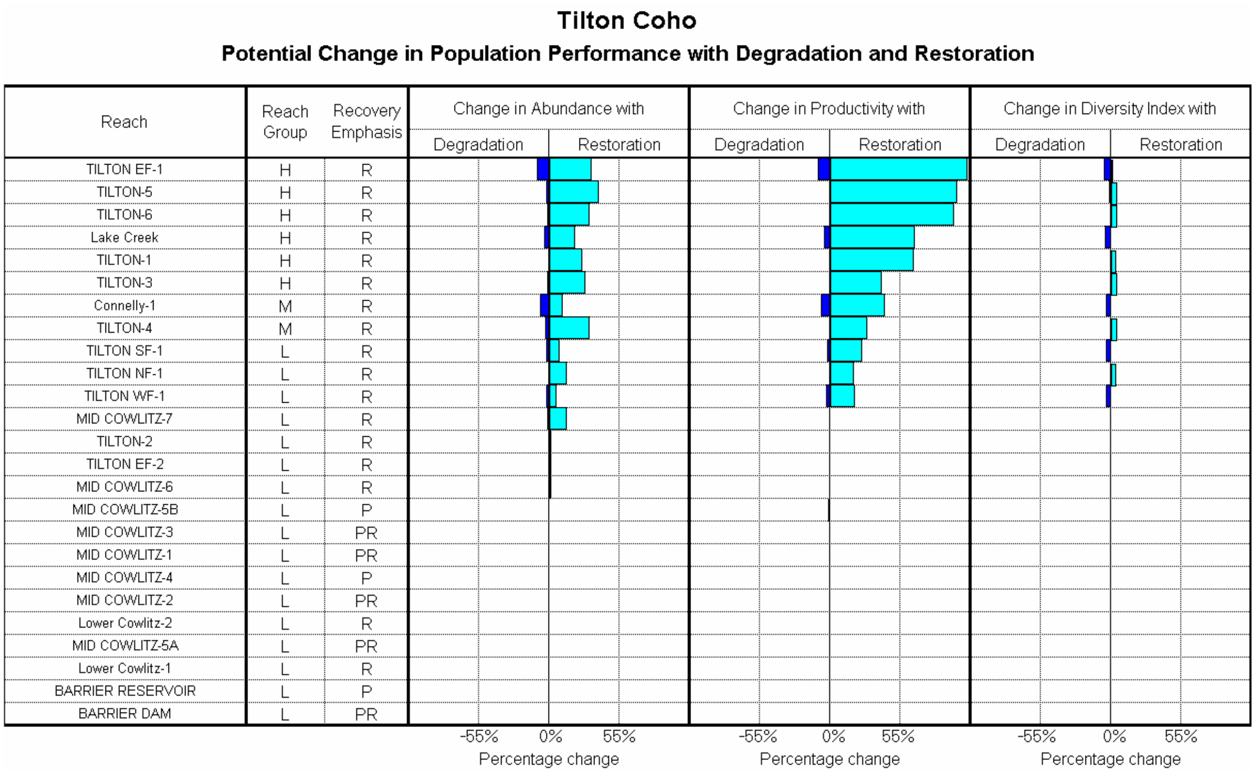


Figure 16. Tilton coho ladder diagram

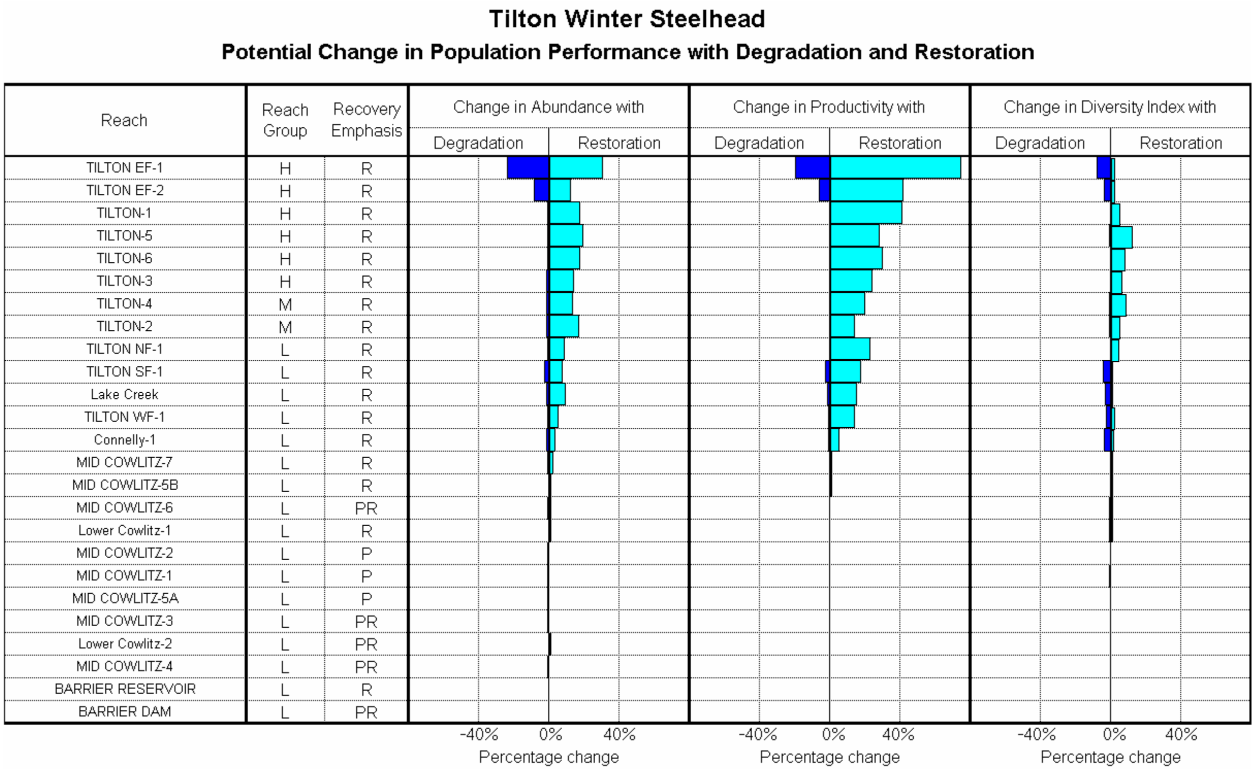


Figure 17. Tilton River winter steelhead ladder diagram.

3.4.3 *Habitat Factor Analysis*

The Habitat Factor Analysis of EDT identifies the most important habitat factors affecting fish in each reach. Whereas the EDT reach analysis identifies reaches where changes are likely to significantly affect the fish, the Habitat Factor Analysis identifies specific stream reach conditions that may be modified to produce an effect. Like all EDT analyses, the habitat factor analysis compares current/patient and historical/template habitat conditions. For each reach, EDT generates what is referred to as a “consumer reports diagram”, which identifies the degree to which individual habitat factors are acting to suppress population performance. The effect of each habitat factor is identified for each life stage that occurs in the reach and the relative importance of each life stage is indicated. For additional information and examples of this analysis, see Appendix E. Inclusion of the consumer report diagram for each reach is beyond the scope of this document. A summary of the most critical life stages and the habitat factors affecting them are displayed for each species in the Upper Cowlitz and Cispus basins in Table 5 and in Table 6 for species in the Tilton basin.

Table 5. Summary of the primary limiting factors affecting life stages of focal salmonid species. Results are summarized from EDT Analysis

Upper Cowlitz/Cispus.

Species and Lifestage		*Primary factors*	*Secondary factors*	*Tertiary factors*
Upper Cowlitz/Cispus Fall Chinook				
most critical	Egg incubation	channel stability	sediment	
second	Fry colonization	habitat diversity	flow, food, channel stability	predation
third	0-age summer rearing	habitat diversity, pathogens	competition (hatchery)	channel stability, food, key habitat
Upper Cowlitz/Cispus Spring Chinook				
most critical	Egg incubation	channel stability, sediment		
second	0-age summer rearing	competition (hatchery), food, habitat diversity, pathogens		
third	0-age winter rearing	channel stability, flow, food, habitat diversity		
Upper Cowlitz Coho				
most critical	Egg incubation	channel stability, sediment		
second	0-age summer rearing	habitat diversity	competition (hatchery), food, predation, key habitat	pathogens
third	0-age winter rearing	habitat diversity	flow, key habitat	channel stability, food
Upper Cowlitz/Cispus Winter Steelhead				
most critical	1-age summer rearing	competition (hatchery), flow, pathogens	habitat diversity, predation	chnannel stability
second	0-age summer rearing	competition (hatchery), pathogens	habitat diversity	food, flow
third	Egg incubation	sediment	channel stability, temperature	oxygen, pathogens, key habitat

Table 6. Summary of the primary limiting factors affecting life stages of focal salmonid species. Results are summarized from EDT Analysis

Tilton

Species and Lifestage		*Primary factors*	*Secondary factors*	*Tertiary factors*
Tilton Fall Chinook				
most critical	Egg incubation	channel stability, sediment	flow, temperature	
second	Fry colonization	habitat diversity, food, sediment	flow, channel stability, predation	
third	Spawning	sediment	temperature, habitat diversity	predation, pathogens
Tilton Spring Chinook				
most critical	Egg incubation	channel stability, sediment	Temperature,	flow
second	Prespawning holding	flow	habitat diversity, temperature	pathogens, harassment, key habitat
third	Fry colonization	habitat diversity, sediment	flow	food
Tilton Coho				
most critical	0-age winter	habitat diversity, flow, sediment	channel stability, key habitat	food, predation
second	Egg incubation	channel stability, sediment	habitat diversity	flow, temperature
third	Prespawning holding	sediment	habitat diversity	
Tilton Winter Steelhead				
most critical	Egg incubation	sediment, temperature	pathogens, flow	channel stability, key habitat
second	0,1-age winter rearing	flow	habitat diversity, sediment	flood, channel stability, predation
third	0-age summer rearing	flow	competition (hatchery), habitat diversity, pathogens, temperature	food, predation, key habitat

The consumer reports diagrams have also been summarized to show the relative importance of habitat factors by reach. The summary figures are referred to as habitat factor analysis diagrams and are displayed for each species below. The reaches are ordered according to their combined restoration and preservation rank. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to historical conditions.

Upper Cowlitz and Cispus Basins

Almost all of the key fall Chinook (Figure 18) and spring Chinook (Figure 19) restoration reaches within the upper Cowlitz and Cispus watersheds are in the mainstem Cowlitz (only one high priority reach in the Cispus). These reaches are primarily affected by loss of habitat diversity, decreased channel stability, and excessive fine sediment, and in the case of spring Chinook, by competition and pathogens. The causes of these impacts are the same as those described for winter steelhead restoration reaches.

Key coho restoration reaches exist in both the upper Cowlitz and Cispus watersheds. The habitat impacts affecting these areas are loss of habitat diversity, loss of channel stability, increased sediments, and loss of key habitat (Figure 20). The cause of these impacts is the same as described earlier for winter steelhead reaches.

Key winter steelhead restoration reaches are in both mainstem and tributary locations. These reaches are most negatively influenced by low habitat diversity, sediment, poor channel stability, altered flow regimes, competition with hatchery fish, and pathogens (Figure 21). Low habitat diversity is a result of loss of side channel habitat in these mainstem reaches. Historically, these reaches had abundant LWD, but now have very little (Mobrand Biometrics 1999, USFS 1997a). LWD was removed from the floodplains and harvested from riparian areas. The loss of LWD has contributed to the loss of habitat diversity and channel stability. Bank stability is a problem due to excessive sediment accumulations causing channel widening. Sediment problems arise because of mass wasting, road erosion, and concentrated overland runoff associated with land use throughout the basin. Disease and competition concerns arise because of the extensive hatchery influence in the basin.

Tilton Basin

Important reaches for both fall Chinook (Figure 22) and spring Chinook (Figure 23) are located in the mainstem, EF, SF, and WF Tilton. These reaches have been most negatively impacted by sediment, flow alterations, and temperature regime changes, with lesser impacts from decreased habitat diversity, pathogens, and loss of key habitat. There is an increased peak flow risk due to high road densities and reductions in forest cover throughout the basin. Low flows have also been cited as a problem (Harza 1997 as cited in Wade 2000). High road densities have also been implicated in increased fine sediment delivery rates within the basin. Habitat diversity has been reduced due to LWD reductions related to channel cleaning, timber harvest in riparian zones, debris torrents, dam break floods, and increased peak flows (EA 1998 as cited in Wade 2000). Temperature regimes have been influenced by changes in riparian vegetation. Over 87% of riparian corridors in the Mayfield/Tilton basin lack riparian vegetation or have early-seral stage riparian conditions. Pathogenic and competition concerns arise from the extensive distribution of hatchery fish in the Cowlitz basin.

For coho, important reaches include mainstem reaches, the lower EF Tilton, and Lake and Connelly Creeks. These reaches have been degraded in the form increased sediment, lost habitat diversity, altered flow regimes, decreased channel stability, and loss of key habitat

(Figure 24). The causes of these impacts are the same as those discussed above for fall Chinook and spring Chinook.

Key winter steelhead reaches in the Tilton include the mainstem Tilton from Bear Canyon to the East Fork Tilton, and in the East Fork Tilton. These reaches have been primarily impacted by sediment, habitat diversity, flow, temperature, and channel stability. The causes of these impacts are the same as those discussed above for fall Chinook and spring Chinook.

Upper Cowlitz/Cispus Fall Chinook

ReachName	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
UPPER COWLITZ-1E	⬤	⬤				•			●		•			•	•	●
CISPUS-1C	●	●				•			●	⬤	•			•		●
UPPER COWLITZ-1D	●	●		•		•			•		•			•	•	•
UPPER COWLITZ-1C	●	●		•		•			•		•			•	•	•
UPPER COWLITZ-1CC	●	●		•		•			•		•			•	•	•
UPPER COWLITZ-1CCC	●	●		•		•			•		•			•	•	•
UPPER COWLITZ-1A	●	●		•		•			•	⬤	•			•		•
UPPER COWLITZ-1B	●	●		•		•			•	⬤	•			•		•
UPPER COWLITZ-1F	●	●		•		•			•		•			•	•	•
CISPUS-1A	+	●	•			•			•	●	•			•		
UPPER COWLITZ-1AA	●	●		•		•			•	⬤	•			•		•
MID COWLITZ-7	•	●		•		•			•		•			●		•
UPPER COWLITZ-2	●	●		•		•			•		•			•		•
MID COWLITZ-5B	•	●		•		•			✛		•			⬤	•	●
Skate Cr - 1	●	●	•						•	●	•			•	•	✚
CISPUS-3	●	●		•		•			●	⬤	•			•		•
CISPUS-1B	●	●		•		•			•	⬤	•			•		•
CISPUS-1F	•	●		•		•			•	⬤	•			•		•
CISPUS-2	•	●		•		•			•	⬤	•			•		•
CISPUS-1E	•	●		•		•			•	⬤	•			•		•
YELLOWJACKET-1	●	●							•	⬤	•			•		+
Silver Cr - 1	●	●	•					•	•	●	•				•	●
MID COWLITZ-6	•	●		•		•			+		•			●	•	+
CISPUS-1D	●	•				•			•	●	•			•		•
Butter Creek-1	●	●							•	●	•				•	⬤
MID COWLITZ-5A	•	●		•		•			✛		•			●	•	✚
Johnson Cr - 1	●	●							•	●	•				•	✚
Lower Cowlitz-2	•	●	●	●		•			+	•	•			●	•	✚
UPPER COWLITZ-4	●	●							•							
MID COWLITZ-4	•	●		•		•			+		•			●	•	+
MID COWLITZ-2		•	•	•		•			+		•			●	•	+
MID COWLITZ-3	•	●	•	•		•			+		•			●	•	+
Lower Cowlitz-1	•	●	●	●		•			+	•	•			●	•	✚
MID COWLITZ-1		•	•	•		•			+		•			●	•	+
CISPUS-4	•	•														•
UPPER COWLITZ-3	•	•							•							•
CISPUS NF-1	•	•														•

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

Figure 18. Upper Cowlitz and Cispus fall Chinook habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to template conditions. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams. Some low priority reaches are not included for display purposes.

Upper Cowlitz/Cispus Spring Chinook

ReachName	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
UPPER COWLITZ-1E	⬤	⬤		•		●			●		●			●	●	●
CISPUS-1C	⬤	⬤		•		●			●	⬤	●			●		●
UPPER COWLITZ-1CC	●	⬤		•		●			●		●			●	•	•
UPPER COWLITZ-1AA	●	⬤		●		●			●	⬤	●			●		•
UPPER COWLITZ-1B	⬤	⬤		•		●			●	⬤	●			●		•
UPPER COWLITZ-1CCC	●	⬤		•		●			●		●			●	•	•
UPPER COWLITZ-1C	●	⬤		•		●			●		●			●	•	•
UPPER COWLITZ-1D	●	⬤		•		●			●		●			●	•	•
UPPER COWLITZ-1A	●	●		•		●			●	⬤	●			●		•
CISPUS-1A	+	⬤	●	•		•			●	⬤	•			•		
CISPUS-3	●	●		•		●			●	⬤	•			●		
Hall Cr - 1	•	●	●	•		•		●	•	⬤	●			•		●
UPPER COWLITZ-1F	●	●		•		•			•		•			•	•	•
Johnson Cr - 1	●	⬤				•			●	●	•			•	•	✚
CISPUS-2	●	●		•		●			●	⬤	•			●		+
MID COWLITZ-7	•	⬤	+	●		•			●	•	●			⬤	•	•
UPPER COWLITZ-2	●	●				•			•		•			•	•	•
Silver Cr - 1	●	⬤	•			•		•	●	●	•			•	•	+
CISPUS-1F	•	●		•		•			•	⬤	•			•		+
MID COWLITZ-6	•	●	+	●		•			•	•	•			⬤	•	✚
YELLOWJACKET-1	•	●		•		•			•	⬤	•			•		+
Skate Cr - 2	•	●	•						•	•	•			•		●
CISPUS-1E	•	●		•		•			•	⬤	•			•		•
Skate Cr - 1	•	●	●			•			•	●	•			•	•	+
MID COWLITZ-5A	•	•		•		•			•		•			●	•	
CISPUS-1B	●	●		•		•			•	●	•			•		•
Burton Creek	•	●	•			•		•	•	•	•			•	•	✚
Dry Creek	•	●							•	●	•			•	•	•
CISPUS-1D	●	●		•		•			•	●	•			•		•
UPPER COWLITZ-4	•	●							•							
MID COWLITZ-4		•		•										•		
MID COWLITZ-3	•	•		•					•		•			•		•
Johnson Cr - 2	•	•								•						
Garret Creek	•	●	•			•		•	•	•	•			•	•	✚
MID COWLITZ-2	•	●	•	•		•			•	•	•			●	•	•
Mullins Creek	•	●	•			•		•	•	•	•			•		✚
MID COWLITZ-5B	•	•		•		•			•		•			●	•	●
Smith Cr - 1	•	●							•	●					•	•
Silver Cr - 2		•														+
Hampton Creek	•	•	•			•		•	•	•	•			•		✚
MID COWLITZ-1	•	•		•					•	•	•			•	•	•
Cunninham Creek	•	•	•					•	•	•	•			•		✚
Butter Creek-1	•	●	•					•	•	•	•				•	●
Lower Cowlitz-2	•	●	•	●		•				•	•			●	•	●
YELLOWJACKET-2		•							•	•						•
UPPER COWLITZ-3	•	•														•
Woods																
Skate Cr - 3		•	•						•	•						•

High Impact ⬤ Moderate Impact ● Low Impact • None Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

Figure 19. Upper Cowlitz and Cispus spring chinook habitat factor analysis. Some low priority reaches are not included for display purposes

Upper Cowlitz/Cispus Coho

ReachName	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
UPPER COWLITZ-1E	⬤	⬤		•		●			●		●			●		●
MID COWLITZ-7	•	●		•		•			•		•			•		✛
UPPER COWLITZ-1AA	⬤	⬤		●		●			●	⬤	●			●		•
CISPUS-3	⬤	⬤		●		●			●	⬤	●			●		⬤
UPPER COWLITZ-1A	●	●		•		•			•	●	•			•		✛
CISPUS-2	●	⬤		●		●			●	⬤	●			●		⬤
UPPER COWLITZ-1B	⬤	⬤		•		●			●	●	●			•		
CISPUS-1A	✛	⬤	•	•		●			●	⬤	●			•		
UPPER COWLITZ-1C	●	⬤		•		●			●		•			•		●
CISPUS-1C	●	●		•		●			•	⬤	•			●		•
UPPER COWLITZ-1CC	●	⬤		•		●			●		•			•		●
Skate Cr - 1	●	⬤	•	•		●			●	●	●			•	•	●
UPPER COWLITZ-1D	●	●		•		•			•		•			•		●
UPPER COWLITZ-1CCC	●	⬤		•		•			•		•			•		•
Silver Cr - 1	●	⬤		•		•			•	•	•			•	•	●
YELLOWJACKET-1	●	⬤		•		•			●	●	•			•		●
Schooley Creek	•	●		•		•			•	•	•			•	•	✚
CISPUS-1F	●	●		•		•			•	●	•			•		✛
UPPER COWLITZ-1F	●	●		•		•			•		•			•		●
Hall Cr - 1	•	●	•	•		●		•	●	●	●			●		●
Johnson Cr - 1																
Kiona Cr - 1	•	●	•	•		•			•	●	•			•		✚
Hampton Creek	•	●	•	•	•	•		•	•	●	●			•	•	✛
CISPUS-1E	•	●		•		•			•	●	•			•		•
Kilborn Creek	•	●	•	•	•	•		•	•	●	●			•	•	✚
Smith Cr - 1	•	●		•		•			•	•	•			•	•	●
CISPUS-1D	●	●		•		•			•	•	•			•		•
CISPUS-1B	●	●		•		•			•	●	•			•		•
Siler Creek-1	•	●		•	•	•			●	●	●			•	•	●
Mullins Creek	•	●		•		•			•	•	•			•	•	✚
Davis Creek-1	•	•		•		•			•	•	•			•		✛
Garret Creek	•	●	•	•	•	•		•	•	•	●			•	•	✚
Kiona Cr - 2	•	●		•		•			•	•	•			•		✛
Cunninham Creek	•	●	•	•		•			•	•	•			•	•	✚
Silver Cr - 2	•	•								•						✛
UPPER COWLITZ-2	●	●		•		•			•		•			•		●
Burton Creek	•	●		•		•			•	•	•			•	•	✚
Woods	•	•		•		•			•		•			•		●
Skate Cr - 3	•	●		•		•			•	•	•			•	•	●
Dry Creek	•	•		•		•			•	•	•			•		●
Greenhorn Cr - 1																
Crystal Cr - 1																
Willame Cr - 1	•	•							•	•						•
UPPER COWLITZ-4	•	●							•					•		•
CISPUS NF-1																
MID COWLITZ-6		●		●						•				●		✛
Butter Creek-1	•	•							•	•	•					●

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

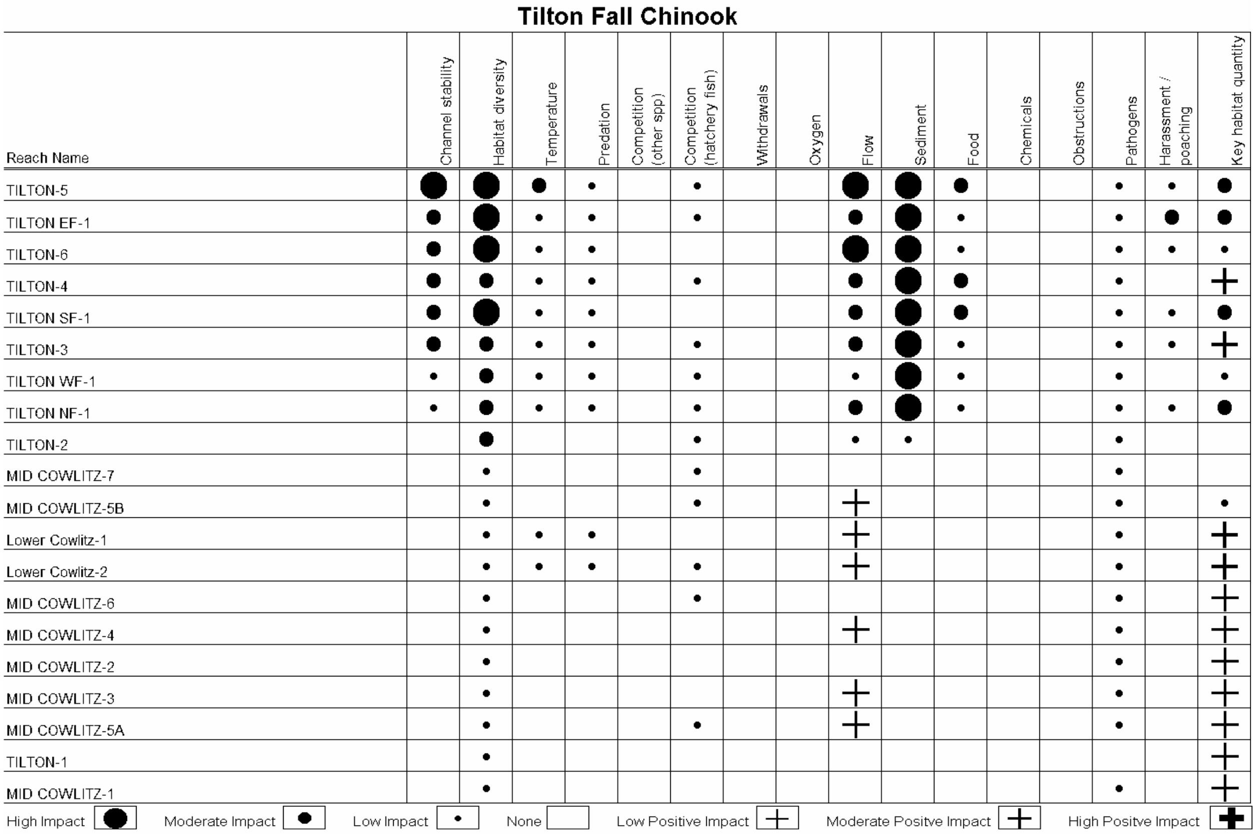
Figure 20. Upper Cowlitz and Cispus coho habitat factor analysis. Some low priority reaches are not included for display purposes.

Upper Cowlitz/Cispus Winter Steelhead

ReachName	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
UPPER COWLITZ-1E	●	⬤		•		●			●		●			●	•	+
YELLOWJACKET-1	•	●		●		●			●	⬤	●			●		✚
CISPUS-3	•	●		●		●			●	⬤	•			●		✚
CISPUS-2	●	●		●		●			●	⬤	•			●		✚
UPPER COWLITZ-2	●	●		•		●			●		●			●	•	●
Silver Cr - 1	●	⬤	●	•		●		•	⬤	●	●			●	•	+
UPPER COWLITZ-1D	●	●		•		●			●		•			●	•	+
CISPUS-1F	•	●		●		●			●	⬤	•			●		+
Johnson Cr - 1	●	⬤		•		•			●	●	•			•	•	✚
UPPER COWLITZ-1CC	●	●		•		●			●		•			●	•	+
UPPER COWLITZ-1C	●	●		•		●			●		•			●	•	+
UPPER COWLITZ-1CCC	●	●		•		●			●		•			●	•	+
UPPER COWLITZ-1B	●	●		•		●			●	●	•			●	•	+
Butter Creek-1	●	⬤	•	•		•		•	●	●	●			•	•	⬤
CISPUS-1E	•	●		•		●			●	⬤	•			●		•
UPPER COWLITZ-1AA	●	●		•		●			●	⬤	•			●		+
UPPER COWLITZ-1F	●	●		•		●			●		•			●	•	•
CISPUS-4	●	●		•		●			●		•			•		●
UPPER COWLITZ-4	•	⬤				•			●		•			•		
CISPUS-1C	•	●		•		•			•	⬤	•			•		
YELLOWJACKET-2	•	⬤		•		●			●	⬤	•			•		+
CISPUS-1D	●	●		•		•			●	●	•			•		•
UPPER COWLITZ-1A	●	●		•		●			●	●	•			●		+
Smith Cr - 1	•	●				•			•	●	•			•	•	•
Skate Cr - 1	•	●	•	•		•			●	●	•			•	•	✚
Skate Cr - 2	•	●	•	•		•			●	●	•			●	•	●
Johnson Cr - 2	•	●		•		•			•	●	•			•		
CISPUS-1A		●	•			•			•	●				•		
Silver Cr - 2	•	●	•	•		•		•	●	•	•			•		✚
CISPUS NF-1	•	●		•		•			●		•			•		●
CISPUS-1B	•	●		•		•			•	●	•			•		•
Quartz Cr - 1	●	●		•	•	●			●	●	●			•		+
Iron Cr - 1	●	⬤		•	•	●			●		●			•	•	⬤
UPPER COWLITZ-3	•	●	•			•			●		•			•		•
Dry Creek	•	●				•			•	•	•			•		•
MID COWLITZ-7	•	●		•		•			•		•			●		•
Willame Cr - 1	•	●	•			•			●	●	•			•		•
Greenhorn Cr - 1		•				•			•							+
Hall Cr - 1		•	•	•		•		•	•	●	•			•		+
Crystal Cr - 1	•	•				•			•		•			•		•

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact + High Positve Impact ✚

Figure 21. Upper Cowlitz and Cispus winter steelhead habitat factor analysis.



Tilton Fall Chinook

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
TILTON-5	⬤	⬤	●	•		•			⬤	⬤	●			•	•	●
TILTON EF-1	●	⬤	•	•		•			●	⬤	•			•	●	●
TILTON-6	●	⬤	•	•					⬤	⬤	•			•	•	•
TILTON-4	●	●	•	•		•			●	⬤	●			•		+
TILTON SF-1	●	⬤	•	•					●	⬤	●			•	•	●
TILTON-3	●	●	•	•		•			●	⬤	•			•	•	+
TILTON WF-1	•	●	•	•		•			•	⬤	•			•		•
TILTON NF-1	•	●	•	•		•			●	⬤	•			•	•	●
TILTON-2		●				•			•	•				•		
MID COWLITZ-7		•				•								•		
MID COWLITZ-5B		•				•			+					•		•
Lower Cowlitz-1		•	•	•					+					•		+
Lower Cowlitz-2		•	•	•		•			+					•		+
MID COWLITZ-6		•				•								•		+
MID COWLITZ-4		•							+					•		+
MID COWLITZ-2		•												•		+
MID COWLITZ-3		•							+					•		+
MID COWLITZ-5A		•				•			+					•		+
TILTON-1		•														+
MID COWLITZ-1		•												•		+

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

Figure 22. Tilton fall Chinook habitat factor analysis diagram.

Tilton Spring Chinook

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
TILTON-6	●	⬤	⬤	•		●			⬤	⬤	•			●	•	⬤
TILTON-5	●	⬤	⬤	•		•			⬤	⬤	•			●	•	●
TILTON EF-1	●	⬤	●	•		•			●	⬤	•			●	•	●
TILTON-3	●	●	●	•		•			●	⬤	•			•	•	✚
TILTON-4	•	●	●	•		•			●	⬤	•			•		✚
TILTON SF-1	•	●	●			•			●	⬤	•			•	•	●
TILTON WF-1	•	●	●			•			●	●	•			•		●
TILTON EF-2	•	●	•			•			●	●	•			•	•	●
TILTON NF-1	•	●	●			•			●	●	•			•		●
MID COWLITZ-6	•	●		•		•			•		•			●		✚
TILTON-1		●	•			•			•	●	•			•		➕
MID COWLITZ-7		•		•					•					•		
MID COWLITZ-5B	•	•		•		•			•		•			•		•
TILTON-2	•	●	•						•	•				•		
MID COWLITZ-5A																
MID COWLITZ-1																
MID COWLITZ-4																
MID COWLITZ-3																
MID COWLITZ-2		•												•		
Lower Cowlitz-2		•		•										•		•
Lower Cowlitz-1		•														•

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✚ High Positve Impact ➕

Figure 23. Tilton spring chinook habitat factor analysis.

Tilton Coho

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
TILTON EF-1	●	⬤	•	•		●			●	⬤	•			●	•	●
TILTON-5	●	⬤	●	•		●			⬤	⬤	•			●		●
TILTON-6	●	⬤	•	•		●			⬤	⬤	•			●		●
Lake Creek	●	⬤	•	•		●			●	⬤	•			●		⬤
TILTON-1	•	⬤	•	•		•		•	●	⬤	•			•		✚
TILTON-3	⬤	⬤	•	•		•			●	⬤	•			•		✚
Connelly-1	●	•	•	•		•			●	⬤	•			•		⬤
TILTON-4	●	●	●	•		●			●	⬤	●			●		✚
TILTON SF-1	•	●	•	•		•			•	●	•			•		•
TILTON NF-1	•	●	•	•		•			●	●	•			•		╋
TILTON WF-1	•	●	•	•		•			•	●	•			•		╋
MID COWLITZ-7	•	⬤		•		•			•	•	•			●		╋
TILTON-2		•		•						●						
TILTON EF-2		•								•						•
MID COWLITZ-6		•		•										•		╋
MID COWLITZ-5B																
MID COWLITZ-3																
MID COWLITZ-1																
MID COWLITZ-4																
MID COWLITZ-2																
Lower Cowlitz-2		•														
MID COWLITZ-5A																
Lower Cowlitz-1																
BARRIER RESERVOIR																
BARRIER DAM																

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ╋ High Positve Impact ✚

Figure 24. Tilton coho habitat factor analysis.

Tilton Winter Steelhead

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
TILTON EF-1	●	●	⬤	●		●			⬤	⬤	•			●	•	⬤
TILTON EF-2	•	●	●	•		•			●	⬤	•			●	•	⬤
TILTON-1	•	●	●	•		•		•	●	⬤	•			●	•	✚
TILTON-5	•	●	⬤	•		●			⬤	⬤	•			●		•
TILTON-6	•	●	●	•		●			⬤	⬤	•			●	•	+
TILTON-3	●	●	●	•		•			●	⬤	•			●	•	✚
TILTON-4	•	•	●	•		•			●	⬤	•			●		✚
TILTON-2	●	●	●	•		•			●	⬤	+			●		
TILTON NF-1	•	●	●	•		•			●	●	•			•		●
TILTON SF-1	•	●	●	•		•			●	●	•			•		●
Lake Creek	•	●	●	•		•			●	⬤	•			•	•	✚
TILTON WF-1		•	●	•		•			●	●	•			•		●
Connelly-1	•	•	•	•		•			•	●	•			•		●
MID COWLITZ-7		•		•		•			•					•		•
MID COWLITZ-5B		•		•										•	•	•
MID COWLITZ-6		•												•		
Lower Cowlitz-1		•													•	•
MID COWLITZ-2																
MID COWLITZ-1																
MID COWLITZ-5A																
MID COWLITZ-3		•														•
Lower Cowlitz-2		•													•	•
MID COWLITZ-4																
BARRIER RESERVOIR		•														
BARRIER DAM																

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

Figure 25. Tilton winter steelhead habitat factor analysis.

3.5 Watershed Process Limitations

This section describes watershed process limitations that contribute to stream habitat conditions significant to focal fish species. Reach level stream habitat conditions are influenced by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input, and large woody debris recruitment are often affected by upstream conditions and by contributing landscape factors. Accordingly, restoration of degraded channel habitat may require action outside the targeted reach, often extending into riparian and hillslope (upland) areas that are believed to influence the condition of aquatic habitats.

Watershed process impairments that affect stream habitat conditions were evaluated using a watershed process screening tool termed the Integrated Watershed Assessment (IWA). The IWA is a GIS-based assessment that evaluates watershed impairments at the subwatershed scale (3,000 to 12,000 acres). The tool uses landscape conditions (i.e. road density, impervious surfaces, vegetation, soil erodability, and topography) to identify the level of impairment of 1) riparian function, 2) sediment supply conditions, and 3) hydrology (runoff) conditions. For sediment and hydrology, the level of impairment is determined for local conditions (i.e. within subwatersheds, not including upstream drainage area) and at the watershed level (i.e. integrating the entire drainage area upstream of each subwatershed). See Appendix E for additional information on the IWA.

The IWA analysis was performed independently for the Mayfield-Tilton, Riffe Lake, Cispus River and Upper Cowlitz River Watersheds which collectively make up the upper Cowlitz River basin. These watersheds were analyzed separately because the upper Cowlitz basin is dissected by dams and storage reservoirs which interrupt watershed processes at the basin level. The results of IWA analyses for each watershed are described below.

Mayfield-Tilton

The Mayfield-Tilton watershed is located in the north-central portion of WRIA 26, and in the northwestern portion of the upper Cowlitz basin. For the purpose of recovery planning, the watershed is divided into 25 planning subwatersheds covering a total of approximately 154,000 acres (240 sq mi). IWA results for the Mayfield-Tilton watershed are shown in Table 7. A reference map showing the location of each subwatershed in the basin is presented in Figure 26. Maps of the distribution of local and watershed level IWA results are displayed in Figure 27.

3.5.1 *Hydrology*

Current Conditions.— Hydrologic conditions across the Mayfield-Tilton River watershed are generally rated as impaired. Moderately impaired subwatersheds occurring in the upper area of the Winston Creek drainage (20502-20504) make up the exceptions. Most of the land north of the Tilton River is within the Gifford Pinchot National Forest, but land around the lake is primarily under state and private ownership. Wetland area in the uplands of the Mayfield-Tilton River watershed is limited, and the percentage of watershed lying in the rain-on-snow zone is 35%. The low percentage of buffering wetlands, and the moderately high percentage of area in the rain-on-snow zone suggest a relatively high potential for adverse hydrologic impacts on channel conditions.

Hydrologic conditions within the subwatersheds along the Cowlitz (20602, 20603) are considered functional at the watershed level by the IWA analysis. This condition is an artifact of the influence of Mossyrock Dam and the Riffe Lake watershed situated directly upstream. However, hydrologic conditions along the mainstem Cowlitz within the watershed are impacted by Mayfield Dam, and therefore cannot be considered truly functional. In most cases, upstream impairments in the Mayfield-Tilton watershed are muted by the reservoir, and therefore, they have little effect on downstream subwatersheds.

Predicted Future Trends.— Subwatersheds with a high percentage of public lands (10401-10403, 20504) are predicted to trend towards gradual improvement in hydrologic conditions as vegetation slowly matures and the influence of improved forestry and road management practices is manifest. Subwatersheds located on private timber lands are predicted to trend stable, given the likelihood of ongoing timber harvest rotations and high forest road densities, offset by improved forestry and road management practices. Hydrologic conditions on private lands not in large commercial forestry operations may continue to degrade if timber harvest continues and commercial and residential development expands.

Table 7. IWA results for the Mayfield-Tilton Watershed

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
10101	I	M	M	I	M	none
10102	I	M	M	I	M	10103
10103	I	M	M	I	M	none
10104	I	M	M	I	M	10102, 10103
10201	I	M	M	I	M	none
10202	I	M	M	I	M	10201
10301	I	M	M	I	M	10101, 10102, 10103, 10104, 10201, 10202, 10302, 10303, 10401, 10402, 10403
10302	I	M	I	I	M	none
10303	I	M	M	I	M	10101, 10102, 10103, 10104, 10201, 10202
10401	I	M	M	I	M	none
10402	I	I	M	I	M	10401
10403	I	I	M	I	M	10401, 10402
10501	I	M	M	I	M	10101, 10102, 10103, 10104, 10201, 10202, 10301, 10302, 10303, 10401, 10402, 10403, 10502, 10504
10502	I	M	M	I	M	10101, 10102, 10103, 10104, 10201, 10202, 10301, 10302, 10303, 10401, 10402, 10403, 10504
10503	I	M	M	I	M	10101, 10102, 10103, 10104, 10201, 10202, 10301, 10302, 10303, 10401, 10402, 10403, 10501, 10502, 10504, 10505
10504	I	M	M	I	M	10101, 10102, 10103, 10104, 10201, 10202, 10301, 10302, 10303, 10401, 10402, 10403
10505	I	M	M	I	M	none
20501	I	M	M	I	M	20503
20502	I	M	M	M	M	20504
20503	M	M	F	M	M	none
20504	M	M	F	M	M	none
20505	I	M	M	I	M	20501, 20502, 20503, 20504
20601	I	M	I	F	M	none
20602	I	F	I	I	F	none
20603	I	M	I	F	M	10101, 10102, 10103, 10104, 10201, 10202, 10301, 10302, 10303, 10401, 10402, 10403, 10501, 10502, 10503, 10504, 10505, 20501, 20502, 20503, 20504, 20505, 20601, 20602

Notes:

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170800040#####.

[b] IWA results for watershed processes at the subwatershed level (i.e., not considering upstream effects). This information is used to identify areas that are potential sources of degraded conditions for watershed processes, abbreviated as follows:

F: Functional
M: Moderately impaired
I: Impaired

[c] IWA results for watershed processes at the watershed level (i.e., considering upstream effects). These results integrate the contribution from all upstream subwatersheds to watershed processes and are used to identify the probable condition of these processes in subwatersheds where key reaches are present.

[d] Subwatersheds upstream from this subwatershed.

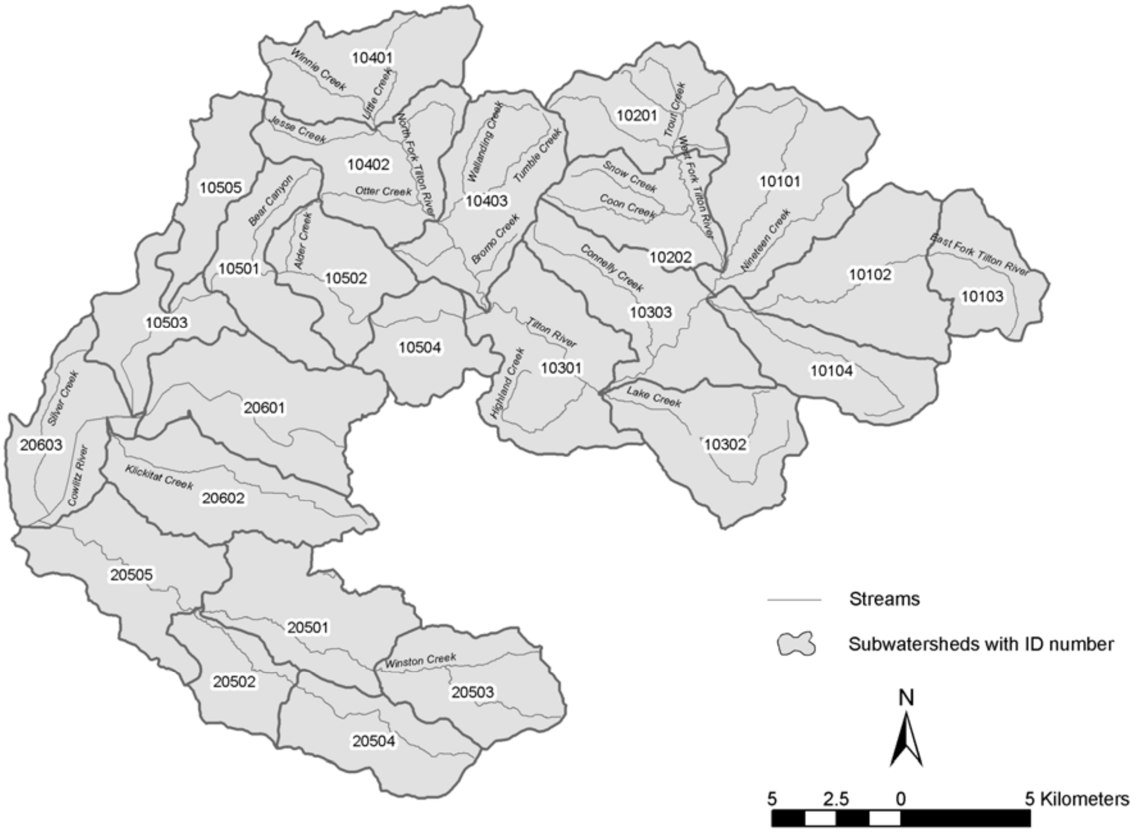


Figure 26. Map of the Mayfield-Tilton watershed showing the location of the IWA subwatersheds

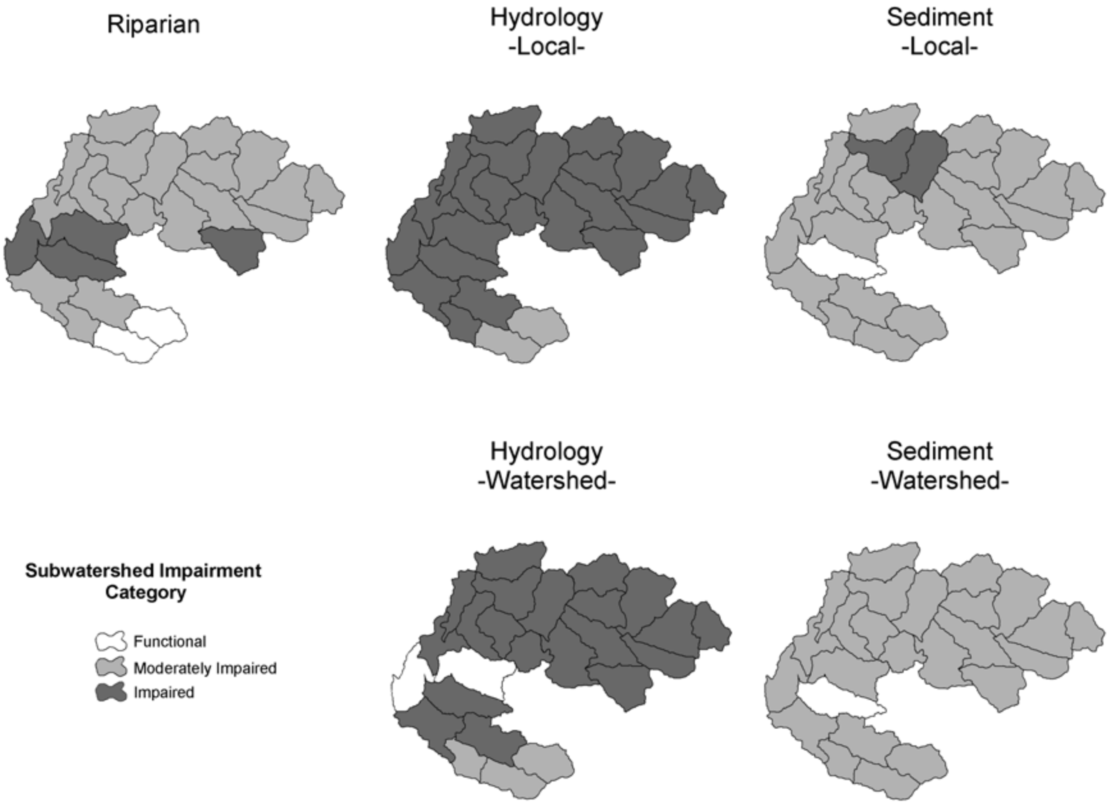


Figure 27. IWA subwatershed impairment ratings by category for the Mayfield-Tilton basin

3.5.2 *Sediment Supply*

Current Conditions.— Sediment conditions in the Mayfield-Tilton watershed range from functional to impaired at the local level. The middle and lower subwatersheds of the NF Tilton drainage (10402, 10403) are rated as impaired for sediment. In contrast, functional sediment conditions are found in Klickitat Creek (20602). The remainder of the watershed is rated as moderately impaired for sediment at the local level. Conditions are generally similar at the watershed level. However, sediment conditions in the NF Tilton drainage (10402, 10403) become moderately impaired at the local level, reflecting a buffering influence by only moderately impaired conditions in the Tilton headwaters (10401). All of the subwatersheds in the Mayfield-Tilton watershed have low to moderate natural erodability ratings, based on geology type and slope class, averaging 20 on a scale of 0-126. Mature vegetation cover is relatively low within the watershed, and road densities and road crossing densities are relatively high.

Sediment conditions along the Cowlitz mainstem (20601, 20603) are rated as moderately impaired at the watershed level. However, these ratings do not fully reflect the modified sediment regime of this portion of the watershed. The mainstem Cowlitz in these subwatersheds is inundated under storage reservoirs, and sediment transport to these reaches from upstream areas of the basin is disconnected by dams. Therefore, these ratings best reflect the influence of local subwatershed level sediment inputs.

Predicted Future Trends.— In subwatersheds with high percentage public land ownership (10401-10403), sediment conditions are predicted to trend towards gradual improvement over the next 20 years as improved road management practices and vegetation recovery mitigate the impacts of high forest road densities. Sediment supply conditions in the other subwatersheds, which are mostly comprised of private timber lands, are expected to trend stable or slightly improve due to new forest practices regulations that govern timber harvest and road building/maintenance practices.

3.5.3 *Riparian Condition*

Current Conditions.— Riparian condition ratings for the Mayfield-Tilton watershed range from functional to impaired. Riparian conditions in the upper subwatersheds of Winston Creek (20503, 20504) are rated as functional, while subwatersheds along the Cowlitz mainstem (20602, 20603) and Klickitat Creek (20602) are rated as impaired. The remaining subwatersheds are rated as moderately impaired for riparian conditions.

Predicted Future Trends.— The predicted trend for riparian conditions is for general improvement over the next 20 years due to riparian buffer timber harvest protections. The exceptions are private lands in the southern portion of the watershed that are at risk of increased residential development.

Riffe Lake

The Riffe Lake watershed is located in the center of WRIA 26, in the north-central portion of the region. The watershed is comprised of 15 subwatersheds covering a total of approximately 92,200 acres. IWA results for the Riffe Lake watershed are shown in Table 8. A reference map showing the location of each subwatershed in the basin is presented in Figure 28. Maps of the distribution of local and watershed level IWA results are displayed in Figure 29.

3.5.4 *Hydrology*

Current Conditions.— Local hydrologic conditions across the Riffe Lake watershed range from functional to impaired, with subwatersheds rated as functional located in most headwaters areas and along the mainstem of the upper Cowlitz River. Functional hydrologic conditions are located in the southwest portion of the watershed, including Tumwater Creek (20203) and Goat Creek (20202), which lies partly in Mt. St. Helens National Monument. Moderately impaired hydrologic conditions are in the central part of the watershed, including Landers (20303), Shelton (20402), and Indian Creeks (20405). Impaired conditions lie along the Cowlitz mainstem at the west and east ends, and in the Rainey Creek drainage (20101, 20102). Most of these impaired conditions are buffered by the reservoir and therefore do not impact downstream conditions greatly. Potentially important subwatersheds for reintroduction of anadromous fish in this watershed are located along the Cowlitz (10303-10307), which are partially inundated by the storage reservoirs.

The situation for hydrology changes drastically when looking at watershed level conditions, reflecting the influence of conditions in upstream subwatersheds on the IWA analysis. The number of subwatersheds with functional ratings increases from 3 to 10, and the number with impaired ratings drops from 9 to 3.

Predicted Future Trends.— The high percentage of private land ownership, coupled with the amount of logging, development around the reservoir, and road density, indicates that the watershed conditions will either trend stable or gradually degrade over the next 20 years. As long as the dams are in place, protection of the intact hydrologic process will probably only improve local conditions for resident fish and the few fish that reach the reservoir.

Table 8. IWA results for the Riffe Lake watershed.

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
30801	I	M	M	F	M	30802
30802	I	M	M	F	M	none
20101	I	M	M	F	M	none
20102	I	M	I	I	M	20101
20103	I	M	M	I	M	none
20201	F	M	M	F	M	30801, 30802
20202	F	M	F	F	M	none
20301	I	M	M	F	M	30801, 30802, 20101, 20102, 20103, 20201, 20202, 20302
20302	I	M	M	F	M	30801, 30802, 20201, 20202
20303	M	M	F	M	M	none
20401	I	M	M	F	M	30801, 30802, 20101, 20102, 20103, 20201, 20202, 20301, 20302, 20303, 20401, 20402, 20403, 20404, 20405
20402	M	M	M	M	M	none
20403	F	M	M	F	M	30801, 30802, 20101, 20102, 20103, 20201, 20202, 20301, 20302, 20303, 20403, 20405
20404	I	M	M	I	M	none
20405	M	M	M	F	M	30801, 30802, 20101, 20102, 20103, 20201, 20202, 20301, 20302, 20303

Notes:

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170800040#####.

[b] IWA results for watershed processes at the subwatershed level (i.e., not considering upstream effects). This information is used to identify areas that are potential sources of degraded conditions for watershed processes, abbreviated as follows:

F: Functional
M: Moderately impaired
I: Impaired

[c] IWA results for watershed processes at the watershed level (i.e., considering upstream effects). These results integrate the contribution from all upstream subwatersheds to watershed processes and are used to identify the probable condition of these processes in subwatersheds where key reaches are present.

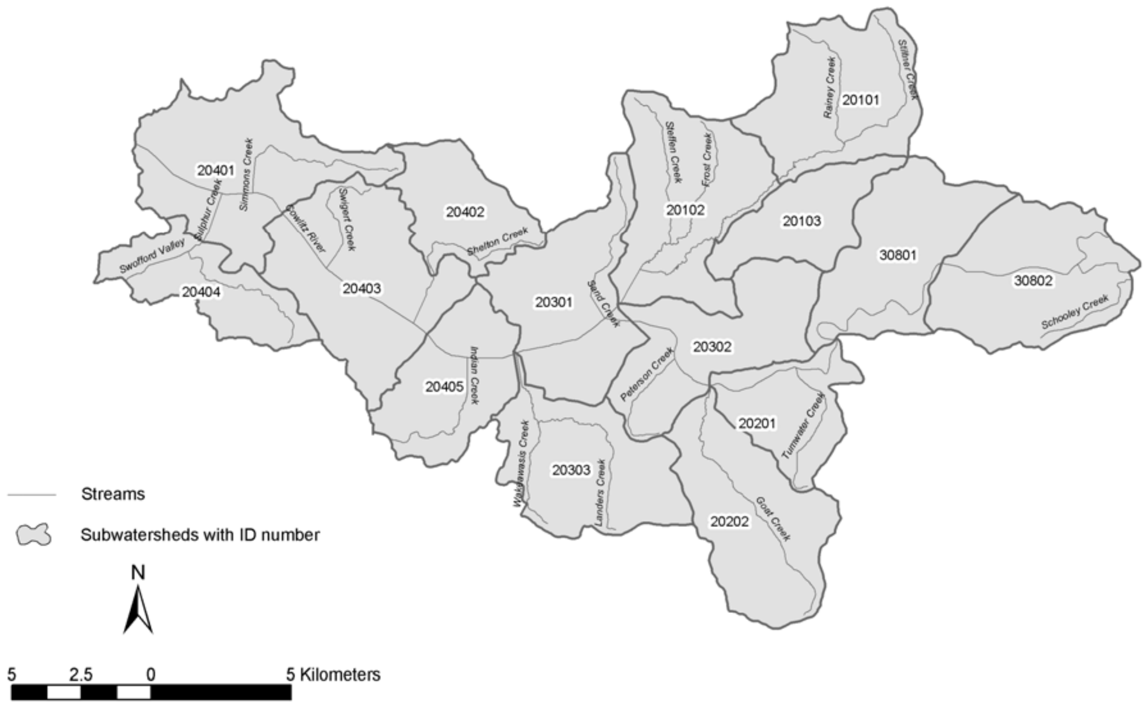


Figure 28. Map of the Riffe Lake watershed showing the location of the IWA subwatersheds

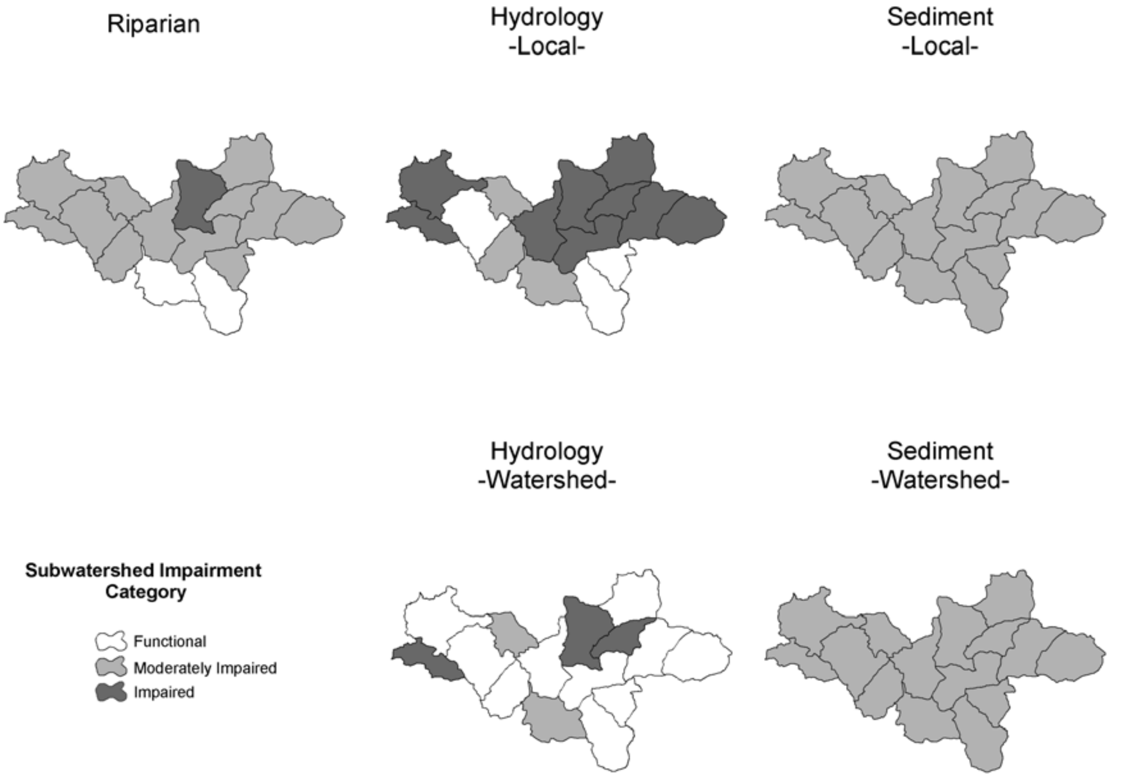


Figure 29. IWA subwatershed impairment ratings by category for the Riffe Lake watershed.

3.5.5 *Sediment Supply*

Current Conditions.—According to IWA model results, all of the subwatersheds within the Riffe Lake watershed possess moderately impaired sediment process conditions at both the local and watershed levels. These conditions are probably driven by both local and upstream problems.

Most of the local sediment condition issues are the same as the hydrology condition issues: low mature vegetation cover, moderately high road densities, and moderately high stream crossing densities. As with hydrology, the downstream effects are minimal due to the reservoir.

Watershed level sediment ratings in subwatersheds along the mainstem Cowlitz do not fully reflect the influence of dams and storage reservoirs on sediment dynamics. These ratings more accurately reflect the influence of local subwatershed level conditions on sediment delivery to the reservoir.

Predicted Future Trends.— Given that most of this area will be actively managed as timberland, the trend in sediment conditions is expected to remain relatively constant over the next 20 years.

3.5.6 *Riparian Condition*

Current Conditions.— Riparian conditions are primarily moderately impaired throughout the Riffe Lake watershed, with impaired conditions in the Frost-Rainey Creek subwatershed (20502).

Predicted Future Trends.— Riparian conditions are predicted to remain stable, with a gradual trend towards improvement as improved forestry and road management practices are more broadly implemented on private timber lands.

Cispus River Watershed

The Cispus River watershed is located in the eastern half of WRIA 26, in the northeast portion of the region. The Cispus River originates on the flanks of Mt. Adams and the higher peaks along the Cascade Crest. The watershed is comprised of 37 subwatersheds covering a total of approximately 278,800 acres (436 sq mi). IWA results for the Cispus River watershed are shown in Table 9. A reference map showing the location of each subwatershed in the basin is presented in Figure 30. Maps of the distribution of local and watershed level IWA results are displayed in Figure 31.

3.5.7 *Hydrology*

Current Conditions.— Hydrologic conditions across the Cispus River watershed range from functional to moderately impaired, with functional subwatersheds located in most headwaters areas and along the mainstem of the Cispus River. Subwatersheds rated moderately impaired include the upper NF Cispus (40902-40904), Iron Creek (50501-50503), and Muddy Creek (40401, 40402), upper Adams Creek (40502) and Goat Creek (40101). The Muddy Fork, Adams Creek and Goat Creek subwatersheds are all located in Wilderness Areas, and originate in high elevation areas above the tree line. Therefore, hydrologic conditions within these subwatersheds are expected to be functional as opposed to moderately impaired. Hydrologic conditions in the Cispus and its smaller tributaries subwatersheds, including Yellowjacket Creek, are in good condition. As shown in Figure 31, the relatively intact hydrologic conditions in the

Cispus headwaters appear to buffer hydrologic conditions in the mainstem subwatersheds and the lower areas of the NF.

Predicted Future Trends.— Nearly all of the land area in the Cispus River watershed lies within GPNF, and is managed by the USFS. Wetland area in the uplands of the Cispus River is limited. Hydrologically mature forest cover in these subwatersheds is generally higher than in other areas of the region (averaging 60%) and road densities are low to moderate (28 subwatersheds <3 mi/sq mi). Due to the high percentage of public land ownership, forest cover within these subwatersheds is predicted to generally mature and improve. Based on this information, hydrologic conditions are predicted to trend stable or improve gradually over the next 20 years.

Other streams referred to in the LFA include Greenhorn Creek (50401), Iron Creek (50501-50503), Orr Creek (40702), and Woods Creek (50601) (Wade 2000). Orr and Greenhorn Creeks are headwaters tributaries, and are characterized by functional hydrologic conditions. The subwatersheds in the Iron Creek drainage and the Woods Creek subwatershed are characterized by moderately impaired hydrologic conditions. All of these subwatersheds have moderate to high road densities (3.0-4.4 mi/sq mi), and three out of four of these subwatersheds have moderately high stream crossing densities. Given the high road densities and the public land ownership, hydrologic conditions in these subwatersheds will probably remain constant or improve gradually over the next 20 years.

Table 9.Summary of IWA results for the Cispus River watershed

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
40101	M	M	M	M	M	none
40102	F	M	F	F	M	none
40201	F	F	F	F	F	none
40301	F	M	F	F	F	40101, 40102, 40201
40302	F	F	M	F	F	40101, 40102, 40201, 40301
40401	M	M	F	M	F	40402
40402	M	F	M	M	F	none
40501	F	M	F	F	F	40502
40502	M	F	M	M	F	none
40601	F	M	M	F	M	40602
40602	F	M	F	F	M	none
40701	F	F	M	F	F	none
40702	F	F	F	F	F	40101, 40102, 40201, 40301, 40302, 40401, 40402, 40701
40703	F	F	F	F	M	40101, 40102, 40201, 40301, 40302, 40401, 40402, 40501, 40502, 40601, 40602, 40701, 40702, 40703, 40704
40801	F	F	M	F	F	40101, 40102, 40201, 40301, 40302, 40401, 40402, 40501, 40502, 40601, 40602, 40701, 40702, 40703, 40704, 40802
40802	F	F	M	F	M	40101, 40102, 40201, 40301, 40302, 40401, 40402, 40501, 40502, 40601, 40602, 40701, 40702, 40703, 40704
40901	M	M	F	F	M	40902, 40903, 40904
40902	M	M	M	M	M	none
40903	M	M	M	M	M	40902, 40904
40904	M	F	M	M	F	40902
50101	F	M	M	F	M	50102
50102	M	I	M	M	I	none
50201	F	M	M	F	M	50101, 50102, 50202, 50203, 50204, 50205
50202	F	M	F	F	M	50203, 50204, 50205

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
50203	F	M	M	F	M	none
50204	F	M	F	F	M	50203, 50205
50205	F	M	M	F	M	none
50301	M	M	M	F	F	40101, 40102, 40201, 40301, 40302, 40401, 40402, 40501, 40502, 40601, 40602, 40701, 40702, 40703, 40704, 40801, 40802, 40901, 40902, 40903, 40904
50302	M	M	M	F	M	40101, 40102, 40201, 40301, 40302, 40401, 40402, 40501, 40502, 40601, 40602, 40701, 40702, 40703, 40704, 40801, 40802, 40901, 40902, 40903, 40904, 50101, 50102, 50201, 50202, 50203, 50204, 50205, 50301
50401	F	M	F	F	M	none
50501	F	M	F	M	M	50502, 50503
50502	M	M	F	M	M	50503
50503	M	M	M	M	M	none
50601	M	M	M	M	M	none
50602	M	M	F	F	M	40101, 40102, 40201, 40301, 40302, 40401, 40402, 40501, 40502, 40601, 40602, 40701, 40702, 40703, 40704, 40801, 40802, 40901, 40902, 40903, 40904, 50101, 50102, 50201, 50202, 50203, 50204, 50205, 50301, 50302, 50401, 50501, 50502, 50503, 50601, 50602
50701	M	M	M	F	M	40101, 40102, 40201, 40301, 40302, 40401, 40402, 40501, 40502, 40601, 40602, 40701, 40702, 40703, 40704, 40801, 40802, 40901, 40902, 40903, 40904, 50101, 50102, 50201, 50202, 50203, 50204, 50205, 50301, 50302, 50401, 50501, 50502, 50503, 50601, 50602, 50702
50702	F	M	M	F	M	none

Notes:

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170800040#####.

[b] IWA results for watershed processes at the subwatershed level (i.e., not considering upstream effects). This information is used to identify areas that are potential sources of degraded conditions for watershed processes, abbreviated as follows:

F: Functional
M: Moderately impaired
I: Impaired

[c] IWA results for watershed processes at the watershed level (i.e., considering upstream effects). These results integrate the contribution from all upstream subwatersheds to watershed processes and are used to identify the probable condition of these processes in subwatersheds where key reaches are present.

[d] Subwatersheds upstream from this subwatershed.

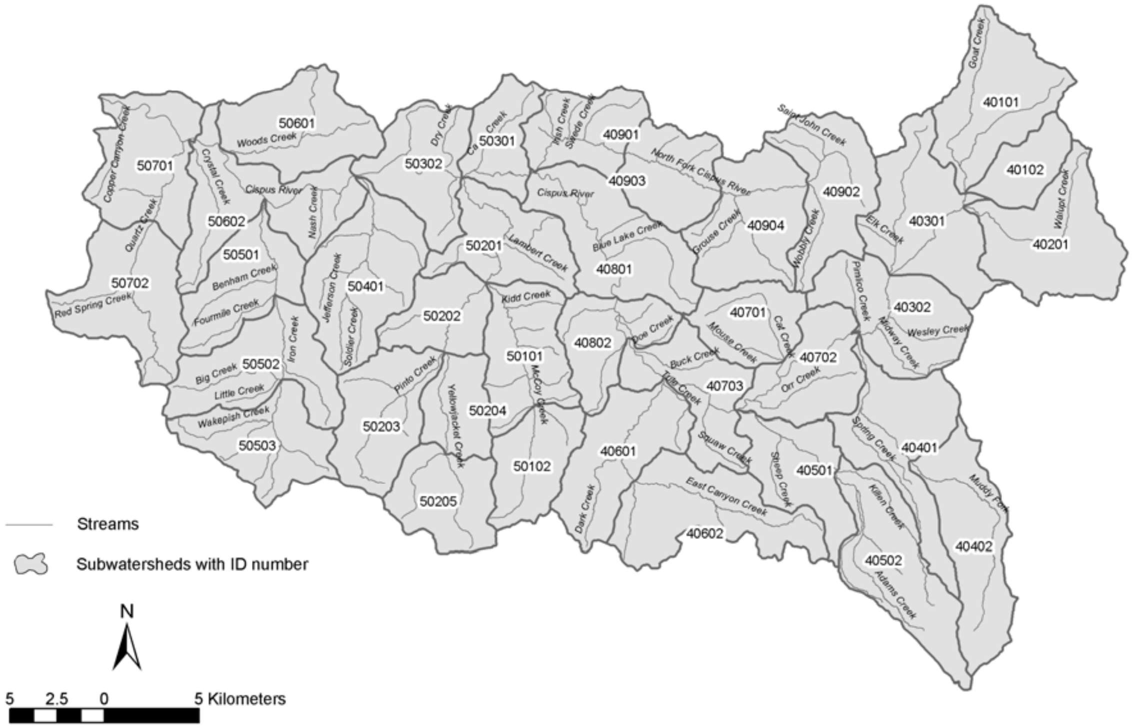


Figure 30. Map of the Cispus watershed showing the location of the IWA subwatersheds.

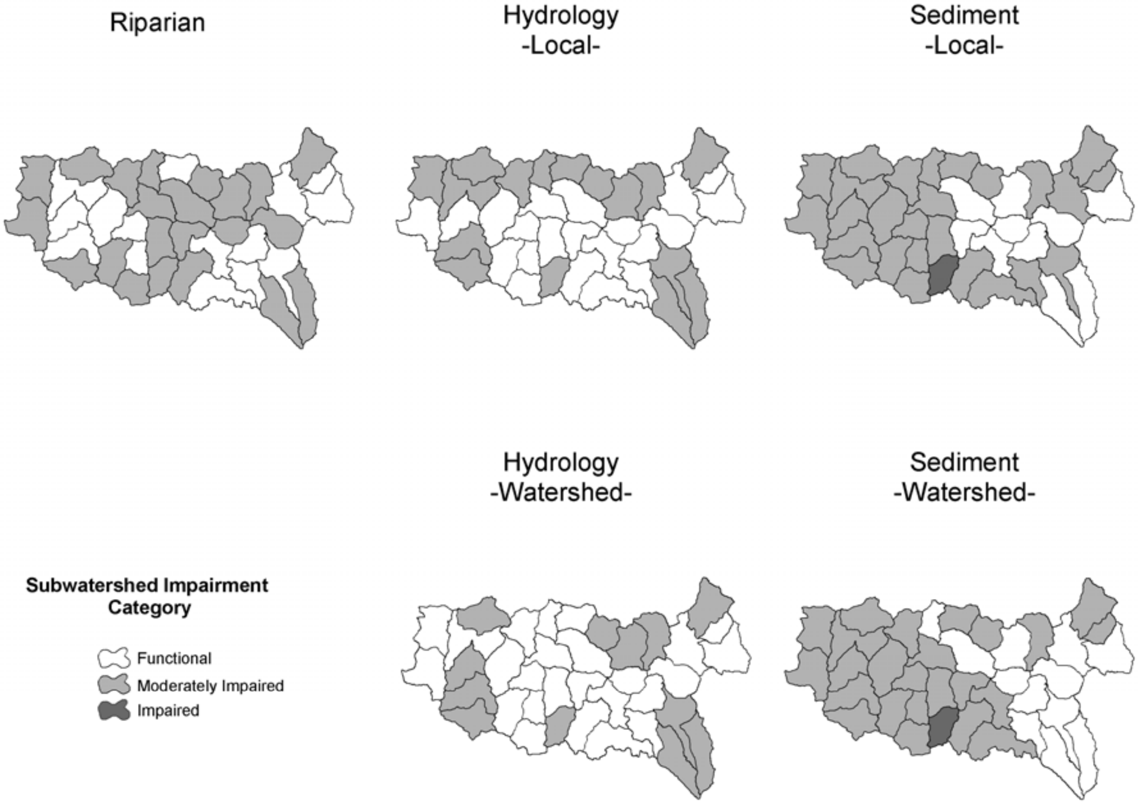


Figure 31. IWA subwatershed impairment ratings by category for the Cispus watershed.

3.5.8 *Sediment Supply*

Current Conditions.— The majority of subwatersheds in the Cispus watershed possess moderately impaired sediment conditions. Functional sediment conditions at both the local and watershed levels can be found in headwaters subwatersheds, especially in the western portion of the watershed above the mouth of Adams Creek (40501) and Orr Creek (40702). Sediment condition ratings trend towards moderately impaired on a downstream gradient. The subwatershed encompassing the upper reaches of McCoy Creek (50102) is rated impaired for sediment conditions at the local and watershed level.

Within the NF Cispus River drainage (40901-40904), three out the four subwatersheds possess moderately impaired sediment conditions. Subwatershed 40904, which includes Timothy Creek, is functional with respect to sediment. The other subwatersheds in the drainage are moderately impaired for sediment for many of the same reasons they were moderately impaired for hydrology, moderate to high unsurfaced road densities in sensitive areas (e.g., steep slopes with erodable geology).

Except for a few headwater subwatersheds such as Camp Creek (50301), most of the middle and lower mainstem Cispus watershed is rated moderately impaired with respect to sediment. The reach between Iron Creek and the North Fork lies downstream from moderately impaired subwatersheds including the North Fork drainage, Yellowjacket Creek drainage (50201-50205, 50101-50102), Greenhorn Creek subwatershed (50401) and Woods Creek subwatershed (50601) Most of these subwatersheds have low natural erodability ratings, ranging from 1-21. Road densities in most of these subwatersheds are moderate to low, usually falling between 2-3 mi/sq mi. Stream crossings and percent of mature forest cover vary, but they also tend to be moderate to low.

Predicted Future Trends.— Timber harvesting will continue, but due to public ownership it will be relatively modest into the foreseeable future, and impacts will be mitigated by improved forestry and road management practices. Impacts resulting from recreational uses, however, are likely to increase with growing population pressures. Considering these circumstances, the trend in sediment conditions is expected to remain relatively constant or to slightly improve over the next 20 years

3.5.9 *Riparian Condition*

Current Conditions.— Riparian conditions are rated functional to moderately impaired throughout the Cispus River watershed, with headwater subwatersheds and smaller drainages containing a mix of both conditions. None of the subwatersheds are rated as impaired. It is important to note that in many subwatersheds rated as moderately impaired, stream channels originate above the treeline and limited riparian vegetation is a natural condition (e.g., the headwaters of the Muddy Fork and Adams Creek on the flanks of Mt. Adams). Many of the functional riparian subwatersheds are located in the eastern portion of the watershed in wilderness, where several subwatersheds are rated functional for all three watershed processes. Conditions become more unfavorable (moderately impaired) as you move downstream. However, even in the upper-most mainstem Cispus (40101) and the Muddy Fork Cispus (40401, 40402), there are moderately impaired subwatersheds with respect to riparian condition.

Riparian conditions in the NF Cispus and mainstem Cispus subwatersheds (40901-40904) are primarily moderately impaired, except for the Swede-Irish Creeks subwatershed (40901), which is rated functional. Riparian ratings for the subwatersheds containing important fish habitat reaches of the mainstem Cispus River (50301, 50302, 50602) are also primarily moderately impaired.

Predicted Future Trends.— Given the large proportion of public land ownership throughout the Cispus River watershed, and the assumption that the trend for hydrologic recovery in these subwatersheds will also benefit riparian conditions, the predicted trend is for general improvement over the next 20 years. The generally low streamside road densities in the Cispus watershed indicate generally good potential for riparian recovery.

Upper Cowlitz

The Upper Cowlitz River watershed is located in the eastern half of WRIA 26, in the northeast portion of the region. The watershed is comprised of 54 subwatersheds covering a total of approximately 364,000 acres (564 sq mi). IWA results for the Upper Cowlitz River watershed are shown in Table 10. A reference map showing the location of each subwatershed in the basin is presented in Figure 32. Maps of the distribution of local and watershed level IWA results are displayed in Figure 33.

3.5.10 *Hydrology*

Current Conditions.— Almost all of the land area in the upper Cowlitz watershed lies within National Forest, National Park, or in designated wilderness area. The percentage of watershed lying in a rain-on-snow zone is low (16%), but could have some impact, especially in the higher elevation subwatersheds, such as the Ohanapecosh River.

Local hydrologic conditions across the Upper Cowlitz River watershed range from functional to impaired, with functional subwatersheds located in most headwaters areas and along the mainstem of the Upper Cowlitz River (30301-30303) downstream of and including the Smith Creek (30101, 30102) and Johnson Creek (20501-20504) drainages. Moderately impaired subwatersheds include the Muddy Fork drainage (10401-10405), Willame Creek (30201, 30202), the Cowlitz downstream of the Cowlitz-Ohanapecosh confluence (10302, 20201), and a few headwater tributary subwatersheds of the Ohanapecosh River (10201, 10202) and Skate Creek (20402). Most of these impaired conditions are buffered by headwater tributaries and by the upstream influences along the Cowlitz mainstem. Impaired areas include the Silver (30501, 30503, 30505) and Kiona Creek (30601) drainages in the southwest portion of the watershed.

The relatively intact local hydrologic conditions in the Upper Cowlitz headwaters appear to buffer hydrologic conditions in the mainstem subwatersheds at the watershed level.

Predicted Future Trends.— Due to the high percentage of public land ownership, especially protected land, forest cover within these subwatersheds is predicted to generally mature and improve. Wetland area in the uplands of the upper Cowlitz River is limited. Based on this information, hydrologic conditions are predicted to trend stable or improve gradually over the next 20 years.

Table 10. IWA results for the Upper Cowlitz River watershed

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
10101	F	F	F	F	F	none
10102	F	M	F	F	F	10101, 10103
10103	F	F	F	F	F	none
10201	M	F	M	M	F	none
10202	M	F	M	M	F	none
10203	F	F	F	F	F	10201, 10202
10204	F	F	F	F	F	none
10205	F	M	F	F	F	10201, 10202, 10203, 10204
10206	F	F	F	F	F	10101, 10102, 10103, 10201, 10202, 10203, 10204, 10205,
10301	F	M	F	F	M	none
10302	M	M	F	F	F	10101, 10102, 10103, 10201, 10202, 10203, 10204, 10205, 10206, 10301, 10303, 10304, 10305, 10306, 10307
10303	F	F	F	F	F	10301, 10304, 10305, 10306, 10307
10304	F	F	F	F	F	none
10305	F	F	F	F	F	none
10306	F	F	F	F	F	10304, 10305
10307	F	M	F	F	M	none
10401	M	M	I	M	M	none
10402	M	I	M	M	I	none
10403	F	F	M	F	F	none
10404	F	F	M	M	F	10401, 10402, 10403
10405	F	F	F	M	F	10401, 10402, 10403, 10404
20101	F	F	F	F	M	none
20102	F	M	M	F	M	none
20201	M	M	M	F	M	20102
20202	F	M	F	F	M	none
20301	M	M	M	M	M	none

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
20302	F	M	M	F	M	20301
20401	F	F	M	F	F	none
20402	M	F	F	M	F	none
20403	F	M	M	F	F	20401, 20402
20501	F	F	M	F	F	20502, 20503, 20504
20502	F	M	F	F	M	none
20503	F	F	M	F	F	none
20504	F	M	F	F	M	none
20601	I	M	M	F	F	10101, 10102, 10103, 10201, 10202, 10203, 10204, 10205, 10206, 10301, 10302, 10303, 10304, 10305, 10306, 10307, 10401, 10402, 10403, 10404, 10405, 20101, 20102, 20201, 20202, 20301, 20302, 20401, 20402, 20403
20602	I	M	M	I	M	none
30101	F	M	M	F	M	30102
30102	F	M	M	F	M	none
30201	I	M	M	I	M	none
30202	F	M	F	M	M	30201
30301	F	M	M	F	F	10101, 10102, 10103, 10201, 10202, 10203, 10204, 10205, 10206, 10301, 10302, 10303, 10304, 10305, 10306, 10307, 10401, 10402, 10403, 10404, 10405, 20101, 20102, 20201, 20202, 20301, 20302, 20401, 20402, 20403, 20501, 20502, 20503, 20504, 20601, 20602, 30101, 30102, 30201, 30202
30302	F	M	M	F	F	10101, 10102, 10103, 10201, 10202, 10203, 10204, 10205, 10206, 10301, 10302, 10303, 10304, 10305, 10306, 10307, 10401, 10402, 10403, 10404, 10405, 20101, 20102, 20201, 20202, 20301, 20302, 20401, 20402, 20403, 20501, 20502, 20503, 20504, 20601, 20602, 30101, 30102, 30201, 30202, 30301
30303	F	M	M	F	M	10101, 10102, 10103, 10201, 10202, 10203, 10204, 10205, 10206, 10301, 10302, 10303, 10304, 10305, 10306, 10307, 10401, 10402, 10403, 10404, 10405, 20101, 20102, 20201, 20202, 20301, 20302, 20401, 20402, 20403, 20501, 20502, 20503, 20504, 20601, 20602, 30101, 30102, 30201, 30202, 30301, 30302
30401	M	M	M	F	M	10101, 10102, 10103, 10201, 10202, 10203, 10204, 10205, 10206, 10301, 10302, 10303, 10304, 10305, 10306, 10307, 10401, 10402, 10403, 10404, 10405, 20101, 20102, 20201, 20202, 20301, 20302, 20401, 20402, 20403, 20501, 20502, 20503, 20504, 20601, 20602, 30101, 30102, 30201, 30202, 30301, 30302, 30303

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
30402	F	F	M	F	M	10101, 10102, 10103, 10201, 10202, 10203, 10204, 10205, 10206, 10301, 10302, 10303, 10304, 10305, 10306, 10307, 10401, 10402, 10403, 10404, 10405, 20101, 20102, 20201, 20202, 20301, 20302, 20401, 20402, 20403, 20501, 20502, 20503, 20504, 20601, 20602, 30101, 30102, 30201, 30202, 30301, 30302, 30303, 30401
30501	I	M	M	I	M	none
30502	M	M	M	M	M	none
30503	I	M	M	I	M	30504
30504	M	F	M	I	M	30502
30505	I	M	M	I	M	none
30506	M	M	M	I	M	30501, 30502, 30503, 30504, 30505
30601	I	M	M	I	M	none
30602	I	M	M	F	M	10101, 10102, 10103, 10201, 10202, 10203, 10204, 10205, 10206, 10301, 10302, 10303, 10304, 10305, 10306, 10307, 10401, 10402, 10403, 10404, 10405, 20101, 20102, 20201, 20202, 20301, 20302, 20401, 20402, 20403, 20501, 20502, 20503, 20504, 20601, 20602, 30101, 30102, 30201, 30202, 30301, 30302, 30303, 30401, 30402, 30501, 30502, 30503, 30504, 30505, 30506, 30601, 30602, 30701,
30701	M	M	M	M	M	none

Notes:

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170800040#####.

[b] IWA results for watershed processes at the subwatershed level (i.e., not considering upstream effects). This information is used to identify areas that are potential sources of degraded conditions for watershed processes, abbreviated as follows:

F: Functional
M: Moderately impaired
I: Impaired

[c] IWA results for watershed processes at the watershed level (i.e., considering upstream effects). These results integrate the contribution from all upstream subwatersheds to watershed processes and are used to identify the probable condition of these processes in subwatersheds where key reaches are present.

[d] Subwatersheds upstream from this subwatershed.

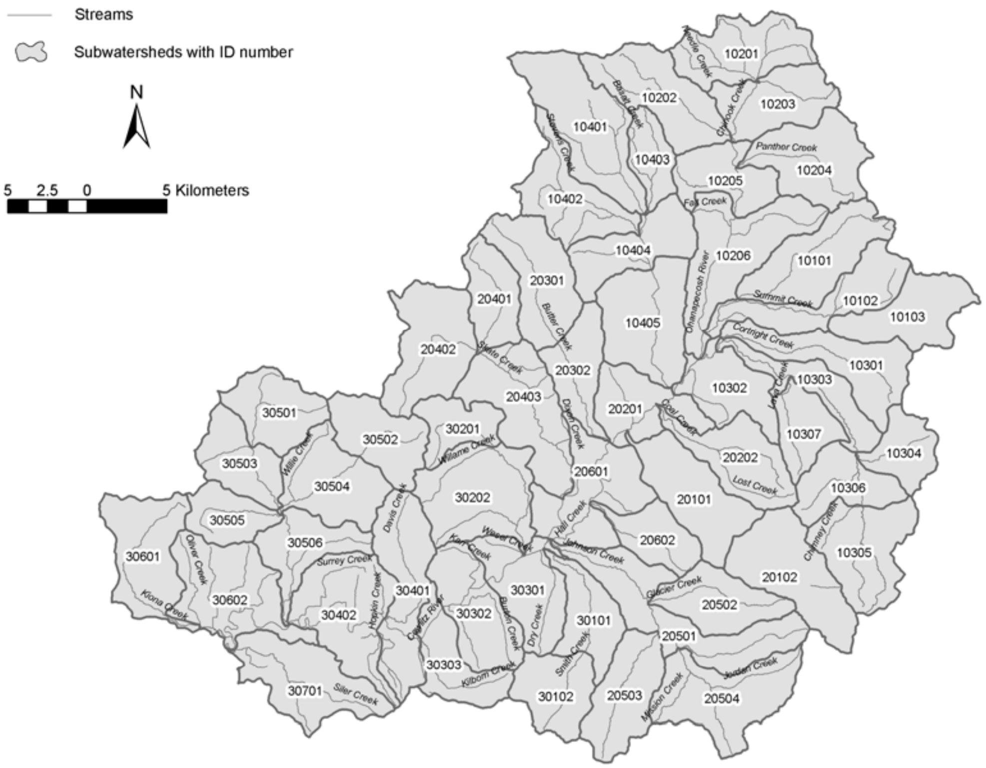


Figure 32. Map of the upper Cowlitz basin showing the location of the IWA subwatersheds

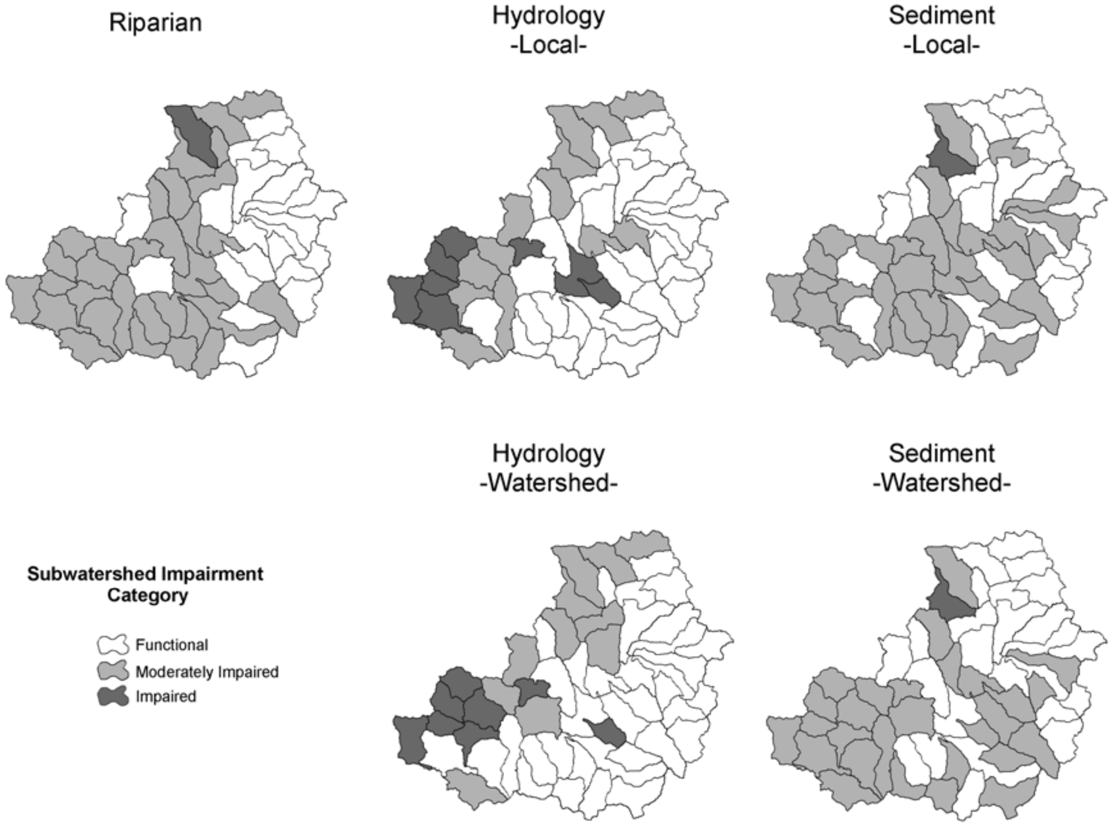


Figure 33. IWA subwatershed impairment ratings by category for the Upper Cowlitz basin

3.5.11 *Sediment Supply*

Current Conditions.— Functional sediment conditions at both the local and watershed levels can be found in headwaters subwatersheds, especially in the eastern portion of the watershed. However, the sediment conditions trend towards moderately impaired on a downstream gradient towards the mainstem Cowlitz at the lower end of the watershed. All of the subwatersheds in the Upper Cowlitz watershed have low natural erodability ratings, averaging 16 on a scale of 0-126. This suggests that these subwatersheds would not be large sources of sediment impacts under disturbed conditions. Except for the Silver Creek drainage, road densities and streamside road densities in these subwatersheds are also relatively low.

Predicted Future Trends.— Given the high percentage of public land ownership in these subwatersheds, and the relatively low level of current impacts, the trend in sediment conditions is expected to remain relatively constant or to slightly improve over the next 20 years.

3.5.12 *Riparian Condition*

Current Conditions.— Riparian conditions are rated functional to moderately impaired throughout the Upper Cowlitz River watershed. Most of the functional riparian subwatersheds are located in the eastern portion of the watershed, where many subwatersheds are rated functional for all three watershed processes. The majority of headwaters subwatersheds in this portion of the watershed are rated functional. Conditions become more unfavorable (moderately impaired) moving downstream. However, even in the upper-most reaches of the Ohanapecosh River (10201, 10202) and Skate Creek (20401), there are moderately impaired subwatersheds with respect to riparian condition.

Predicted Future Trends.— Based on the assumption that the trend for hydrologic recovery in these subwatersheds will also benefit riparian conditions, the predicted trend is for general improvement over the next 20 years.

3.6 Other Factors and Limitations

3.6.1 *Hatcheries*

Hatcheries currently release over 50 million salmon and steelhead per year in Washington lower Columbia River subbasins. Many of these fish are released to mitigate for loss of habitat. Hatcheries can provide valuable mitigation and conservation benefits may also cause significant adverse impacts if not prudently and properly employed. Risks to wild fish include genetic deterioration, reduced fitness and survival, ecological effects such as competition or predation, facility effects on passage and water quality, mixed stock fishery effects, and confounding the accuracy of wild population status estimates. This section describes hatchery programs in the upper Cowlitz subbasin and discusses their potential effects.

There are no salmon or steelhead hatcheries operating in the upper Cowlitz basin. Mossyrock Hatchery produces trout for regional plants into Southwest Washington lakes and the Tilton River. The Cowlitz Salmon Hatchery and Cowlitz Trout Hatchery in the lower Cowlitz produce spring Chinook and late-timed winter steelhead fingerlings for reintroduction into the upper Cowlitz and Tilton basins. There are no juvenile coho released into the upper basin, but adult coho are collected at the salmon hatchery and transported to the upper basin to spawn. The main threats from hatchery steelhead and salmon are ecological interactions between upper Cowlitz natural juveniles and hatchery released juveniles.

Table 11. Upper Cowlitz Basin hatchery production.

Hatchery	Release Location	Spring Chinook	Winter Steelhead
Cowlitz Salmon	Upper Cowlitz	300,000	
Cowlitz Trout	Upper Cowlitz		287,500
Cowlitz Trout	Tilton		100,000

Regional hatchery strategies and measures are focused on evaluating and reducing biological risks and reducing the risks to natural populations. Artificial production programs within the Cowlitz facilities will be evaluated in detail through the WDFW Benefit-Risk Assessment Procedure (BRAP) relative to risks to natural populations. The resulting program specific actions will be developed, evaluated, and documented through the Hatchery and Genetic Management Plan for public review and consideration by NOAA Fisheries (details in programs Volume I, Chapter 8).

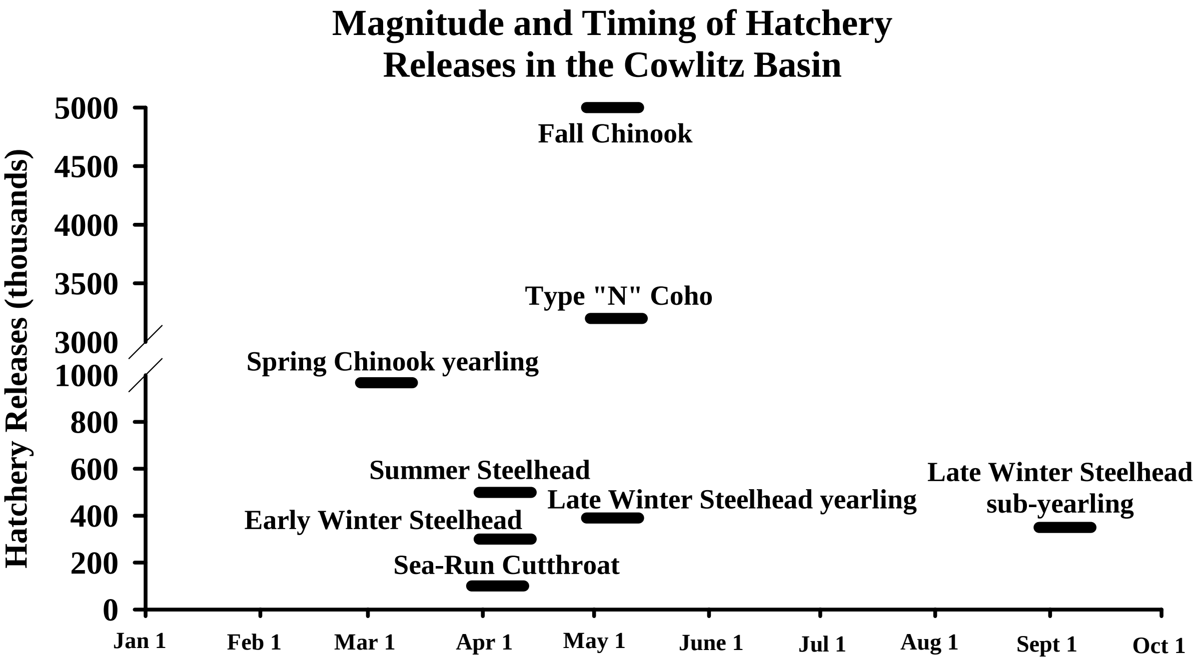


Figure 34. Magnitude and timing of hatchery releases in the Cowlitz basin by species, based on 2003 brood production goals.

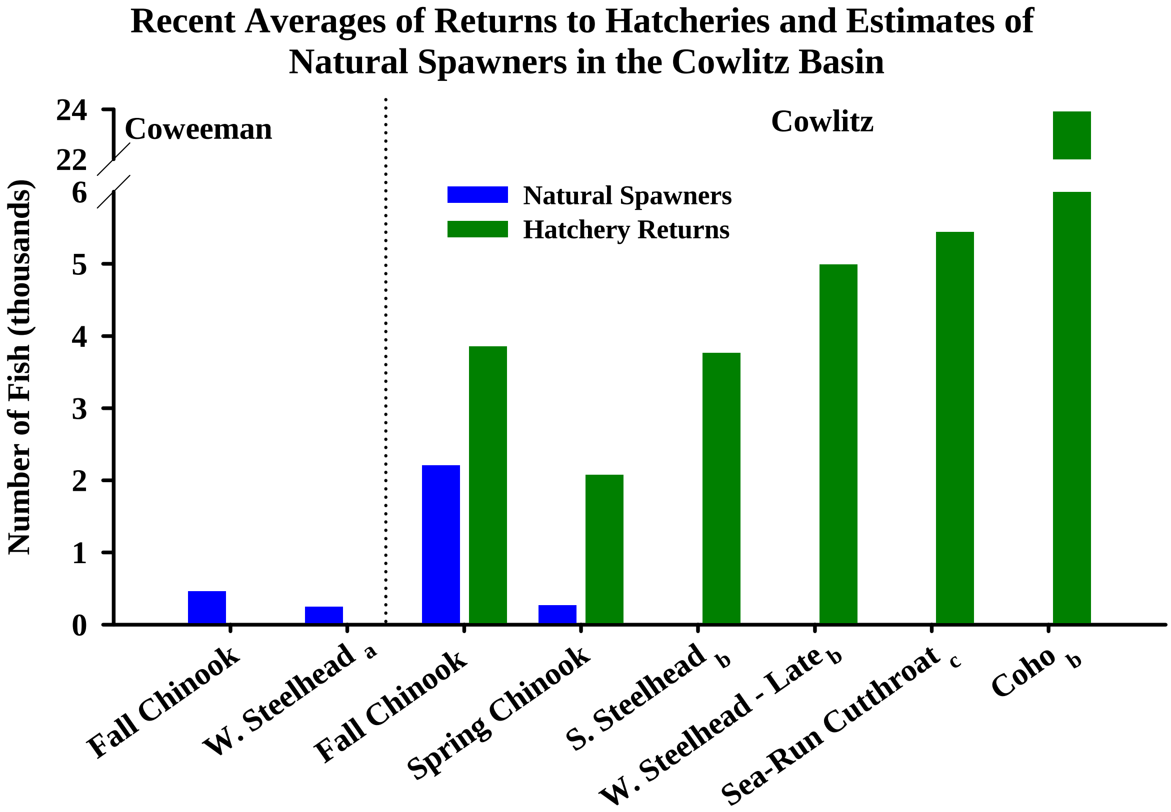


Figure 35. Recent average hatchery returns and estimates of natural spawning escapement in the Cowlitz basin by species. The years used to calculate averages varied by species, based on available data. The data used to calculate average hatchery returns and natural escapement for a particular species and basin were derived from the same years in all cases. All data were from the period 1992 to the present. Calculation of each average utilized a minimum of 5 years of data.

Biological Risk Assessment

The evaluation of hatchery programs and implementation of hatchery reform in the Lower Columbia is occurring through several processes. These include: 1) the LCFRB recovery planning process; 2) Hatchery Genetic Management Plan (HGMP) preparation for ESA permitting; 3) FERC related plans on the Cowlitz River and Lewis River; and 4) the federally mandated Artificial Production Review and Evaluation (APRE) process. Through each of these processes, WDFW is applying a consistent framework to identify the hatchery program enhancements that will maximize fishing-related economic benefits and promote attainment of regional recovery goals. Developing hatcheries into an integrated, productive, stock recovery tool requires a policy framework for considering the acceptable risks of artificial propagation, and a scientific assessment of the benefits and risks of each proposed hatchery program. WDFW developed the Benefit-Risk Assessment Procedure (BRAP) to provide that framework. The BRAP evaluates hatchery programs in the ecological context of the watershed, with integrated assessment and decisions for hatcheries, harvest, and habitat. The risk assessment procedure consists of five basic steps, grouped into two blocks:

Policy Framework

- Assess population status of wild populations
- Develop risk tolerance profiles for all stock conditions
- Assign risk tolerance profiles to all stocks

Risk Assessment

- Conduct risk assessments for all hatchery programs
- Identify appropriate management actions to reduce risk

Following the identification of risks through the assessment process, a strategy is developed to describe a general approach for addressing those risks. Building upon those strategies, program-specific actions and an adaptive management plan are developed as the final steps in the WDFW framework for hatchery reform.

Table 12 identifies hazards levels associated with risks involved with hatchery programs in the Upper Cowlitz Basin. Table 13 identifies preliminary strategies proposed to address risks identified in the BRAP for the same populations.

The BRAP risk assessments and strategies to reduce risk have been key in providing the biological context to develop the hatchery recovery measures for lower Columbia River sub-basins.

Table 12. Preliminary BRAP for hatchery programs affecting populations in the Upper Cowlitz, Cispus and Tilton Basins.

Symbol	Description
○	Risk of hazard consistent with current risk tolerance profile.
?	Magnitude of risk associated with hazard unknown.
●	Risk of hazard exceeds current risk tolerance profile.
▨	Hazard not relevant to population

Upper Cowlitz Population	Hatchery Program		Risk Assessment of Hazards											
			Genetic			Ecological			Demographic		Facility			
	Name	Release (millions)	Effective Population Size	Domestication	Diversity	Predation	Competition	Disease	Survival Rate	Reproductive Success	Catastrophic Loss	Passage	Screening	Water Quality
Fall Chinook	Cowlitz Fall Chinook	5.000	▨	▨	▨	○	?	○	▨	▨	▨	○	○	○
	Cowlitz Coho 1+	3.200	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Coho Eggs	0.181	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sp. Chinook 1+	0.912	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sp. Chinook 0+	0.300	▨	▨	▨	○	?	○	▨	▨	▨	○	○	○
	Friends of the Cowlitz Sp. Chinook 1	0.055	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Early W. Steelhead 1+	0.300	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Late W. Steelhead 1+	0.390	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Colwitz Late W. Steelhead 0+	0.200	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz S. Steelhead	0.450	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Friends of the Cowlitz S. Steelhead 1	0.100	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sea-run Cutthroat 1+ Net Per	0.010	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sea-run Cutthroat 1+	0.150	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
Spring Chinook	Cowlitz Fall Chinook	5.000	▨	▨	▨	○	?	○	▨	▨	▨	○	○	○
	Cowlitz Coho 1+	3.200	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Coho Eggs	0.181	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sp. Chinook 1+	0.912	○	○	○	?	?	○	○	?	○	○	○	○
	Cowlitz Sp. Chinook 0+	0.300	○	○	○	○	?	○	○	?	○	○	○	○
	Friends of the Cowlitz Sp. Chinook 1	0.055	○	○	○	?	?	○	○	?	○	○	○	○
	Cowlitz Early W. Steelhead 1+	0.300	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Late W. Steelhead 1+	0.390	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Colwitz Late W. Steelhead 0+	0.200	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz S. Steelhead	0.450	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Friends of the Cowlitz S. Steelhead 1	0.100	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sea-run Cutthroat 1+ Net Per	0.010	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sea-run Cutthroat 1+	0.150	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
Winter Steelhead	Cowlitz Fall Chinook	5.000	▨	▨	▨	○	?	○	▨	▨	▨	○	○	○
	Cowlitz Coho 1+	3.200	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Coho Eggs	0.181	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sp. Chinook 1+	0.912	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sp. Chinook 0+	0.300	▨	▨	▨	○	?	○	▨	▨	▨	○	○	○
	Friends of the Cowlitz Sp. Chinook 1	0.055	○	○	?	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Early W. Steelhead 1+	0.300	○	○	?	?	?	○	○	?	○	○	○	○
	Cowlitz Late W. Steelhead 1+	0.390	○	○	?	?	?	○	○	?	○	○	○	○
	Colwitz Late W. Steelhead 0+	0.200	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz S. Steelhead	0.450	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Friends of the Cowlitz S. Steelhead 1	0.100	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sea-run Cutthroat 1+ Net Per	0.010	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Cowlitz Sea-run Cutthroat 1+	0.150	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○

	Hatchery Program		Genetic			Ecological			Demographic		Facility			
Cispus Population	Name	Release (millions)	Effective Population Size	Domestication	Diversity	Predation	Competition	Disease	Survival Rate	Reproductive Success	Catastrophic Loss	Passage	Screening	Water Quality
Spring Chinook	Cowlitz Fall Chinook	5.000				●	?	●				●	●	●
	Cowlitz Coho 1+	3.200				?	?	●				●	●	●
	Cowlitz Coho Eggs	0.181				?	?	●				●	●	●
	Cowlitz Sp. Chinook 1+	0.912	●	●	●	?	?	●	●	?	●	●	●	●
	Cowlitz Sp. Chinook 0+	0.300	●	●	●	●	?	●	●	?	●	●	●	●
	Friends of the Cowlitz Sp. Chinook 1	0.055	●	●	●	?	?	●	●	?	●	●	●	●
	Cowlitz Early W. Steelhead 1+	0.300				?	?	●				●	●	●
	Cowlitz Late W. Steelhead 1+	0.390				?	?	●				●	●	●
	Colwitz Late W. Steelhead 0+	0.200				?	?	●				●	●	●
	Cowlitz S. Steelhead	0.450				?	?	●				●	●	●
	Friends of the Cowlitz S. Steelhead 1	0.100				?	?	●				●	●	●
	Cowlitz Sea-run Cutthroat 1+ Net Per	0.010				?	?	●				●	●	●
	Cowlitz Sea-run Cutthroat 1+	0.150				?	?	●				●	●	●
Winter Steelhead	Cowlitz Fall Chinook	5.000				●	?	●				●	●	●
	Cowlitz Coho 1+	3.200				?	?	●				●	●	●
	Cowlitz Coho Eggs	0.181				?	?	●				●	●	●
	Cowlitz Sp. Chinook 1+	0.912				?	?	●				●	●	●
	Cowlitz Sp. Chinook 0+	0.300				●	?	●				●	●	●
	Friends of the Cowlitz Sp. Chinook 1	0.055	●	●	?	?	?	●				●	●	●
	Cowlitz Early W. Steelhead 1+	0.300	●	●	?	?	?	●	●	?	●	●	●	●
	Cowlitz Late W. Steelhead 1+	0.390	●	●	?	?	?	●	●	?	●	●	●	●
	Colwitz Late W. Steelhead 0+	0.200				?	?	●				●	●	●
	Cowlitz S. Steelhead	0.450				?	?	●				●	●	●
	Friends of the Cowlitz S. Steelhead 1	0.100				?	?	●				●	●	●
	Cowlitz Sea-run Cutthroat 1+ Net Per	0.010				?	?	●				●	●	●
	Cowlitz Sea-run Cutthroat 1+	0.150				?	?	●				●	●	●

	Hatchery Program		Genetic			Ecological			Demographic		Facility			
Tilton Population	Name	Release (millions)	Effective Population Size	Domestication	Diversity	Predation	Competition	Disease	Survival Rate	Reproductive Success	Catastrophic Loss	Passage	Screening	Water Quality
Spring Chinook	Cowlitz Fall Chinook	5.000				●	?	●				●	●	●
	Cowlitz Coho 1+	3.200				?	?	●				●	●	●
	Cowlitz Coho Eggs	0.181				?	?	●				●	●	●
	Cowlitz Sp. Chinook 1+	0.912	●	●	●	?	?	●	●	?	●	●	●	●
	Cowlitz Sp. Chinook 0+	0.300	●	●	●	●	?	●	●	?	●	●	●	●
	Friends of the Cowlitz Sp. Chinook 1	0.055	●	●	●	?	?	●	●	?	●	●	●	●
	Cowlitz Early W. Steelhead 1+	0.300				?	?	●				●	●	●
	Cowlitz Late W. Steelhead 1+	0.390				?	?	●				●	●	●
	Colwitz Late W. Steelhead 0+	0.200				?	?	●				●	●	●
	Cowlitz S. Steelhead	0.450				?	?	●				●	●	●
	Friends of the Cowlitz S. Steelhead 1	0.100				?	?	●				●	●	●
	Cowlitz Sea-run Cutthroat 1+ Net Per	0.010				?	?	●				●	●	●
	Cowlitz Sea-run Cutthroat 1+	0.150				?	?	●				●	●	●
Winter Steelhead	Cowlitz Fall Chinook	5.000				●	?	●				●	●	●
	Cowlitz Coho 1+	3.200				?	?	●				●	●	●
	Cowlitz Coho Eggs	0.181				?	?	●				●	●	●
	Cowlitz Sp. Chinook 1+	0.912				?	?	●				●	●	●
	Cowlitz Sp. Chinook 0+	0.300				●	?	●				●	●	●
	Friends of the Cowlitz Sp. Chinook 1	0.055	●	●	?	?	?	●				●	●	●
	Cowlitz Early W. Steelhead 1+	0.300	●	●	?	?	?	●	●	?	●	●	●	●
	Cowlitz Late W. Steelhead 1+	0.390	●	●	?	?	?	●	●	?	●	●	●	●
	Colwitz Late W. Steelhead 0+	0.200				?	?	●				●	●	●
	Cowlitz S. Steelhead	0.450				?	?	●				●	●	●
	Friends of the Cowlitz S. Steelhead 1	0.100				?	?	●				●	●	●
	Cowlitz Sea-run Cutthroat 1+ Net Per	0.010				?	?	●				●	●	●
	Cowlitz Sea-run Cutthroat 1+	0.150				?	?	●				●	●	●

Table 13. Preliminary strategies proposed to address risks identified in the BRAP for Upper Cowlitz, Cispus and Tilton Basins populations.

	Hatchery Program		Risk Assessment of Hazards														
			Address Genetic Risks					Address Ecological Risks				Address Demographic Risks		Address Facility Risks			
Upper Cowlitz Population	Name	Release (millions)	Mating Procedure	Integrated Program	Segregated Program	Research/ Monitoring	Broodstock Source	Number Released	Release Procedure	Disease Containment	Research/ Monitoring	Culture Procedure	Research/ Monitoring	Reliability	Improve Passage	Improve Screening	Pollution Abateme
Fall Chinook	Cowlitz Fall Chinook	5.000		●	●	●							●				
	Cowlitz Coho 1+	3.200						●	●		●						
	Cowlitz Coho Eggs	0.181						●	●		●						
	Cowlitz Sp. Chinook 1+	0.912						●	●		●						
	Cowlitz Sp. Chinook 0+	0.300															
	Friends of the Cowlitz Sp. Ch. 1+	0.055						●	●		●						
	Cowlitz Early W. Steelhead 1+	0.300						●	●		●						
	Cowlitz Late W. Steelhead 1+	0.390						●	●		●						
	Cowlitz Late W. Steelhead 0+	0.200						●	●		●						
	Cowlitz S. Steelhead 1+	0.450						●	●		●						
	Friends of the Cowlitz S. Steelhead 1+	0.100						●	●		●						
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.010						●	●		●						
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.150						●	●		●						
Spring Chinook	Cowlitz Fall Chinook	5.000															
	Cowlitz Coho 1+	3.200						●	●		●						
	Cowlitz Coho Eggs	0.181						●	●		●						
	Cowlitz Sp. Chinook 1+	0.912		●	●	●		●	●		●		●				
	Cowlitz Sp. Chinook 0+	0.300		●	●	●		●	●		●		●				
	Friends of the Cowlitz Sp. Ch. 1+	0.055		●	●	●		●	●		●		●				
	Cowlitz Early W. Steelhead 1+	0.300						●	●		●						
	Cowlitz Late W. Steelhead 1+	0.390						●	●		●						
	Cowlitz Late W. Steelhead 0+	0.200						●	●		●						
	Cowlitz S. Steelhead 1+	0.450						●	●		●						
	Friends of the Cowlitz S. Steelhead 1+	0.100						●	●		●						
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.010						●	●		●						
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.150						●	●		●						

	Hatchery Program		Risk Assessment of Hazards														
			Address Genetic Risks					Address Ecological Risks				Address		Address Facility Risks			
Cispus Population	Name	Release (millions)	Mating Procedure	Integrated Program	Segregated Program	Research/ Monitoring	Broodstock Source	Number Released	Release Procedure	Disease Containment	Research/ Monitoring	Culture Procedure	Research/ Monitoring	Reliability	Improve Passage	Improve Screening	Pollution Abatement
Spring Chinook	Cowlitz Fall Chinook	5.000															
	Cowlitz Coho 1+	3.200						●	●		●						
	Cowlitz Coho Eggs	0.181						●	●		●						
	Cowlitz Sp. Chinook 1+	0.912		●	●	●		●	●		●		●				
	Cowlitz Sp. Chinook 0+	0.300		●	●	●		●	●		●		●				
	Friends of the Cowlitz Sp. Ch. 1+	0.055		●	●	●		●	●		●		●				
	Cowlitz Early W. Steelhead 1+	0.300						●	●		●						
	Cowlitz Late W. Steelhead 1+	0.390						●	●		●						
	Cowlitz Late W. Steelhead 0+	0.200						●	●		●						
	Cowlitz S. Steelhead 1+	0.450						●	●		●						
	Friends of the Cowlitz S. Steelhead 1+	0.100						●	●		●						
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.010						●	●		●						
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.150						●	●		●						

	Hatchery Program		Risk Assessment of Hazards														
			Address Genetic Risks					Address Ecological Risks				Address		Address Facility Risks			
Tilton Population	Name	Release (millions)	Mating Procedure	Integrated Program	Segregated Program	Research/ Monitoring	Broodstock Source	Number Released	Release Procedure	Disease Containment	Research/ Monitoring	Culture Procedure	Research/ Monitoring	Reliability	Improve Passage	Improve Screening	Pollution Abatement
Spring Chinook	Cowlitz Fall Chinook	5.000															
	Cowlitz Coho 1+	3.200						●	●		●						
	Cowlitz Coho Eggs	0.181						●	●		●						
	Cowlitz Sp. Chinook 1+	0.912		●	●	●		●	●		●		●				
	Cowlitz Sp. Chinook 0+	0.300		●	●	●		●	●		●		●				
	Friends of the Cowlitz Sp. Ch. 1+	0.055		●	●	●		●	●		●		●				
	Cowlitz Early W. Steelhead 1+	0.300						●	●		●						
	Cowlitz Late W. Steelhead 1+	0.390						●	●		●						
	Cowlitz Late W. Steelhead 0+	0.200						●	●		●						
	Cowlitz S. Steelhead 1+	0.450						●	●		●						
	Friends of the Cowlitz S. Steelhead 1+	0.100						●	●		●						
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.010						●	●		●						
	Cowlitz Sea-run Cutthroat 1+ Net Pen	0.150						●	●		●						

Impact Assessment

The potential significance of negative hatchery impacts within the subbasin on natural populations was estimated with a simple index based on: 1) intra-specific effects resulting from depression in wild population productivity that can result from interbreeding with less fit hatchery fish and 2) inter-specific effects resulting from predation of juvenile salmonids of other species. The index reflects only a portion of net hatchery effects but can provide some sense of the magnitude of key hatchery risks relative to other limiting factors. Fitness effects are among the most significant intra-specific hatchery risks and can also be realistically quantified based on hatchery fraction in the natural spawning population and assumed fitness of the hatchery fish relative to the native wild population. Predation is among the most significant inter-specific effects and can be estimated from hatchery release numbers by species. This index assumed that equilibrium conditions have been reached for the hatchery fraction in the wild and for relative fitness of hatchery and wild fish. This simplifying assumption was necessary because more detailed information is lacking on how far the current situation is from equilibrium. The index does not consider the numerical benefits of hatchery spawners to natural population numbers, ecological interactions between hatchery and wild fish other than predation, or out-of-basin interactions, all of which are difficult to quantify. Appendix E contains a detailed description of the method and rationale behind this index.

The indexed potential for negative impacts of hatchery spawners on wild population fitness in the Upper Cowlitz Basin ranges from a low of 20% for fall Chinook to 30% for winter steelhead in all rivers in the basin (Table 14). The high potential for fitness impacts in this basin result from the high percentage of hatchery fish in the current populations which originated from reintroduction programs (Table 14). However, the high incidence of fall Chinook, spring Chinook, coho and winter steelhead hatchery spawners suggests that the fitness of natural and hatchery fish is now probably quite similar and natural populations might decline substantially without continued hatchery subsidy under current habitat and passage conditions. Interspecific impacts from predation appear to be nil for all species with the exception of chum in the lower basin, which may be preyed upon by hatchery released winter steelhead.

Table 14. Presumed reductions in wild population fitness as a result of natural hatchery spawners and survival as a result of interactions with other hatchery species for upper Cowlitz salmon and steelhead populations.

Population	Annual releases[a]	Hatchery fraction[b]	Fitness category[c]	Assumed fitness[d]	Fitness impact[e]	Interacting releases[f]	Interspecies impact[g]
Fall Chinook	0	0.67	2	0.7	0.20	--	--
Spring Chinook							
Upper Cowlitz	300,000[h]	0.90	2	0.7	0.27	--	--
Tilton	0	0.90	2	0.7	0.27	--	--
Cispus	--[h]	0.90	2	0.7	0.27	--	--
Chum	0[i]	0	--	--	0	2,189,500	0.109
Coho							
Upper Cowlitz	0[j]	0.96	2	0.7	0.29	0	0
Tilton	0[j]	0.96	2	0.7	0.29	0	0
Cispus	0[j]	0.96	2	0.7	0.29	0	0
Winter steelhead							
Upper Cowlitz	287,500[k]	1.00	2	0.7	0.300	0	0
Tilton	100,000[l]	1.00	2	0.7	0.300	0	0
Cispus	--[k]	1.00	2	0.7	0.300	0	0

[a] Annual release goals.

[b] Proportion of natural spawners that are first generation hatchery fish.

[c] Broodstock category: 1 = derived from native local stock, 2 = domesticated stock of native local origin, 3 = originates from same ESU but substantial divergence may have occurred, 4 = out-of-ESU origin or origin uncertain

[d] Productivity of naturally-spawning hatchery fish relative to native wild fish prior to significant hatchery influence. Because population-specific fitness estimates are not available for most lower Columbia River populations, we applied hypothetical rates comparable to those reported in the literature and the nature of local hatchery program practices.

[e] Index based on hatchery fraction and assumed fitness.

[f] Number of other hatchery releases with a potential to prey on the species of interest. Includes steelhead and coho for fall chinook and coho. Includes steelhead for chum.

[g] Predation impact based on interacting releases and assumed species-specific predation rates.

[h] 300,000 fingerling spring chinook from Cowlitz Trout Hatchery are released annually in an attempt to restore the upper Cowlitz population. An additional 967,000 yearlings are released in the lower Cowlitz from Cowlitz Salmon Hatchery.

[i] There are no records of hatchery chum releases in the basin.

[j] Hatchery coho (predominately late coho type N) fry and adults have been released since 1997 and 1998, respectively, into the upper Cowlitz and Cispus Rivers. Outmigrating juvenile coho are collected and transported around the Cowlitz Falls Dam; collection efficiencies have ranged from 17-45%. Recent efforts have also released adults into the Tilton River basin; any juveniles produced in the Tilton need to be collected at Mayfield Dam.

[k] Includes 37,500 yearlings and 250,000 subyearlings of late run stock intended to restore an upper Cowlitz basin population.

[l] Fingerling releases for reintroduction purposes.

3.6.2 *Harvest*

Fishing generally affects salmon populations through directed and incidental harvest, catch and release mortality, and size, age, and run timing alterations because of uneven fishing on different run components. From a population biology perspective, this results in fewer spawners and can alter age, size, run timing, fecundity, and genetic characteristics. Fewer spawners result in fewer eggs for future generations and diminish marine-derived nutrients delivered via dying adults, now known to be significant to the growth and survival of juvenile salmon in aquatic ecosystems. The degree to which harvest-related limiting factors influence productivity varies by species and location.

Most harvest of wild Columbia River salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. Fish are caught in the Canada/Alaska ocean, U.S. West Coast ocean, lower Columbia River commercial and recreational, tributary recreational, and in-river treaty Indian (including commercial, ceremonial, and subsistence) fisheries. Total exploitation rates have decreased for lower Columbia salmon and steelhead, especially since the 1970s as increasingly stringent protection measures were adopted for declining natural populations.

Current fishing impact rates on lower Columbia River naturally-spawning salmon populations ranges from 2.5% for chum salmon to 45% for tule fall Chinook (Table 15). These rates include estimates of direct harvest mortality as well as estimates of incidental mortality in catch and release fisheries. Fishery impact rates for hatchery produced spring Chinook, coho, and steelhead are higher than for naturally-spawning fish of the same species because of selective fishing regulations. These rates generally reflect recent year (2001-2003) fishery regulations and quotas controlled by weak stock impact limits and annual abundance of healthy targeted fish. Actual harvest rates will vary for each year dependent on annual stock status of multiple west coast salmon populations, however, these rates generally reflect expected impacts of harvest on lower Columbia naturally-spawning and hatchery salmon and steelhead under current harvest management plans.

Table 15. Approximate annual exploitation rates (% harvested) for naturally-spawning lower Columbia salmon and steelhead under current management controls (represents 2001-2003 fishing period).

	AK./Can. Ocean	West Coast Ocean	Col. R. Comm.	Col. R. Sport	Trib. Sport	**Wild Total**	Hatchery Total	Historic Highs
Spring Chinook	13	5	1	1	2	**22**	53	65
Fall Chinook (Tule)	15	15	5	5	5	**45**	45	80
Fall Chinook (Bright)	19	3	6	2	10	**40**	Na	65
Coho	<1	9	6	2	1	**18**	51	85
Steelhead	0	<1	3	0.5	5	**8.5**	70	75

Columbia River fall Chinook are subject to freshwater and ocean fisheries from Alaska to their rivers of origin in fisheries targeting abundant Chinook stocks originating from Alaska, Canada, Washington, Oregon, and California. Columbia tule fall Chinook harvest is constrained by a Recovery Exploitation Rate (RER) developed by NOAA Fisheries for management of Coweeman naturally-spawning fall Chinook. Some In-basin sport fisheries are closed to the retention of fall chinook to protect naturally spawning populations. Harvest of lower Columbia bright wild fall Chinook is managed to achieve an escapement goal of 5,700 natural spawners in the North Fork Lewis.

Harvest of upper Cowlitz coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River as well as recreational fisheries in the Lower Cowlitz Basin. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish.

Steelhead are not encountered by ocean fisheries and non-Indian commercial steelhead fisheries are prohibited in the Columbia River. Incidental mortality of steelhead occurs in freshwater commercial fisheries directed at Chinook and coho and freshwater sport fisheries directed at hatchery steelhead and salmon. All recreational fisheries are managed to selectively harvest fin-marked hatchery steelhead and commercial fisheries cannot retain hatchery or wild steelhead.

Access to harvestable surpluses of strong stocks in the Columbia River and ocean is regulated by impact limits on weak populations mixed with the strong. Weak stock management of Columbia River fisheries became increasingly prevalent in the 1960s and 1970s in response to continuing declines of upriver runs affected by mainstem dam construction. In the 1980s coordinated ocean and freshwater weak stock management commenced. More fishery restrictions followed ESA listings in the 1990s. Each fishery is controlled by a series of regulating factors. Many of the regulating factors that affect harvest impacts on Columbia River stocks are associated with treaties, laws, policies, or guidelines established for the management of other stocks or combined stocks, but indirectly control impacts of Columbia River fish as well. Listed fish generally comprise a small percentage of the total fish caught by any fishery. Every listed fish may correspond to tens, hundreds, or thousands of other stocks in the total catch. As a result of weak stock constraints, surpluses of hatchery and strong naturally-spawning runs often go unharvested. Small reductions in fishing rates on listed populations can translate to large reductions in catch of other stocks and recreational trips to communities which provide access to fishing, with significant economic consequences.

Selective fisheries for adipose fin-clipped hatchery spring Chinook (since 2001), coho (since 1999), and steelhead (since 1984) have substantially reduced fishing mortality rates for naturally-spawning populations and allowed concentration of fisheries on abundant hatchery fish. Selective fisheries occur in the Columbia River and tributaries, for spring Chinook and steelhead, and in the ocean, Columbia River, and tributaries for coho. Columbia River hatchery fall Chinook are not marked for selective fisheries, but likely will be in the future because of recent legislation enacted by Congress.

3.6.3 *Mainstem and Estuary Habitat*

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. Juvenile and adult salmon may be found in the mainstem and estuary at all times of the year, as different species, life history strategies and size classes continually rear or move through these waters. A variety of human activities in the mainstem and estuary have decreased both the quantity and quality of habitat used by juvenile salmonids. These include floodplain development; loss of side channel habitat, wetlands and marshes; and alteration of flows due to upstream hydro operations and irrigation withdrawals.

Effects on salmonids of habitat changes in the mainstem and estuary are complex and poorly understood. Effects are similar for upper Cowlitz populations to those of most other subbasin salmonid populations. Effects are likely to be greater for fall Chinook which rear for extended periods in the mainstem and estuary than for steelhead and coho which move through more quickly. Estimates of the impacts of human-caused changes in mainstem and estuary habitat conditions are available based on changes in river flow, temperature, and predation as represented by EDT analyses for the NPCC Multispecies Framework Approach (Marcot et al. 2002). These estimates generally translate into a 10-60% reduction in salmonid productivity depending on species (Appendix E). Estuary effects are described more fully in the estuary subbasin volume of this plan (Volume II-A).

3.6.4 *Hydropower Construction and Operation*

The hydropower system is the primary factor for decline in the upper Cowlitz basin. Mayfield Dam (RM 52), built in 1962, blocks anadromous passage to the upper Cowlitz, Tilton, and Cispus river watersheds. In addition, two more dams, Mossyrock (RM 66), and Cowlitz Falls Dam (RM 88.5) impound the upper watershed. Historically, spawning grounds in the upper basin produced 20% of the fall Chinook and 38% of the steelhead in the Cowlitz basin (Mobrand Biometrics 1999). The hydropower facilities impede volitional access to upstream habitats. Furthermore, over 48 miles of stream habitat was flooded by the Mayfield, Mossyrock, and Cowlitz Falls Dams.

Upper Cowlitz species are also affected by changes in the Columbia River mainstem and estuary related to Columbia basin hydropower development and operation. The mainstem Columbia River and estuary provide important habitats for anadromous species during juvenile and adult migrations between spawning and rearing streams and the ocean where they grow and mature. These habitats are particularly important for fall Chinook which rear extensively in the Columbia mainstem and estuary. Aquatic habitats have been fundamentally altered throughout the Columbia River basin by the construction and operation of a complex of tributary and mainstem dams and reservoirs for power generation, navigation, and flood control.

The hydropower infrastructure and flow regulation affects adult migration, juvenile migration, mainstem spawning success, estuarine rearing, water temperature, water clarity, gas supersaturation, and predation. Dams block or impede passage of anadromous juveniles and adults. Columbia River spring flows are greatly reduced from historical levels as water is stored for power generation and irrigation, while summer and winter flows have increased. These flow changes affect juvenile and adult migration, and have radically altered habitat forming processes. Flow regulation and reservoir construction have increased average water temperature in the Columbia River mainstem and summer temperatures regularly exceed optimums for salmon. Supersaturation of water with atmospheric gases, primarily nitrogen, when water is spilled over high dams causes gas bubble disease. Predation by fish, bird, and marine mammals has been exacerbated by habitat changes. The net effect of these direct and indirect effects is difficult to quantify but is expected to be less significant for populations originating from lower Columbia River subbasins than for upriver salmonid populations. Additional information on hydropower effects can be found in the Regional Recovery and Subbasin Plan Volume I.

3.6.5 *Ecological Interactions*

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Salmon and steelhead are affected throughout their lifecycle by ecological interactions with non native species, food web components, and predators. Each of these factors can be exacerbated by human activities either by direct actions or indirect effects of habitat alternation. Effects of non-native species on salmon, effects of salmon on system productivity, and effects of native predators on salmon are difficult to quantify. Strong evidence exists in the scientific literature on the potential for significant interactions but effects are often context- or case-specific.

Predation is one interaction where effects can be estimated although interpretation can be complicated. In the lower Columbia River, northern pikeminnow, Caspian tern, and marine mammal predation on salmon has been estimated at approximately 5%, 10-30%, and 3-12%, respectively of total salmon numbers (see Appendix E for additional details). Predation has always been a source of salmon mortality but predation rates by some species have been exacerbated by human activities.

3.6.6 *Ocean Conditions*

Salmonid numbers and survival rates in the ocean vary with ocean conditions and low productivity periods increase extinction risks of populations stressed by human impacts. The ocean is subject to annual and longer-term climate cycles just as the land is subject to periodic droughts and floods. The El Niño weather pattern produces warm ocean temperatures and warm, dry conditions throughout the Pacific Northwest. The La Niña weather patterns is typified by cool ocean temperatures and cool/wet weather patterns on land. Recent history is dominated by a high frequency of warm dry years, along with some of the largest El Niños on record—particularly in 1982-83 and 1997-98. In contrast, the 1960s and early 1970s were dominated by a cool, wet regime. Many climatologists suspect that the conditions observed since 1998 may herald a return to the cool wet regime that prevailed during the 1960s and early 1970s.

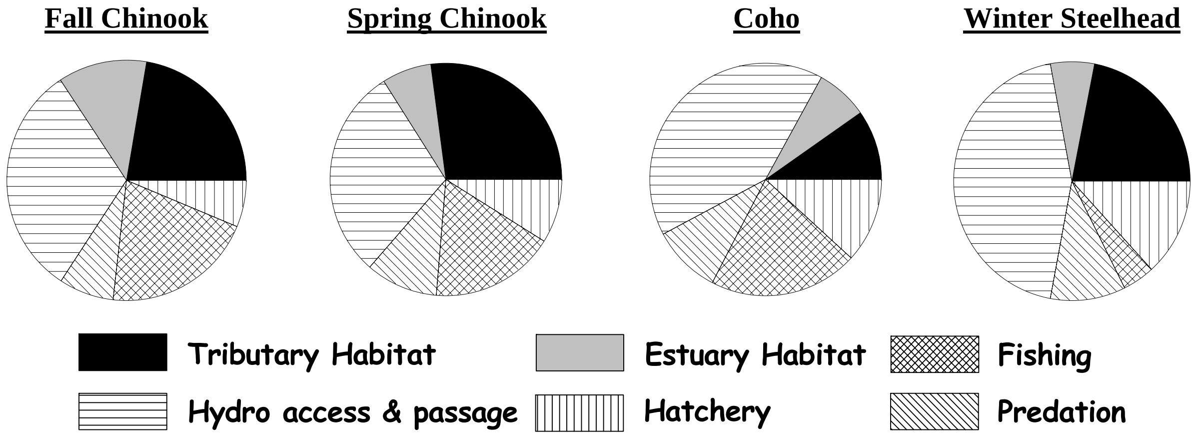
Abrupt declines in salmon populations throughout the Pacific Northwest coincided with a regime shift to predominantly warm dry conditions from 1975 to 1998 (Beamish and Bouillon 1993, Hare et al 1999, McKinnell et al. 2001, Pyper et al. 2001). Warm dry regimes result in generally lower survival rates and abundance, and they also increase variability in survival and wide swings in salmon abundance. Some of the largest Columbia River fish runs in recorded history occurred during 1985–1987 and 2001–2002 after strong El Niño conditions in 1982–83 and 1997–98 were followed by several years of cool wet conditions.

The reduced productivity that accompanied an extended series of warm dry conditions after 1975 has, together with numerous anthropogenic impacts, brought many weak Pacific Northwest salmon stocks to the brink of extinction and precipitated widespread ESA listings. Salmon numbers naturally ebb and flow as ocean conditions vary. Healthy salmon populations are productive enough to withstand these natural fluctuations. Weak salmon populations may disappear or lose the genetic diversity needed to withstand the next cycle of low ocean productivity (Lawson 1993).

Recent improvements in ocean survival may portend a regime shift to generally more favorable conditions for salmon. The large spike in recent runs and a cool, wet climate would provide a respite for many salmon populations driven to critical low levels by recent conditions. The National Research Council (1996) concluded: *"Any favorable changes in ocean conditions—which could occur and could increase the productivity of some salmon populations for a time—should be regarded as opportunities for improving management techniques. They should not be regarded as reasons to abandon or reduce rehabilitation efforts, because conditions will change again"*. Additional details on the nature and effects of variable ocean conditions on salmonids can be found in the Regional Recovery and Subbasin Plan Volume I.

3.7 Summary of Human Impacts on Salmon and Steelhead

Stream habitat, estuary/mainstem habitat, harvest, hatchery and ecological interactions have all contributed to reductions in productivity, numbers, and population viability. Pie charts in Figure 36 describe the relative magnitude of potentially-manageable human impacts in each category of limiting factor for the Upper Cowlitz Subbasin salmon and steelhead. Impact values were developed for a base period corresponding to species listing dates. This depiction is useful for identifying which factors are most significant for each species and where improvements might be expected to provide substantial benefits. Larger pie slices indicate greater significance and scope for improvement in an impact for a given species. These numbers also serve as a working hypothesis for factors limiting salmonid numbers and viability.



Note: Pie charts display data for the Upper Cowlitz River only.

Figure 36. Relative contribution of potentially manageable impacts on upper Cowlitz River salmonid populations.

This assessment indicates that current salmonid status is the result of large impacts distributed among several factors. No single factor accounts for a majority of effects on all species. Thus, substantial improvements in salmonid numbers and viability will require significant improvements in several factors. Hydrosystem impacts account for the largest relative impact on all species. Loss of tributary habitat quality and quantity is also relatively important for all species, but less so for coho. Harvest has a sizeable effect on fall and spring Chinook and coho but is relatively minor for winter steelhead. Hatchery impacts are substantial for coho, and winter steelhead; moderate for spring Chinook, and relatively low for fall Chinook. Loss of estuary habitat quantity and quality has had the largest impact on fall Chinook. Predation impacts are moderate for all species.

Impacts were defined as the proportional reduction in average numbers or productivity associated with each effect. Tributary and estuary habitat impacts are the differences between the pre-development historical baseline and current conditions. Hydro impacts identify the percentage of historical habitat blocked by impassable dams and the mortality associated with juvenile and adult passage of other dams. Fishing impacts are the direct and indirect mortality in ocean and freshwater fisheries. Hatchery impacts include the equilibrium effects of reduced natural population productivity caused by natural spawning of less-fit hatchery fish and also effects of inter-specific predation by larger hatchery smolts on smaller wild juveniles. Hatchery impacts do not include other potentially negative indirect effects or potentially beneficial effects of augmentation of natural production. Predation includes mortality from northern pikeminnow, Caspian terns, and marine mammals in the Columbia River mainstem and estuary. Predation is not a direct human impact but was included because of widespread interest in its relative significance. Methods and data for these analyses are detailed in Appendix E.

Potentially-manageable human impacts were estimated for each factor based on the best available scientific information. Proportions are standardized to a total of 1.0 for plotting purposes. The index is intended to illustrate order-of-magnitude rather than fine-scale differences. Only the subset of factors we can potentially manage were included in this index – natural mortality factors beyond our control (e.g. naturally-occurring ocean mortality) are excluded. Not every factor of interest is included in this index – only readily-quantifiable impacts are included.

4.0 Key Programs and Projects

This section provides brief summaries of current federal, state, local, and non-governmental programs and projects pertinent to recovery, management, and mitigation measures and actions in this basin. These descriptions provide a context for descriptions of specific actions and responsibilities in the management plan portion of this subbasin plan. More detailed descriptions of these programs and projects can be found in the Comprehensive Program Directory (Appendix C).

4.1 Federal Programs

4.1.1 *NOAA Fisheries*

NOAA Fisheries is responsible for conserving, protecting and managing pacific salmon, ground fish, halibut, marine mammals and habitats under the Endangered Species Act, the Marine Mammal Protection Act, the Magnuson-Stevens Act, and enforcement authorities. NOAA administers the ESA under Section 4 (listing requirements), Section 7 (federal actions), and Section 10 (non-federal actions).

4.1.2 *US Army Corps of Engineers*

The U.S. Army Corps of Engineers (USACE) is the Federal government's largest water resources development and management agency. USACE programs applicable to Lower Columbia Fish & Wildlife include: 1) Section 1135 – provides for the modification of the structure or operation of a past USACE project, 2) Section 206 – authorizes the implementation of aquatic ecosystem restoration and protection projects, 3) Hydroelectric Program – applies to the construction and operation of power facilities and their environmental impact, 4) Regulatory Program – administration of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act.

4.1.3 *Environmental Protection Agency*

The Environmental Protection Agency (EPA) is responsible for the implementation of the Clean Water Act (CWA). The broad goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters so that they can support the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water. The CWA requires that water quality standards (WQS) be set for surface waters. WQS are aimed at translating the broad goals of the CWA into waterbody-specific objectives and apply only to the surface waters (rivers, lakes, estuaries, coastal waters, and wetlands) of the United States.

4.1.4 *United States Forest Service*

The United States Forest Service (USFS) manages federal forest lands within the Gifford Pinchot National Forest (GPNF) and Wilderness Areas. The GPNF operates under the Gifford Pinchot Forest Plan (GPFP). Management prescriptions within the GPFP have been guided by the 1994 Northwest Forest Plan, which calls for management of forests according to a suite of management designations including Reserves (e.g. late successional forests, riparian forests), Adaptively-Managed Areas, and Matrix Lands. Most timber harvest occurs in Matrix Lands. The GPNF implements a wide range of ecosystem restoration activities. Lands within Wilderness Areas are managed for protection and/or passive restoration of ecosystem processes.

4.1.5 *Natural Resources Conservation Service*

Formerly the Soil Conservation Service, the USDA Natural Resources Conservation Service (NRCS) works with landowners to conserve natural resources on private lands. The NRCS accomplishes this through various programs including, but not limited to, the Conservation Technical Assistance Program, Soil Survey Program, Conservation Reserve Enhancement Program, and the Wetlands Reserve Program. The NRCS works closely with local Conservation Districts; providing technical assistance and support.

4.1.6 *National Park Service*

Mount Rainier National Park was established on March 2, 1899 and encompasses 235,625 acres, ranging in elevation from 1,610 ft to 14,410 ft above sea level. The Park is approximately 97 percent wilderness and as such, offers a high degree of protection for the headwaters of the Cowlitz Subbasin.

4.1.7 *Northwest Power and Conservation Council*

The Northwest Power and Conservation Council, an interstate compact of Idaho, Montana, Oregon, and Washington, has specific responsibility in the Northwest Power Act of 1980 to mitigate the effects of the hydropower system on fish and wildlife of the Columbia River Basin. The Council does this through its Columbia River Basin Fish and Wildlife Program, which is funded by the Bonneville Power Administration. Beginning in Fiscal Year 2006, funding is guided by locally developed subbasin plans that are expected to be formally adopted in the Council’s Fish and Wildlife Program in December 2004.

4.1.8 *Federal Energy Regulatory Commission*

Non-federal hydroelectric projects that meet certain criteria operate under licenses issued by the Federal Energy Regulatory Commission (FERC). A hydroelectric license prescribes operations and safety precautions, as well as environmental protection, mitigation and enhancements. The FERC relicensing process requires years of extensive planning, including environmental studies, agency consensus, and public involvement.

4.2 State Programs

4.2.1 *Washington Department of Natural Resources*

The Washington Department of Natural Resources governs forest practices on non-federal lands and is steward to state owned aquatic lands. Management of DNR public forest lands is governed by tenets of their proposed Habitat Conservation Plan (HCP). Management of private industrial forestlands is subject to Forest Practices regulations that include both protective and restorative measures.

4.2.2 *Washington Department of Fish & Wildlife*

WDFW’s Habitat Division supports a variety of programs that address salmonids and other wildlife and resident fish species. These programs are organized around habitat conditions (Science Division, Priority Habitats and Species, and the Salmon and Steelhead Habitat Inventory and Assessment Program); habitat restoration (Landowner Incentive Program, Lead Entity Program, and the Conservation and Reinvestment Act Program, as well as technical assistance in the form of publications and technical resources); and habitat protection (Landowner Assistance, GMA, SEPA planning, Hydraulic Project Approval, and Joint Aquatic Resource Permit Applications).

4.2.3 *Washington Department of Ecology*

The Department of Ecology (DOE) oversees: the Water Resources program to manage water resources to meet current and future needs of the natural environment and Washington's communities; the Water Quality program to restore and protect Washington's water supplies by preventing and reducing pollution; and Shoreline and the Environmental Assistance program for implementing the Shorelines Management Act, the State Environmental Protection Act, the Watershed Planning Act, and 401 Certification of ACOE Permits.

4.2.4 *Washington Department of Transportation*

The Washington State Department of Transportation (WSDOT) must ensure compliance with environmental laws and statutes when designing and executing transportation projects. Programs that consider and mitigate for impacts to salmonid habitat include: the Fish Passage Barrier Removal program; the Regional Road Maintenance ESA Section 4d Program, the Integrated Vegetation Management & Roadside Development Program; Environmental Mitigation Program; the Stormwater Retrofit Program; and the Chronic Environmental Deficiency Program.

4.2.5 *Interagency Committee for Outdoor Recreation*

Created through the enactment of the Salmon Recovery Act (Washington State Legislature, 1999), the Salmon Recovery Funding Board provides grant funds to protect or restore salmon habitat and assist related activities with local watershed groups known as lead entities. SRFB has helped finance over 500 salmon recovery projects statewide. The Aquatic Lands Enhancement Account (ALEA) was established in 1984 and is used to provide grant support for the purchase, improvement, or protection of aquatic lands for public purposes, and for providing and improving access to such lands. The Washington Wildlife and Recreation Program (WWRP), established in 1990 and administered by the Interagency Committee for Outdoor Recreation, provides funding assistance for a broad range of land protection, park development, preservation/conservation, and outdoor recreation facilities.

4.2.6 *Lower Columbia Fish Recovery Board*

The Lower Columbia Fish Recovery Board encompasses five counties in the Lower Columbia River Region. The 15-member board has four main programs, including habitat protection and restoration activities, watershed planning for water quantity, quality, habitat, and instream flows, facilitating the development of an integrated recovery plan for the Washington portion of the lower Columbia Evolutionarily Significant Units, and conducting public outreach activities.

4.3 Local Government Programs

4.3.1 *Lewis County*

Lewis County is in the process of becoming compliant with the Growth Management Act in its Comprehensive Planning process. Lewis County manages lands through a Critical Areas Ordinance, Stormwater Management, and various other programs.

4.3.2 *Lewis Conservation District*

The Lewis Conservation District provides technical assistance, cost-share assistance, and project monitoring in WRIA 26. The conservation district has developed projects in the Cowlitz Subbasin, including instream work and culvert replacement projects. Lewis CD works with agricultural landowners through CREP and farm planning activities and performs limited educational activities.

4.3.3 *Tacoma Public Utilities (Tacoma Power)*

Tacoma Power is a publicly owned division of Tacoma Public Utilities that operates Mayfield and Mossyrock Dams to provide electricity to the city of Tacoma and surrounding areas. Tacoma Power operates the facilities under a license agreement with the Federal Energy Regulatory Commission (FERC).

4.3.4 *Lewis County Public Utility District*

The Lewis County Public Utility District is a non-profit, customer-owned utility that provides electricity to Lewis County in southwest Washington. The Lewis County PUD and the BPA cooperatively developed the Cowlitz Falls Project. The PUD is owner of the Project, while the BPA has purchased the annual output of the Project under a long-term contract. In exchange for receiving the output of the Project, BPA pays all costs associated with its operation and maintenance. Lewis County PUD buys its power from BPA so the power generated by the Cowlitz Falls Project helps supply the needs of Lewis County residents and businesses.

4.4 Non-governmental Programs

4.4.1 *Columbia Land Trust*

The Columbia Land Trust is a private, non-profit organization founded in 1990 to work exclusively with willing landowners to find ways to conserve the scenic and natural values of the land and water. Landowners donate the development rights or full ownership of their land to the Land Trust. CLT manages the land under a stewardship plan and, if necessary, will legally defend its conservation values.

4.4.2 *Lower Columbia Fish Enhancement Group*

The Washington State Legislature created the Regional Fisheries Enhancement Group Program in 1990 to involve local communities, citizen volunteers, and landowners in the state’s salmon recovery efforts. RFEGs help lead their communities in successful restoration, education and monitoring projects. Every group is a separate, nonprofit organization led by their own board of directors and operational funding from a portion of commercial and recreational fishing license fees administered by the WDFW, and other sources. The mission of the Lower Columbia RFEG (LCFEG) is to restore salmon runs in the lower Columbia River region through habitat restoration, education and outreach, and developing regional and local partnerships.

4.5 NPCC Fish & Wildlife Program Projects

There are no NPCC Fish & Wildlife Program Projects in the Upper Cowlitz Basin.

4.6 Washington Salmon Recovery Funding Board Projects

Type	Project Name	Subbasin
Restoration	Hall Creek	Upper Cowlitz
Restoration	Yellow Jacket Creek, Cipus Creek	Upper Cowlitz

5.0 Management Plan

5.1 Vision

Washington lower Columbia salmon, steelhead, and bull trout are recovered to healthy, harvestable levels that will sustain productive sport, commercial, and tribal fisheries through the restoration and protection of the ecosystems upon which they depend and the implementation of supportive hatchery and harvest practices.

The health of other native fish and wildlife species in the lower Columbia will be enhanced and sustained through the protection of the ecosystems upon which they depend, the control of non-native species, and the restoration of balanced predator/prey relationships.

The Upper Cowlitz Basin will play key role in the recovery of salmon and steelhead. Natural populations of spring Chinook will be reestablished and restored to high levels of viability and coho and winter steelhead will be reestablished and restored to medium levels of viability. These objectives will be accomplished by adequate passage through the hydrosystem and significant reductions in human impacts throughout the lifecycle. Salmonid recovery efforts will provide broad ecosystem benefits to a variety of subbasin fish and wildlife species. Recovery will be accomplished through a combination of improvements in subbasin, Columbia River mainstem, and estuary habitat conditions as well as careful management of hatcheries, fisheries, and ecological interactions among species.

Habitat protection or restoration will involve a wide range of Federal, State, Local, and non-governmental programs and projects. Success will depend on effective programs as well as a dedicated commitment to salmon recovery across a broad section of society.

Some hatchery programs will be realigned to focus on protection, conservation, and recovery of native fish. The need for hatchery measures will decrease as productive natural habitats are restored. Where consistent with recovery, other hatchery programs will continue to provide fish for fishery benefits for mitigation purposes in the interim until habitat conditions are restored to levels adequate to sustain healthy, harvestable natural populations.

Directed fishing on sensitive wild populations will be eliminated and incidental impacts of mixed stock fisheries in the Columbia River and ocean will be regulated and limited consistent with wild fish recovery needs. Until recovery is achieved, fishery opportunities will be focused on hatchery fish and harvestable surpluses of healthy wild stocks.

Cowlitz Basin hydropower effects will be addressed as part of the FERC license requirements for operation of the three dams in the upper Cowlitz River. Columbia basin hydropower effects on Upper Cowlitz Subbasin salmonids will be addressed by mainstem Columbia and estuary habitat restoration measures. Hatchery facilities in the upper Cowlitz will also be called upon to produce fish to help mitigate for hydropower impacts on upriver stocks where compatible with wild fish recovery.

This plan uses a planning period or horizon of 25 years. The goal is to achieve recovery of the listed salmon species and the biological objectives for other fish and wildlife species of interest within this time period. It is recognized, however, that sufficient restoration of habitat conditions and watershed processes for all species of interest will likely take 75 years or more.

5.2 Biological Objectives

Biological objectives for Upper Cowlitz Subbasin salmonid populations are based on recovery criteria developed by scientists on the Willamette/Lower Columbia Technical Recovery Team convened by NOAA Fisheries. Criteria involve a hierarchy of ESU, Strata (i.e. ecosystem areas within the ESU – Coast, Cascade, and Gorge), and Population standards. A recovery scenario describing population-scale biological objectives for all species in all three strata in the lower Columbia ESUs was developed through a collaborative process with stakeholders based on biological significance, expected progress as a result of existing programs, the absence of apparent impediments, and the existence of other management opportunities. Under the preferred alternative, individual populations will variously contribute to recovery according to habitat quality and the population's perceived capacity to rebuild. Criteria, objectives, and the regional recovery scenario are described in greater detail in the Regional Recovery and Subbasin Plan Volume I.

Focal populations in the upper Cowlitz subbasin are targeted to improve to a level that contributes to recovery of the species. The scenario differentiates the role of populations by designating primary, contributing, and stabilizing categories. *Primary populations* are those that would be restored to high or better probabilities of persistence. *Contributing populations* are those where low to medium improvements will be needed to achieve stratum-wide average of moderate persistence probability. *Stabilizing populations* are those maintained at current levels.

Recovery goals call for restoring salmonid populations to viability levels ranging from very low to above high (Table 16). The above high level for spring chinook will provide for a greater than 99% probability of population survival over 100 years and the medium level for coho and winter steelhead will provide for at least a 75% probability of survival. Fall Chinook recovery will be focused downstream of the hydrosystem in the lower Cowlitz River. Cutthroat will benefit from improvements in stream habitat conditions for anadromous species. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and Upper Cowlitz Basin although specific spawning and rearing habitat requirements are not well known. Bull trout do not occur in the basin.

Table 16. Current viability status of upper Cowlitz populations and the biological objective status that is necessary to meet the recovery criteria for the Cascade strata and the lower Columbia ESU.

	ESA	Hatchery	Current		Objective	
Species	Status	Component	Viability	Numbers	Viability	Numbers
Fall Chinook	Threatened	Yes	Very Low	None	Very Low^{S}	NA
Spring Chinook	Threatened	Yes	Low	NA	High+^{P}	2,800-8,100
Coho	Proposed	Yes	Very Low	NA	Medium^{C}	300
Winter Steelhead	Threatened	Yes	Low	None	Medium^{C}	300

P = primary population in recovery scenario
C = contributing population in recovery scenario
S = stabilizing population in recovery scenario

5.3 Integrated Strategy

An Integrated Regional Strategy for recovery emphasizes that 1) it is feasible to recover Washington lower Columbia natural salmon and steelhead to healthy and harvestable levels; 2) substantial improvements in salmon and steelhead numbers, productivity, distribution, and diversity will be required; 3) recovery cannot be achieved based solely on improvements in any one factor; 4) existing programs are insufficient to reach recovery goals, 5) all manageable effects on fish and habitat conditions must contribute to recovery, 6) actions needed for salmon recovery will have broader ecosystem benefits for all fish and wildlife species of interest, and 7) strategies and measures likely to contribute to recovery can be identified but estimates of the incremental improvements resulting from each specific action are highly uncertain. The strategy is described in greater detail in the Regional Recovery and Subbasin Plan Volume I.

The Integrated Strategy recognizes the importance of implementing measures and actions that address each limiting factor and risk category, prescribing improvements in each factor/threat category in proportion to its magnitude of contribution to salmon declines, identifying an appropriate balance of strategies and measures that address regional, upstream, and downstream threats, and focusing near term actions on species at-risk of extinction while also ensuring a long term balance with other species and the ecosystem.

Population productivity improvement increments identify proportional improvements in productivity needed to recover populations from current status to medium, high, and very high levels of population viability consistent with the role of the population in the recovery scenario. Productivity is defined as the inherent population replacement rate and is typically expressed by models as a median rate of population increase (PCC model) or a recruit per spawner rate (EDT model). Corresponding improvements in spawner numbers, juvenile outmigrants, population spatial struction, genetic and life history diversity, and habitat are implicit in productivity improvements.

Improvement targets were developed for each impact factor based on desired population productivity improvements and estimates of potentially manageable impacts (see Section 3.7). Impacts are estimates of the proportional reduction in population productivity associated with human-caused and other potentially manageable impacts from stream habitats, estuary/mainstem habitats, hydropower, harvest, hatcheries, and selected predators. Reduction targets were driven by the regional strategy of equitably allocating recovery responsibilities among the six manageable impact factors. However, these specific improvement targets are not yet developed for upper Cowlitz populations. Productivity improvement targets will be developed as the reintroduction program moves forward and the hydro passage impacts can be understood and assessed at a level less than 100 percent.

The following table displays estimates of baseline impacts for each limiting factor. The Per factor improvement increments will be developed for these upper Cowlitz populations in the future once passage efficiency can be reasonably accounted for in the assessment.

Table 17. Baseline impacts for limiting factors in the the upper Cowlitz subbasin.

	Net	Per	Baseline impacts					
Species	increase	factor	Trib.	Estuary	Hydro.	Pred.	Harvest	Hatch.
Fall Chinook	0%	--	0.71	0.38	1.00	0.23	0.65	0.20
Spring Chinook								
Upper Cowlitz	--	--	0.82	0.20	0.90	0.31	0.53	0.27
Tilton	--	--	--	0.20	1.00	0.31	0.53	0.27
Cispus	--	--	0.88	0.20	1.00	0.31	0.53	0.27
Coho								
Upper Cowlitz	na	na	na	na	na	na	na	na
Tilton	na	na	na	na	na	na	na	na
Cispus	na	na	na	na	na	na	na	na
Winter Steelhead								
Upper Cowlitz	--	--	0.50	0.14	1.00	0.24	0.20	0.30
Tilton	--	--	0.85	0.14	1.00	0.24	0.10	0.30
Cispus	--	--	0.52	0.14	1.00	0.24	0.10	0.30

5.4 Tributary Habitat

Habitat assessment results were synthesized in order to develop specific prioritized measures and actions that are believed to offer the greatest opportunity for species recovery in the subbasin. As a first step toward measure and action development, habitat assessment results were integrated to develop a multi-species view of 1) priority areas, 2) factors limiting recovery, and 3) contributing land-use threats. For the purpose of this assessment, limiting factors are defined as the biological and physical conditions serving to suppress salmonid population performance, whereas threats are the land-use activities contributing to those factors. Limiting Factors refer to local (reach-scale) conditions believed to be directly impacting fish. Threats, on the other hand, may be local or non-local. Non-local threats may impact instream limiting factors in a number of ways, including: 1) through their effects on habitat-forming processes – such as the case of forest road impacts on reach-scale fine sediment loads, 2) due to an impact in a contributing stream reach – such as riparian degradation reducing wood recruitment to a downstream reach, or 3) by blocking fish passage to an upstream reach.

Priority areas and limiting factors were determined through the technical assessment, including primarily EDT analysis and the Integrated Watershed Assessment (IWA). As described later in this section, priority areas are also determined by the relative importance of subbasin focal fish populations to regional recovery objectives. This information allows for scaling of subbasin recovery effort in order to best accomplish recovery at the regional scale. Land-use threats were determined from a variety of sources including Washington Conservation Commission Limiting Factors Analyses, the IWA, the State 303(d) list, air photo analysis, the Barrier Assessment, personal knowledge of investigators, or known cause-effect relationships between stream conditions and land-uses.

Priority areas, limiting factors and threats were used to develop a prioritized suite of habitat measures. Measures are based solely on biological and physical conditions. For each measure, the key programs that address the measure are identified and the sufficiency of existing programs to satisfy the measure is discussed. The measures, in conjunction with the program sufficiency considerations, were then used to identify specific actions necessary to fill gaps in measure implementation. Actions differ from measures in that they address program deficiencies as well as biophysical habitat conditions. The process for developing measures and actions is illustrated in Figure 37 and each component is presented in detail in the sections that follow.

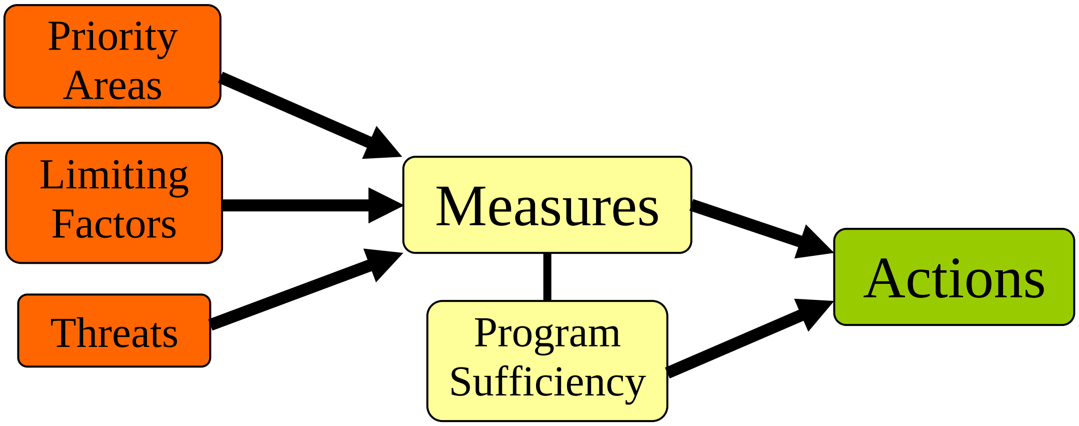


Figure 37. Flow chart illustrating the development of measures and actions.

5.4.1 *Priority Areas, Limiting Factors and Threats*

Priority habitat areas and factors in the subbasin are discussed below in two sections. The first section contains a generalized (coarse-scale) summary of conditions throughout the basin. The second section is a more detailed summary that presents specific reach and subwatershed priorities.

Summary

Decades of human activity in the Upper Cowlitz River Basin have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Moreover, with the exception of fall Chinook, stream habitat conditions within the Upper Cowlitz Basin have a high impact on the health and viability of salmon and steelhead relative to other limiting factors. The following bullets provide a brief overview of each of the priority areas in the basin. These descriptions are a summary of the reach-scale priorities that are presented in the next section. These descriptions summarize the species most affected, the primary limiting factors, the contributing land-use threats, and the general type of measures that will be necessary for recovery. A tabular summary of the key limiting factors and land-use threats can be found in **Error! Reference source not found.**.

- **Upper mainstem Cowlitz & tributaries** *(reaches Upper Cowlitz 1A-2; Silver Cr; Johnson Cr; Hall Cr)* – The upper mainstem Cowlitz reaches with the greatest current or potential production are located between Siler Creek and Hall Creek. This alluvial reach contains historically productive spawning and rearing habitat for fall Chinook, spring Chinook, coho, and winter steelhead. The reaches with the greatest current productivity, and therefore the greatest preservation value, are located between Randle and Packwood. In general, recovery emphasis should be placed primarily on preservation although many areas will also benefit from restoration measures. Effective restoration actions will involve addressing riparian and floodplain degradation related to mixed use development (agriculture, residential) along the river corridor and basin-wide watershed process restoration.
- **Cispus River & tributaries** *(Cispus 1A, 1C, 1F-3; Yellowjacket 1)* – The Cispus supports winter steelhead, coho, and spring Chinook. The most productive reaches are located in the alluvial section from Greenhorn Creek to just upstream of the NF Cispus confluence. The basin is nearly entirely within the Gifford Pinchot National Forest. There is good preservation and restoration potential. The greatest emphasis should be placed on preservation of basin-wide watershed process conditions (runoff, sediment supply).
- **Tilton River & tributaries** *(Tilton 1, 3-6; EF Tilton 1-2)* – The Tilton system, which contains no Tier 1 or 2 reaches, is not expected to play a prominent role in recovery planning. The basin, however, was an important component of the historical upper Cowlitz populations and contains some potentially productive habitat that is currently degraded by watershed process impairments. Limiting factors, threats, and measures have therefore been specified for Tilton basin reaches. The primary impairments are related to intensive timber harvest and road building. There are also stream corridor impairments in and around the town of Morton, WA.

Table 18. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the upper mainstem Cowlitz and tribs (CO), the Cispus River + tribs (CI), and the Tilton + tribs (TI). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	**CO**	**CI**	**TI**
Habitat connectivity			
Blockages to off-channel habitats	✓		✓
Blockages to channel habitats due to structures	✓	✓	✓
Habitat diversity			
Lack of stable instream woody debris	✓	✓	✓
Altered habitat unit composition	✓	✓	✓
Loss of off-channel and/or side-channel habitats	✓		✓
Channel stability			
Bed and bank erosion	✓	✓	✓
Channel down-cutting (incision)	✓	✓	✓
Mass wasting		✓	
Riparian function			
Reduced stream canopy cover	✓	✓	✓
Reduced bank/soil stability	✓	✓	✓
Exotic and/or noxious species	✓		✓
Reduced wood recruitment	✓	✓	✓
Floodplain function			
Altered nutrient exchange processes	✓		✓
Reduced flood flow dampening	✓		✓
Restricted channel migration	✓		✓
Disrupted hyporheic processes	✓		✓
Water quality			
Altered stream temperature regime	✓	✓	✓
Substrate and sediment			
Excessive fine sediment	✓	✓	✓
Embedded substrates	✓	✓	✓
Stream flow			
Altered magnitude, duration, or rate of change			✓

Threats	**CO**	**CI**	**TI**
Hydropower operations			
Passage obstructions (dams)	✓	✓	✓
Agriculture/grazing			
Clearing of vegetation	✓		
Riparian grazing	✓		
Floodplain filling	✓		
Urban/rural development			
Clearing of vegetation	✓		✓
Floodplain filling	✓		✓
Roads – riparian/floodplain impacts	✓		✓
Forest practices			
Timber harvests –sediment supply impacts	✓	✓	✓
Timber harvests – impacts to runoff			✓
Riparian harvests (historical)	✓		✓
Forest roads – impacts to sediment supply	✓	✓	✓
Forest roads – impacts to runoff			✓
Channel manipulations			
Bank hardening	✓		✓
Channel straightening	✓		✓
Artificial confinement	✓		✓

Specific Reach and Subwatershed Priorities

Specific reaches and subwatersheds have been prioritized based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Reaches have been placed into Tiers (1-4), with Tier 1 reaches representing the areas where recovery measures would yield the greatest benefits towards accomplishing the biological objectives. The reach tiering factors in each fish population's importance relative to regional recovery objectives, as well as the relative importance of reaches within the populations themselves. Reach tiers are most useful for identifying habitat recovery measures in channels, floodplains, and riparian areas. Reach-scale priorities were initially identified within individual populations (species) through the EDT Restoration and Preservation Analysis. This resulted in reaches grouped into categories of high, medium, and low priority for each population (see Stream Habitat Limitations section). Within a subbasin, reach rankings for all of the modeled populations were combined, using population designations as a weighting factor. Population designations for this subbasin are described in the Biological Objectives section. The population designations are 'primary', 'contributing', and 'stabilizing'; reflecting the level of emphasis that needs to be placed on population recovery in order to meet ESA recovery criteria.

Spatial priorities were also identified at the subwatershed scale. Subwatershed-scale priorities were directly determined by reach-scale priorities, such that a Group A subwatershed contains one or more Tier 1 reaches. Scaling up from reaches to the subwatershed level was done in recognition that actions to protect and restore critical reaches might need to occur in adjacent and/or upstream upland areas. For example, high sediment loads in a Tier 1 reach may originate in an upstream contributing subwatershed where sediment supply conditions are impaired because of current land use practices. Subwatershed-scale priorities can be used in conjunction with the IWA to identify watershed process restoration and preservation opportunities. The specific rules for designating reach tiers and subwatershed groups are presented in Table 19. Reach tier designations are included in Table 20 and Table 21 for the Upper mainstem Cowlitz/Cispus and Tilton Basins, respectively. Reach tiers and subwatershed groups are displayed spatially in Figure 38 and Figure 39 for the Upper mainstem Cowlitz/Cispus and Tilton Basins, respectively. Summaries of reach- and- subwatershed-scale limiting factors are presented in Table 22 and Table 23.

Table 19. Rules for designating reach tier and subwatershed group priorities. See Biological Objectives section for information on population designations.

Designation	Rule
Reaches	
Tier 1:	All high priority reaches (based on EDT) for one or more primary populations.
Tier 2:	All reaches not included in Tier 1 and which are medium priority reaches for one or more primary species and/or all high priority reaches for one or more contributing populations.
Tier 3:	All reaches not included in Tiers 1 and 2 and which are medium priority reaches for contributing populations and/or high priority reaches for stabilizing populations.
Tier 4:	Reaches not included in Tiers 1, 2, and 3 and which are medium priority reaches for stabilizing populations and/or low priority reaches for all populations.
Subwatersheds	
Group A:	Includes one or more Tier 1 reaches.
Group B:	Includes one or more Tier 2 reaches, but no Tier 1 reaches.
Group C:	Includes one or more Tier 3 reaches, but no Tier 1 or 2 reaches.
Group D:	Includes only Tier 4 reaches.

Table 20. Reach Tiers in the Upper mainstem Cowlitz / Cispus River Basin

Tier 1	Tier 2	Tier 3	Tier 4	
Cispus-1C	Cispus-1A	Butter Creek-1	Barrier Dam	Lower Cowlitz-2
Upper Cowlitz-1AA	Cispus-1F	Cispus -1D	Burton Creek	Mid Cowlitz -1
Upper Cowltiz-1B	Cispus-2	Cispus -1E	Cispus NF-1	Mid Cowlitz -2
Upper Cowlitz-1C	Cispus-3	Cispus -4	Cispus 1B	Mid Cowlitz -3
Upper Cowlitz-1CC	Hall Cr - 1	Schooley Creek	Crystal Cr - 1	Mid Cowlitz -4
Upper Cowlitz-1CCC	Johnson Cr - 1	Skate Cr - 1	Cunninham Creek	Mid Cowlitz -5A
Upper Cowlitz-1E	Mid Cowlitz-6	Upper Cowlitz -4	Davis Creek-1	Mid Cowlitz -5B
	Mid Cowlitz-7	Yellowjacket-2	Dry Creek	Mullins Creek
	Silver Cr - 1		Garret Creek	Quartz Cr - 1
	Upper Cowlitz-1A		Greenhorn Cr - 1	Siler Creek-1
	Upper Cowlitz-1D		Hampton Creek	Silver Cr - 2
	Upper Cowlitz -1F		Iron Cr - 1	Skate Cr - 2
	Upper Cowlitz -2		Johnson Cr -2	Skate Cr - 3
	Yellowjacket-1		Kilborn Creek	Smith Cr - 1
			Kiona Cr - 1	Upper Cowlitz -3
			Kiona Cr - 2	Willamette Cr - 1
			Lower Cowlitz-1	Woods

Table 21 Reach Tiers in the Tilton River Basin

Tier 3	Tier 4
Lake Creek	Connelly-1
Tilton EF-1	Tilton NF-1
Tilton EF-2	Tilton SF-1
Tilton-1	Tilton WF-1
Tilton-3	Tilton-2
Tilton-4	
Tilton-5	
Tilton-6	

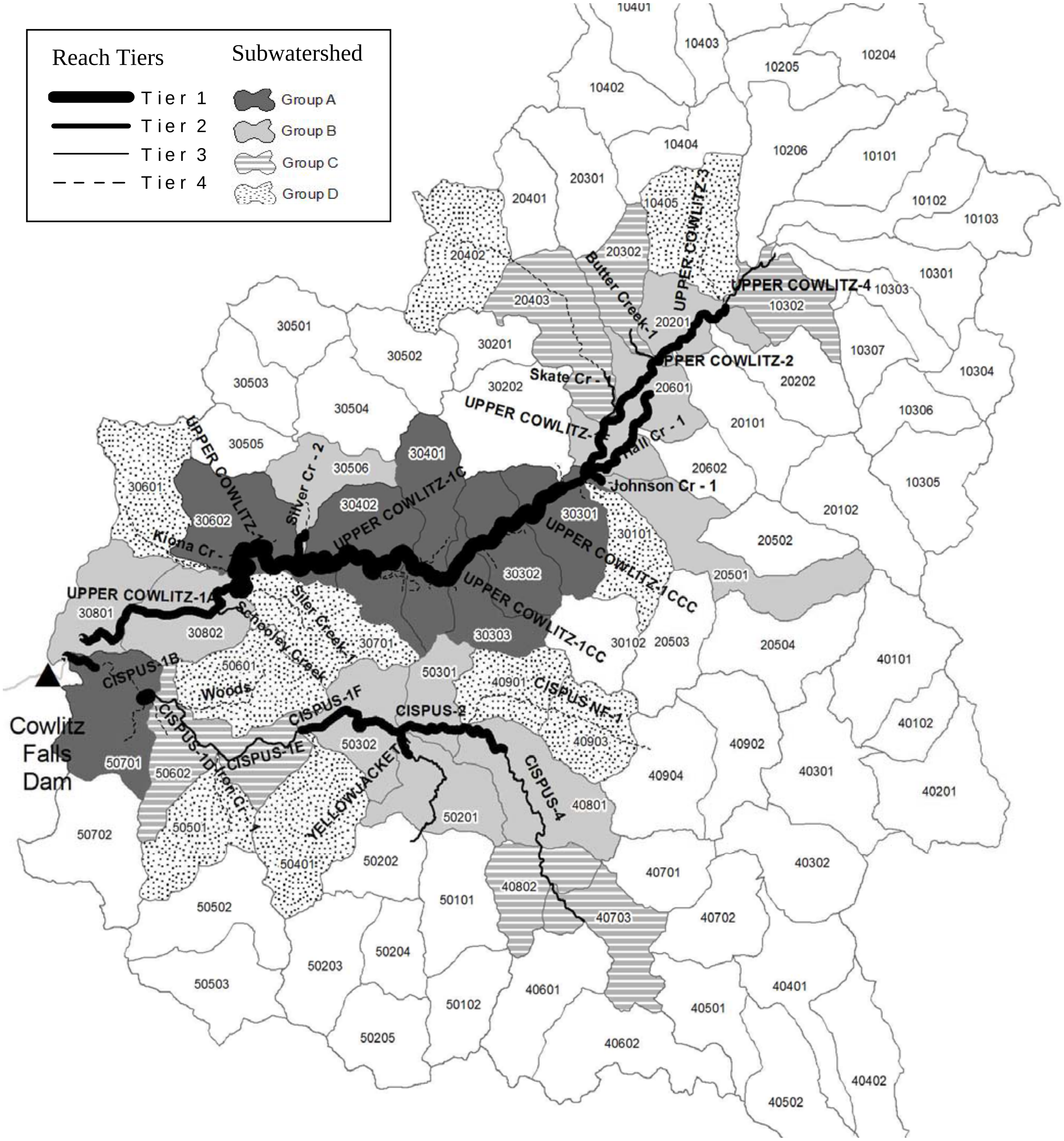


Figure 38. Reach tiers and subwatershed groups in the Upper mainstem Cowlitz / Cispus Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach scale are useful for identifying stream corridor recovery measures. Priorities at the subwatershed scale are useful for identifying watershed process recovery measures. Watershed process recovery measures for stream reaches will need to occur within the surrounding (local) subwatershed as well as in upstream contributing subwatersheds.

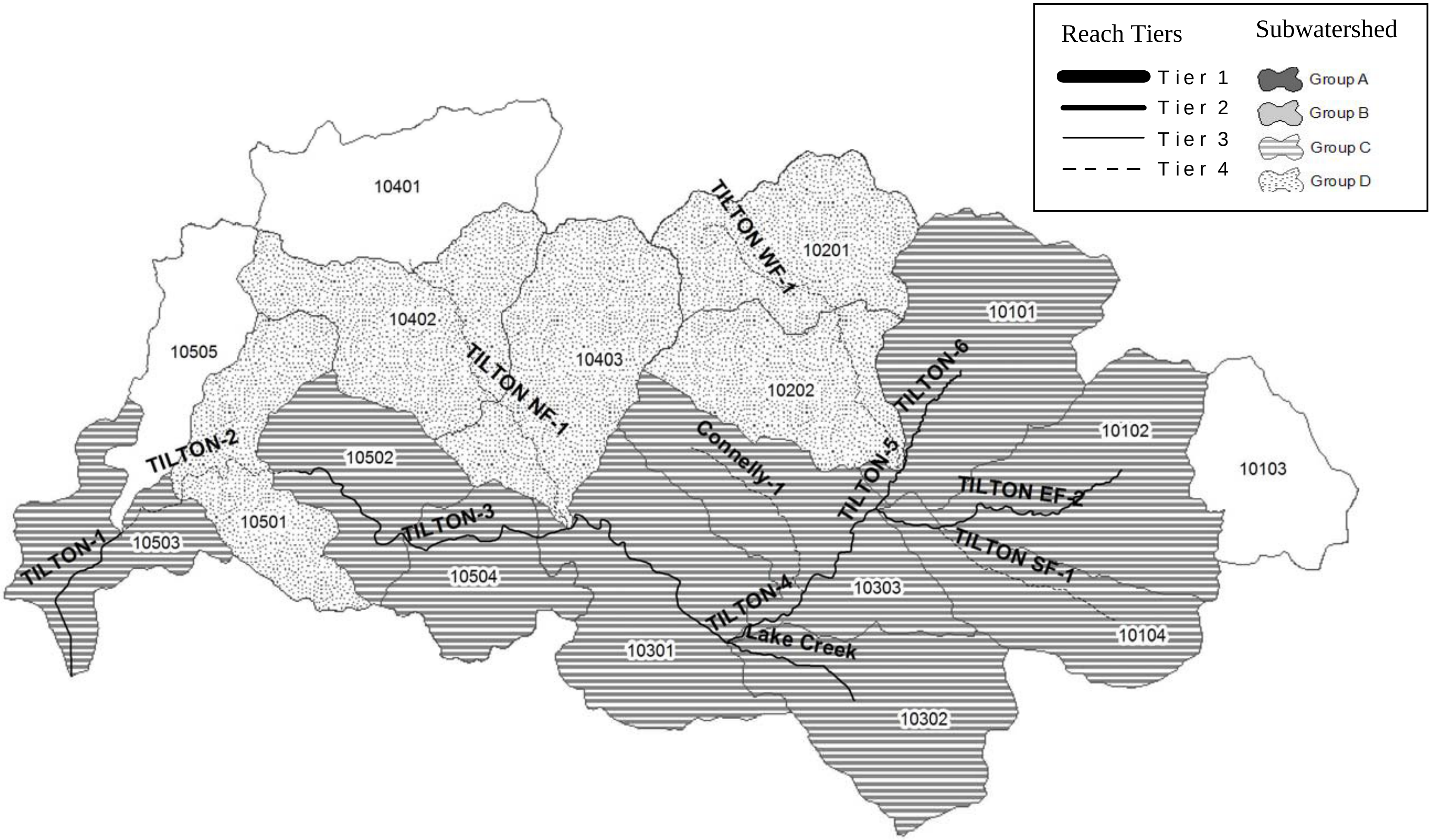


Figure 39. Reach tiers and subwatershed groups in the Tilton Basin. The subwatershed groups are based on Reach Tiers. Priorities at the reach scale are useful for identifying stream corridor recovery measures. Priorities at the subwatershed scale are useful for identifying watershed process recovery measures. Watershed process recovery measures for stream reaches will need to occur within the surrounding (local) subwatershed as well as in upstream contributing subwatersheds.

Table 22. Upper mainstem Cowlitz & Cispus Basin summary table of reach- and subwatershed-scale limiting factors in priority areas. The table is organized by subwatershed groups, beginning with the highest priority group. Species-specific reach priorities, critical life stages, high impact habitat factors, and recovery emphasis (P=preservation, R=restoration, PR=restoration and preservation) are included. Watershed process impairments: F=functional, M=moderately impaired, I=impaired. Species abbreviations: ChS=spring Chinook, ChF=fall Chinook, StS=summer steelhead, StW=winter steelhead.

Sub-watershed Group	Subwatersheds	Reaches within subwatershed	Species present	High priority reaches by species	Critical life stages	High impact habitat factors	Restoration or preservation emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
A	30301	Dry Creek UPPER COWLITZ-1CCC UPPER COWLITZ-1D UPPER COWLITZ-1E	ChS	UPPER COWLITZ-1CCC UPPER COWLITZ-1E	egg incubation fry colonization summer rearing adult holding	channel stability habitat diversity	P	F	M	M	F	F
			StW	UPPER COWLITZ-1D UPPER COWLITZ-1E	summer rearing winter rearing	habitat diversity	PR					
			Coho	UPPER COWLITZ-1E	egg incubation summer rearing winter rearing	channel stability habitat diversity	PR					
			ChF	UPPER COWLITZ-1CCC UPPER COWLITZ-1D UPPER COWLITZ-1E	egg incubation fry colonization early rearing adult holding	channel stability habitat diversity	P					
	30302	Burton Creek Garret Creek UPPER COWLITZ-1CCC	ChS	UPPER COWLITZ-1CCC	egg incubation fry colonization summer rearing adult holding	habitat diversity	P	F	M	M	F	F
			StW									
			Coho									
			ChF	UPPER COWLITZ-1CCC	egg incubation fry colonization early rearing	none	P					
	30303	Kilborn Creek UPPER COWLITZ-1CC	ChS	UPPER COWLITZ-1CC	egg incubation fry colonization summer rearing	habitat diversity	P	F	M	M	F	M
			StW	UPPER COWLITZ-1CC	summer rearing winter rearing	none	P					
			Coho									
			ChF	UPPER COWLITZ-1CC	egg incubation fry colonization early rearing	none	P					
	30401	Cunninham Creek Davis Creek-1 Mullins Creek UPPER COWLITZ-1CC	ChS	UPPER COWLITZ-1CC	egg incubation fry colonization summer rearing	habitat diversity	P	M	M	M	F	M
			StW	UPPER COWLITZ-1CC	summer rearing winter rearing	none	P					
			Coho									
			ChF	UPPER COWLITZ-1CC	egg incubation fry colonization early rearing	none	P					
	30402	Cunninham Creek UPPER COWLITZ-1C	ChS	UPPER COWLITZ-1C	egg incubation fry colonization summer rearing	habitat diversity	P	F	F	M	F	M
			StW	UPPER COWLITZ-1C	summer rearing winter rearing	none	PR					
			Coho									
			ChF	UPPER COWLITZ-1C	egg incubation fry colonization early rearing	none	P					
	30602	Hampton Creek UPPER COWLITZ-1AA UPPER COWLITZ-1B	ChS	UPPER COWLITZ-1AA UPPER COWLITZ-1B	egg incubation fry colonization summer rearing winter rearing	habitat diversity sediment channel stability	PR	I	M	M	F	M
			StW									
			Coho	UPPER COWLITZ-1AA UPPER COWLITZ-1B	egg incubation fry colonization summer rearing	channel stability habitat diversity sediment	PR					
			ChF	UPPER COWLITZ-1B	egg incubation fry colonization early rearing	sediment	PR					
	50701	CISPUS-1A CISPUS-1B CISPUS-1C Quartz Cr - 1	ChS	CISPUS-1C	egg incubation fry colonization summer rearing winter rearing	channel stability habitat diversity sediment	PR	M	M	M	F	M
			StW									
			Coho									
			ChF	CISPUS-1C	egg incubation early rearing	sediment	PR					

Sub-watershed Group	Subwatersheds	Reaches within subwatershed	Species present	High priority reaches by species	Critical life stages	High impact habitat factors	Restoration or preservation emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
B	20201	UPPER COWLITZ-2	ChS StW Coho ChF					M	M	M	F	M
	20501	Johnson Cr - 1 Johnson Cr - 2	ChS					F	F	M	F	F
			StW	Johnson Cr - 1	spawning egg incubation fry colonization summer rearing winter rearing	habitat diversity	PR					
			Coho									
			ChF									
	20601	Hall Cr - 1 UPPER COWLITZ-1F UPPER COWLITZ-2	ChS					I	M	M	F	F
			StW	UPPER COWLITZ-2	summer rearing winter rearing	none	PR					
			Coho									
			ChF									
	30506	Silver Cr - 1 Silver Cr - 2	ChS					M	M	M	I	M
			StW	Silver Cr - 1	spawning egg incubation fry colonization summer rearing winter rearing	habitat diversity flow	R					
			Coho									
			ChF									
	30801	UPPER COWLITZ-1A	ChS					I	M	M	F	M
			StW									
			Coho	UPPER COWLITZ-1A	egg incubation fry colonization summer rearing	none	P					
			ChF	UPPER COWLITZ-1A	egg incubation fry colonization early rearing	sediment	PR					
	30802	Schooley Creek UPPER COWLITZ-1A	ChS					I	M	M	F	M
			StW									
			Coho	UPPER COWLITZ-1A	egg incubation fry colonization summer rearing	none	P					
			ChF	UPPER COWLITZ-1A	egg incubation fry colonization early rearing	sediment	PR					
	40801	CISPUS-3 CISPUS-4	ChS					F	F	M	F	F
			StW	CISPUS-3	egg incubation summer rearing	sediment	PR					
			Coho	CISPUS-3	egg incubation fry colonization summer rearing winter rearing	channel stability habitat diversity sediment key habitat quantity	R					
			ChF									
	50201	YELLOWJACKET-1 YELLOWJACKET-2	ChS					F	M	M	F	M
			StW	YELLOWJACKET-1	egg incubation summer rearing	sediment	PR					
			Coho									
			ChF									
	50301	CISPUS-2	ChS					M	M	M	F	F
			StW	CISPUS-2	egg incubation summer rearing	sediment	PR					
			Coho	CISPUS-2	egg incubation summer rearing winter rearing	habitat diversity sediment key habitat quantity	R					
			ChF									
	50302	CISPUS-1F	ChS					M	M	M	F	M
			StW	CISPUS-1F	egg incubation summer rearing winter rearing	sediment	PR					
			Coho									
			ChF									
	60101	BARRIER RESERVOIR MID COWLITZ-6 MID COWLITZ-7	ChS					I	M	M	M	M
			StW									
			Coho	MID COWLITZ-7	summer rearing winter rearing	none	R					
			ChF									
	60102	MID COWLITZ-5A MID COWLITZ-5B MID COWLITZ-6	ChS StW Coho ChF					I	M	M	M	M

Sub-watershed Group	Subwatersheds	Reaches within subwatershed	Species present	High priority reaches by species	Critical life stages	High impact habitat factors	Restoration or preservation emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
C	10302	UPPER COWLITZ-4	All					M	M	F	F	F
	20302	Butter Creek-1	All					F	M	M	F	M
	20403	Skate Cr - 1 Skate Cr - 2 Skate Cr - 3	All					F	M	M	F	F
	40703	CISPUS-4	All					F	F	F	F	M
	40802	CISPUS-4	All					F	F	M	F	M
	50602	CISPUS-1D CISPUS-1E Crystal Cr - 1	All					M	M	F	F	M
D	10405	UPPER COWLITZ-3	All					F	F	F	M	F
	20402	Skate Cr - 3	ChS StW Coho					M	F	F	M	F
	30101	Smith Cr - 1	ChS StW Coho					F	M	M	F	M
	30402	Cunninham Creek UPPER COWLITZ-1C	All					F	F	M	F	M
	30601	Kiona Cr - 1 Kiona Cr - 2	ChS StW Coho					I	M	M	I	M
	30701	Siler Creek-1	ChS StW Coho					M	M	M	M	M
	40901	CISPUS NF-1	All					M	M	F	F	M
	40903	CISPUS NF-1	All					M	M	M	M	M
	50401	Greenhorn Cr - 1	ChS StW Coho					F	M	F	F	M
	50501	Iron Cr - 1	ChS StW Coho					F	M	F	M	M
	50601	Woods	ChS StW Coho					M	M	M	M	M
	60403	MID COWLITZ-5A	All					I	M	I	I	M
	60407	MID COWLITZ-4 MID COWLITZ-5A	All					I	M	I	I	M
	60408	MID COWLITZ-2 MID COWLITZ-3 MID COWLITZ-4	All					I	M	I	I	M
	70605	MID COWLITZ-1	All					I	I	I	I	M
	70606	Lower Cowlitz-2 MID COWLITZ-1	All					I	I	I	I	M
	80201	Lower Cowlitz-2	All					I	I	I	I	M
	80202	Lower Cowlitz-2	All					I	I	I	I	M
	80203	Lower Cowlitz-2	All					I	I	I	I	M
	80407	Lower Cowlitz-1	All					I	M	I	I	M

Table 23. Tilton Basin summary table of reach- and subwatershed-scale limiting factors in priority areas.

Sub-watershed Group	Sub-watershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors	Preservation or restoration emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
C	10504	TILTON-3	ChS	TILTON-3	spawning egg incubation fry colonization summer rearing winter rearing juvenile migrant (age-1) adult holding	sediment	R	I	M	M	I	M
			StW	TILTON-3	egg incubation summer rearing winter rearing juvenile migrant (age-1) juvenile migrant (age-2) adult migrant	sediment	R					
			Coho	TILTON-3	All	channel stability habitat diversity sediment	R					
	10503	TILTON-1 TILTON-2	ChS	none				I	M	M	I	M
			StW	TILTON-1	egg incubation summer rearing winter rearing	sediment	R					
			Coho	TILTON-1	All	habitat diversity sediment	R					
	10502	TILTON-3	ChS	TILTON-3	spawning egg incubation fry colonization summer rearing winter rearing juvenile migrant (age-1) adult holding	sediment	R	I	M	M	I	M
			StW	TILTON-3	egg incubation summer rearing winter rearing juvenile migrant (age-1) juvenile migrant (age-2) adult migrant	sediment	R					
			Coho	TILTON-3	All	channel stability habitat diversity sediment	R					
	10303	Connelly-1 TILTON-4	ChS	TILTON-4	All	sediment	R	I	M	M	I	M
			StW	none								
			Coho	none								
	10302	Lake Creek	StW	none				I	M	I	I	M
			Coho	Lake Creek	spawning egg incubation fry colonization summer rearing winter rearing juvenile migrant (age-0) adult holding	habitat diversity sediment key habitat	R					
	10301	TILTON-4	ChS	TILTON-4	All	sediment	R	I	M	M	I	M
			StW	none								
			Coho	none								
	10104	TILTON SF-1 TILTON EF-1 TILTON-5	ChS	TILTON EF-1 TILTON-5	spawning egg incubation fry colonization winter rearing juvenile migrant (age-0) adult holding	habitat diversity sediment temperature flow	R	I	M	M	I	M
			StW	TILTON EF-1 TILTON-5	egg incubation summer rearing winter rearing	temperature flow sediment key habitat	R					
			Coho	TILTON EF-1 TILTON-5	spawning egg incubation fry colonization summer rearing winter rearing juvenile migrant (age-0) juvenile migrant (age-1) adult holding	habitat diversity sediment flow	R					
	10102	TILTON EF-2	ChS	none				I	M	M	I	M
			StW	TILTON EF-2	spawning egg incubation fry colonization summer rearing winter rearing	sediment key habitat	R					
			Coho	none								

Sub-watershed Group	Sub-watershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors	Preservation or restoration emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
C	10101	TILTON-6	ChS	TILTON-6	spawning egg incubation fry colonization summer rearing winter rearing juvenile migrant (age-0) adult holding	habitat diversity temperature flow sediment key habitat	R	I	M	M	I	M
			StW	TILTON-6	spawning egg incubation summer rearing winter rearing adult holding	flow sediment	R					
			Coho	TILTON-6	spawning egg incubation fry colonization summer rearing winter rearing juvenile migrant (age-0) adult holding	habitat diversity flow sediment	R					
D	10501	TILTON-2	All	none				I	M	M	I	M
	10403	TILTON NF-1	All	none				I	I	M	I	M
	10402	TILTON NF-1	All	none				I	I	M	I	M
	10202	TILTON WF-1	All	none				I	M	M	I	M
	10201	TILTON WF-1	All	none				I	M	M	I	M

5.4.2 *Habitat Measures*

Measures are means to achieve the regional strategies that are applicable to the Upper Cowlitz subbasin and necessary to accomplish the biological objectives for focal fish species. Measures are based on the technical assessments for this subbasin (Section 3.0) as well as on the synthesis of priority areas, limiting factors, and threats presented earlier in this section. The measures applicable to the Upper Cowlitz Basin are presented in priority order in Table 24. Each measure has a set of submeasures that define the measure in greater detail and add specificity to the particular circumstances occurring within the subbasin. The table for each measure and associated submeasures indicates the limiting factors that are addressed, the contributing threats that are addressed, the species that would be most affected, and a short discussion. Priority locations are given for some measures. Priority locations typically refer to either stream reaches or subwatersheds, depending on the measure. Addressing measures in the highest priority areas first will provide the greatest opportunity for effectively accomplishing the biological objectives.

Following the list of priority locations is a list of the programs that are the most relevant to the measure. Each program is qualitatively evaluated as to whether it is sufficient or needs expansion with respect to the measure. This exercise provides an indication of how effectively the measure is already covered by existing programs, policy, or projects; and therefore indicates where there is a gap in measure implementation. This information is summarized in a discussion of Program Sufficiency and Gaps.

The measures themselves are prioritized based on the results of the technical assessment and in consideration of principles of ecosystem restoration (e.g. NRC 1992, Roni et al. 2002). These principles include the hypothesis that the most efficient way to achieve ecosystem recovery in the face of uncertainty is to focus on the following priorities for approaches: 1) protect existing functional habitats and the processes that sustain them, 2) allow no further degradation of habitat or supporting processes. 3) re-connect isolated habitat, 4) restore watershed processes (ecosystem function), 5) restore habitat structure, and 6) create new habitat where it is not recoverable. These priorities are adjusted depending on the results of the technical assessment and on the specific circumstances occurring in the basin. For example, re-connecting isolated habitat could be adjusted to a lower priority if there is little impact to the population created from passage barriers.

5.4.3 *Habitat Actions*

The prioritized measures and associated gaps are used to develop specific Actions for the subbasin. These are presented in Table 25. Actions are different than the measures in a number of ways: 1) actions have a greater degree of specificity than measures, 2) actions consider existing programs and are therefore not based strictly on biophysical conditions, 3) actions refer to the agency or entity that would be responsible for carrying out the action, and 4) actions are related to an expected outcome with respect to the biological objectives. Actions are not presented in priority order but instead represent the suite of activities that are all necessary for recovery of listed species. The priority for implementation of these actions must consider the priority of the measures they relate to, the “size” of the gap they are intended to fill, and feasibility considerations.

Table 24. Prioritized measures for the Upper Cowlitz Basin, including the Cispus and Tilton systems.

Habitat Measure #1 – Restore access above hydropower system

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore access above Mayfield, Mossyrock, and Cowlitz Falls Dams if warranted to achieve recovery goals	• Blockages to channel habitats	• Cowlitz hydropower system	Spring chinook, fall chinook, winter steelhead, coho	The system of dams on the mainstem Cowlitz River, beginning with Mayfield Dam at River Mile 52, block all volitional access to the upper basin, consisting of up to 300 or more miles of habitat for anadromous species. Juvenile and adult fish are currently trucked around the system of dams and reservoirs.

Priority Locations
1st- Cowlitz hydropower system (Mayfield, Mossyrock, and Cowlitz Falls Dams and reservoirs)

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Tacoma Public Utilities	Cowlitz River Project (Mayfield, Mossyrock, and Barrier Dams)		✓
Lewis County PUD/BPA	Cowlitz Falls Dam		✓
Federal Energy Regulatory Commission (FERC)	Hydropower Project Licensing		✓
WDFW	Habitat Program		✓

Program Sufficiency and Gaps
Tacoma Public Utilities was issued a new license for the Cowlitz River Hydropower Project in 2002. As part of the license agreement, Tacoma Public Utilities is required to evaluate fish returns and survival through the reservoirs in order to assess the feasibility of providing volitional access. Currently, fish are transported upstream and downstream around the dams and reservoirs but it is anticipated that improved passage will eventually be provided at the facilities and Tacoma Public Utilities has been required to set funds aside in escrow for that purpose. Passage at Mayfield Dam would likely be provided through construction of a ladder, whereas passage at the much larger Mossyrock Dam would be provided by either trap and haul or a tramway. Whether or not volitional passage will be required, and the methods of providing such passage, will be determined based on on-going fish survival studies and consultations with the Fisheries Technical Committee and agencies (Settlement Agreement License Article 3). It is anticipated that this process will effectively address passage issues on Cowlitz mainstem dams.

Habitat Measure #2 – Protect stream corridor structure and function

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect floodplain function and channel migration processes B. Protect riparian function C. Protect access to habitats D. Protect instream flows through management of water withdrawals E. Protect channel structure and stability F. Protect water quality G. Protect the natural stream flow regime	Potentially addresses many limiting factors	Potentially addresses many limiting factors	All Species	Stream corridors in the upper Cispus and upper mainstem Cowlitz, which are located primarily in National Forest land, are in good condition and are protected through existing programs. Stream corridors in the lower portion of the upper Cowlitz mainstem and much of the Tilton basin is in private mixed-use (agriculture, rural residential, industrial) and is at risk of increasing development. It is crucial that adequate protections are in place in these areas to prevent further habitat degradation. Preventing further degradation of stream channel structure, riparian function, and floodplain function will be an important component of recovery.

Priority Locations

1st- Tier 1 or 2 reaches in mixed-use lands at risk of further degradation
    Reaches: Upper Cowlitz 1A-2; Cispus 1A, 1C; Hall Cr; Johnson Cr 1; Silver Cr 1
2nd- Tier 3 reaches in mixed-use lands at risk of further degradation
    Reaches: Butter Creek 1; Schooley Creek; Skate Cr 1; Tilton 3-6; Tilton EF 1; Lake Creek (Tilton Basin)
3rd- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NOAA Fisheries	ESA Section 7 and Section 10	✓	
US Army Corps of Engineers (USACE)	Dredge & fill permitting (Clean Water Act sect. 404); Navigable waterways protection (Rivers & Harbors Act Sect, 10)	✓	
USFS	Northwest Forest Plan	✓	
WA Department of Natural Resources (WDNR)	State Lands HCP, Forest Practices Rules, Riparian Easement Program	✓	
WA Department of Fish and Wildlife (WDFW)	Hydraulics Projects Approval	✓	
Lewis County	Comprehensive Planning		✓
City of Morton	Comprehensive Planning, Water Supply		✓
Town of Mossyrock	Comprehensive Planning, Water Supply		✓
Lewis Conservation District / Natural Resources Conservation Service (NRCS)	Agricultural Habitat Protection Practices		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Education, Enforcement, Control		✓
Non-Governmental Organizations (NGOs) (e.g. Columbia Land Trust) and public agencies	Land acquisition and easements		✓

Program Sufficiency and Gaps
Alterations to stream corridor structure that may impact aquatic habitats are regulated through the WDFW Hydraulics Project Approval (HPA) permitting program. Other regulatory protections are provided through USACE permitting, ESA consultations, HCPs, and local government ordinances. Riparian areas within federal timber lands are protected as part of the Northwest Forest Plan. Riparian areas within private timberlands are protected through the Forest Practices Rules (FPR) administered by WDNR. The FPRs came out of an extensive review process and are believed to adequately protect riparian areas with respect to stream shading, bank stability, and LWD recruitment. The program is new, however, and careful monitoring of the effect of the regulations is necessary, particularly effects on subwatershed hydrology and sediment delivery. Land-use conversion and development are increasing throughout the basin and local government ordinances must ensure that new development occurs in a manner that protects key habitats. Conversion of land-use from forest or agriculture to residential use has the potential to increase impairment of aquatic habitat, particularly when residential development is paired with flood control measures. Local governments can limit potentially harmful land-use conversions by thoughtfully directing growth through comprehensive planning and tax incentives, by providing consistent protection of critical areas across jurisdictions, and by preventing development in floodplains, and planning support at the state level (WDOE) will be necessary to facilitate the creation of local floodplain ordinances. In cases where programs are unable to protect critical habitats due to inherent limitations of regulatory mechanism, conservation easements and land acquisition may be necessary.

Habitat Measure #3 – Protect hillslope processes

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Manage forest practices to minimize impacts to sediment supply processes, runoff regime, and water quality B. Manage agricultural practices to minimize impacts to sediment supply processes, runoff regime, and water quality C. Manage growth and development to minimize impacts to sediment supply processes, runoff regime, and water quality	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Agricultural practices – impacts to sediment supply, water quality, and runoff processes • Development – impacts to sediment supply, water quality, and runoff processes	All species	Hillslope runoff and sediment delivery processes have been degraded due to past intensive timber harvest, forest road building, agriculture, and development, particularly in the Tilton Basin and in tributary basins to Mayfield and Riffe Reservoirs. Lowland hillslope processes have been impacted by agriculture and development. Limiting additional degradation will be necessary to prevent further habitat impairment.

Priority Locations

1st- Functional subwatersheds contributing to Tier 1 or 2 reaches (functional for sediment *or* flow according to the IWA – local rating)
Subwatersheds: Cispus Basin (all functional subwatersheds); upper mainstem Cowlitz Basin (all functional subwatersheds)
2nd- All other functional subwatersheds plus Moderately Impaired subwatersheds contributing to Tier 1 or 2 reaches
Subwatersheds: Cispus Basin (all moderately impaired subwatersheds); upper mainstem Cowlitz Basin (all moderately impaired subwatersheds)
3rd- All other Moderately Impaired subwatersheds plus Impaired subwatersheds contributing to Tier 1 or 2 reaches
Subwatersheds: Tilton Basin (all moderately impaired subwatersheds)
4th- All remaining subwatersheds

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, State Lands HCP	✓	
USFS	Northwest Forest Plan	✓	
Lewis County	Comprehensive Planning		✓
City of Morton	Comprehensive Planning		✓
City of Mossyrock	Comprehensive Planning		✓
Lewis Conservation District / NRCS	Agricultural land habitat protection programs		✓

Program Sufficiency and Gaps

Hillslope processes on federal timber lands are protected through the Northwest Forest Plan. Hillslope processes on private forest lands are protected through Forest Practices Rules administered by the WDNR. These rules, developed as part of the Forests & Fish Agreement, are believed to be adequate for protecting watershed sediment supply, runoff processes, and water quality on private forest lands. Small private landowners may be unable to meet some of the requirements on a timeline commensurate with large industrial landowners. Financial assistance to small owners would enable greater and quicker compliance. On non-forest lands (agriculture and developed), local governments comprehensive planning is the primary nexus for protection of hillslope processes. Local governments can control impacts through zoning that protects existing uses, through stormwater management ordinances, and through tax incentives to prevent agricultural and forest lands from becoming developed. These protections are especially important in the Upper Cowlitz basin due to expanding growth. There are few to no regulatory protections of hillslope processes that relate to agricultural practices; such deficiencies need to be addressed through local or state authorities. Protecting hillslope processes on agricultural lands would also benefit from the expansion of technical assistance and landowner incentive programs (NRCS, Conservation Districts).

Habitat Measure #4 - Restore floodplain function and channel migration processes in the mainstem and major tributaries

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Set back, breach, or remove artificial confinement structures	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel incision • Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats	• Floodplain filling • Channel straightening • Artificial confinement	All species	There has been significant degradation of floodplain connectivity and constriction of channel migration zones along the lower portion of the upper mainstem Cowlitz, along the middle mainstem Tilton, and along several tributaries. Selective breaching, setting back, or removing confining structures would help to restore floodplain and CMZ function as well as facilitate the creation of off-channel and side channel habitats. There are feasibility issues with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.

Priority Locations

1st- Tier 1 reaches with hydro-modifications
Reaches: Upper Cowlitz 1AA, 1B, , 1C, 1CC
2nd- Tier 2 reaches with hydro-modifications
Reaches: Upper Cowlitz 1A, 2; Hall Cr 1; Johnson Cr 1; Silver Cr
3rd- Other reaches with hydro-modifications
Reaches: Butter Cr 1; Tilton 3-6; Lake Creek (Tilton trib)

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDFW	Habitat Program		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓

Program Sufficiency and Gaps

There currently are no programs or policy in place that set forth strategies for restoring floodplain function and channel migration processes in the Upper Cowlitz Basin. Without programmatic changes, projects are likely to occur only seldom as opportunities arise and only if financing is made available. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs and government entities to conduct projects. Floodplain restoration projects are often expensive, large-scale efforts that require partnerships among many agencies, NGOs, and landowners. Building partnerships is a necessary first step toward floodplain and CMZ restoration.

Habitat Measure #5- Restore degraded hillslope processes on forest, agricultural, and developed lands

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Upgrade or remove problem forest roads B. Reforest heavily cut areas not recovering naturally C. Employ agricultural Best Management Practices with respect to contaminant use, erosion, and runoff D. Reduce watershed imperviousness E. Reduce effective stormwater runoff from developed areas	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Agricultural practices – impacts to sediment supply, water quality, and runoff processes • Development – impacts to water quality and runoff processes	All species	Hillslope runoff and sediment delivery processes have been degraded due to past intensive timber harvest, road building, agriculture, and development. These processes must be addressed for reach-level habitat recovery to be successful.

Priority Locations

1st- Moderately impaired or impaired subwatersheds contributing to Tier 1 reaches (mod. impaired or impaired for sediment *or* flow according to IWA – local rating)
  Subwatersheds: upper mainstem Cowlitz Basin (all moderately impaired or impaired subwatersheds in the basin except for 30801, 30802, 30701); Cispus (all moderately impaired or impaired subwatersheds in the basin)
2nd- Moderately impaired or impaired subwatersheds contributing to Tier 2 reaches
  Subwatersheds: upper mainstem Cowlitz (30801, 30802, 30701)
3rd- Moderately impaired or impaired subwatersheds contributing to Tier 3 or 4 reaches
  Subwatersheds: Tilton (entire basin)
4th- All remaining subwatersheds

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program		✓
USFS	Northwest Forest Plan, Habitat Projects	✓	
Lewis Conservation District / NRCS	Agricultural Habitat Restoration Programs		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Lewis County	Comprehensive Planning		✓
City of Mossyrock	Comprehensive Planning		✓
City of Morton	Comprehensive Planning		✓

Program Sufficiency and Gaps

Forest management programs including the Northwest Forest Plan (federal timber lands), new Forest Practices Rules (private timber lands), and the WDNR HCP (state timber lands) are expected to afford protections that will passively and actively restore degraded hillslope conditions. Timber harvest rules are expected to passively restore sediment and runoff processes. The road maintenance and abandonment requirements for private timber lands are expected to actively address road-related impairments within a 15 year time-frame. While these strategies are believed to be largely adequate to protect watershed processes, the degree of implementation and the effectiveness of the prescriptions will not be fully known for at least another 15 or 20 years. Of particular concern is the capacity of some forest land owners, especially small forest owners, to conduct the necessary road improvements (or removal) in the required timeframe. Additional financial and technical assistance would enable small forest landowners to conduct the necessary improvements in a timeline parallel to large industrial timber land owners. Ecological restoration of existing developed and agricultural lands occurs relatively infrequently and there are no programs that specifically require restoration in these areas. Restoring existing developed and farmed lands can involve retrofitting facilities with new materials, replacing existing systems, adopting new management practices, and creating or re-configuring landscaping. Means of increasing restoration activity include increasing landowner participation through education and incentive programs, building support for projects on public lands/facilities, requiring Best Management Practices through permitting and ordinances, and increasing available funding for entities to conduct projects.

Habitat Measure #6 - Restore riparian conditions throughout the basin

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore the natural riparian plant community B. Exclude livestock from riparian areas C. Eradicate invasive plant species from riparian areas	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or invasive species	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to agriculture and residential development	All species	There is a high potential benefit due to the many limiting factors that are addressed. Riparian impairment is related to most land-uses and is a concern throughout the basin. The increasing abundance of exotic and invasive species is of particular concern. Riparian restoration projects are relatively inexpensive and are often supported by landowners.

Priority Locations

1st- Tier 1 reaches
2nd- Tier 2 reaches
3rd- Tier 3 reaches
4th- Tier 4 reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program		✓
USFS	Northwest Forest Plan, Habitat Projects	✓	
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Lewis Conservation District / NRCS	Agricultural Habitat Restoration Programs		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Education, Control, Enforcement		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring riparian conditions; however, existing programs will afford protections that will allow for the *passive* restoration of riparian forests. These protections are believed to be adequate for riparian areas on forest lands that are subject to Forest Practices Rules or the State forest lands HCP. Other lands receive variable levels of protection and passive restoration through the local government comprehensive plans. Many degraded riparian zones in urban, agricultural, rural residential, or transportation corridors will not passively restore with existing regulatory protections and will require active measures. Riparian restoration in these areas may entail livestock exclusion, tree planting, road relocation, invasive species eradication, and adjusting current land-use in the riparian zone. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

Habitat Measure #7 – Restore degraded water quality with emphasis on temperature impairments

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Increase riparian shading B. Decrease channel width-to-depth ratios	• Altered stream temperature regime	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to rural development and agriculture	• All species	Several reaches within the Cispus Basin are listed on the 2002-2004 draft 303(d) list for temperature impairment. Restoration of riparian vegetation and a reduction in elevated width-to-depth ratios would present the greatest potential benefit.

Priority Locations

1st- Tier 1 or 2 reaches with 303(d) listings (2002-2004 draft list)
  Reaches: Cispus 1F (temperature); Yellowjacket 1 (temperature)
2nd- Other reaches with 303(d) listings
  Reaches: Yellowjacket 2 (temperature); Greenhorn Cr 1 (temperature); Cispus 1E, 1D (temperature); Iron Cr 1 (temperature)
3rd- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Washington Department of Ecology	Water Quality Program		✓
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program		✓
USFS	Northwest Forest Plan, Habitat Projects	✓	
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Lewis Conservation District / NRCS	Agricultural Habitat Restoration Programs, Centennial Clean Water		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Lewis County Health Department	Septic System Program		✓

Program Sufficiency and Gaps

The WDOE Water Quality Program manages the State 303(d) list of impaired water bodies. There are several listings in the Cispus Basin for temperature (WDOE 2004). A Water Quality Clean-up Plan (TMDL) is required by the WDOE and it is anticipated that the TMDL will adequately set forth strategies to address the temperature impairments. It will be important that the strategies specified in the TMDLs are implementable and adequately funded. The 303(d) listings are believed to address the primary water quality concerns; however, other impairments may exist that the current monitoring effort is unable to detect. Additional monitoring is needed to fully understand the degree of water quality impairment in the basin, especially regarding agricultural pollutants.

Habitat Measure #8 – Provide for adequate instream flows during critical periods

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect instream flows through water rights closures and enforcement B. Restore instream flows through acquisition of existing water rights C. Restore instream flows through implementation of water conservation measures	• Stream flow – maintain or improve flows during low-flow Summer months	• Water withdrawals	All species	Instream flow management strategies for the Upper Cowlitz Basin have been identified as part of Watershed Planning for WRIA 26 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies. This measure applies to instream flows associated with water withdrawals and diversions, generally a concern only during low flow periods. Hydropower regulation and hillslope processes also affect low flows but these issues are addressed in separate measures.

Priority Locations

Entire Basin

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Washington Department of Ecology	Water Resources Program		✓
WRIA 25/26 Watershed Planning Unit	Watershed Planning		✓
Town of Mossyrock	Water Supply Program		✓

Program Sufficiency and Gaps

The Water Resources Program of the WDOE, in cooperation with the WDFW and other entities, manages water rights and instream flow protections. A collaborative process for setting and managing instream flows was launched in 1998 with the Watershed Planning Act (HB 2514), which called for the establishment of local watershed planning groups who's objective was to recommend instream flow guidelines to WDOE through a collaborative process. The current status of this planning effort is to adopt a watershed plan by December 2004. Instream flow management in the Upper Cowlitz Basin will be conducted using the recommendations of the WRIA 25/26 Planning Unit, which is coordinated by the LCFRB. Draft products of the WRIA 25/26 watershed planning effort can be found on the LCFRB website: www.lcfrb.gen.wa.us. The recommendations of the Planning Unit have been developed in close coordination with recovery planning and the instream flow prescriptions developed by this group are anticipated to adequately protect instream flows necessary to support healthy fish populations. The measures specified above are consistent with the planning group's recommended strategies. It is important for WDOE to follow the instream flow rule-making recommendations of the Planning Unit.

Habitat Measure #9 – Restore access to habitat blocked by artificial barriers

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore access to isolated habitats blocked by culverts, dams, or other barriers	• Blockages to channel habitats • Blockages to off-channel habitats	• Dams, culverts, in-stream structures	Spring chinook, fall chinook, winter steelhead, coho	There are many blockages in the Tilton, Cispus, Upper Cowlitz, and reservoir tributaries basins. Many of these are inadequately sized culverts at road crossings. The full extent of these blockages is unknown.

Priority Locations

1st- Many tributary streams with blockages

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
USFS	Northwest Forest Plan, Habitat Projects		✓
WDNR	Forest Practices Rules, Family Forest Fish Passage, State Forest Lands HCP		✓
WDFW	Habitat Program		✓
Washington Department of Transportation / WDFW	Fish Passage Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Lewis County	Roads		✓

Program Sufficiency and Gaps

The Forest Practices Rules require forest landowners to restore fish passage at artificial barriers by 2016. Small forest landowners are given the option to enroll in the Family Forest Fish Program in order to receive financial assistance to fix blockages. The USFS has identified and repaired many blockages as a part of on-going programs. The Washington State Department of Transportation, in a cooperative program with WDFW, manages a program to inventory and correct blockages associated with state highways. The Salmon Recovery Funding Board, through the Lower Columbia Fish Recovery Board, funds barrier removal projects. Past efforts have corrected major blockages and have identified others in need of repair. Additional funding is needed to correct remaining blockages. Further monitoring and assessment is needed to ensure that all potential blockages have been identified and prioritized.

Habitat Measure #10 - Restore channel structure and stability

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting B. Structurally modify channel morphology to create suitable habitat C. Restore natural rates of erosion and mass wasting within river corridors	• Lack of stable instream woody debris • Altered habitat unit composition • Reduced bank/soil stability • Excessive fine sediment • Excessive turbidity • Embedded substrates	• None (symptom-focused restoration strategy)	All species	Large wood installation projects could benefit habitat conditions in many areas although watershed processes contributing to wood deficiencies should be considered and addressed prior to placing wood in streams. Other structural enhancements to stream channels may be warranted in some places, especially in lowland alluvial reaches that have been simplified through channel straightening and confinement.

Priority Locations

1st- Tier 1 reaches
2nd- Tier 2 reaches
3rd- Tier 3 reaches
4th- Tier 4 reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
USFS	Northwest Forest Plan, Habitat Projects		
WDFW	Habitat Program		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Lewis Conservation District / NRCS	Landowner technical assistance, Farm Planning, Conservation Programs (e.g. CREP)		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring channel stability and structure. Passive restoration is expected to slowly occur as a result of protections afforded to riparian areas and hillslope processes. Past projects have largely been opportunistic and have been completed due to the efforts of local NGOs, landowners, and government agencies; such projects are likely to continue in a piecemeal fashion as opportunities arise and if financing is made available. The lack of LWD in stream channels, and the importance of wood for habitat of listed species, places an emphasis on LWD supplementation projects. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

Table 25. Habitat actions for the Upper Cowlitz Basin

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
U-Cowl 1. Restore access above hydropower system	Expansion of existing program or activity	Tacoma Power, Lewis County PUD, FERC	1	High: the system of dams on the Cowlitz blocks volitional anadromous access to approximately 300 miles of habitat	High: Increased spawning and rearing capacity due to access to blocked habitat	High
U-Cowl 2. Continue to manage federal forest lands according to the Northwest Forest Plan	Activity is currently in place	USFS	2, 3, 5, 6, 7 & 9	High: National Forest and National Monument lands in the upper basin	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	High
U-Cowl 3. Conduct floodplain restoration where feasible along the upper mainstem Cowlitz and the middle mainstem Tilton. Build partnerships with landowners and provide financial incentives	New program or activity	NRCS, LCD, NGOs, WDFW, LCFRB, USACE, LCFEG	4, 6, 7, 9 & 10	Medium: Upper mainstem Cowlitz and middle mainstem Tilton	High: Restoration of floodplain function, habitat diversity, and habitat availability.	High
U-Cowl 4. Fully implement and enforce the Forest Practices Rules (FPRs) on private timber lands in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	2, 3, 5, 6, 7 & 9	High: Private commercial timber lands	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
U-Cowl 5. Expand standards in local government comprehensive plans to afford adequate protections of ecologically important areas (i.e. stream channels, riparian zones,	Expansion of existing program or activity	Lewis County, City of Morton, Town of Mossyrock	2 & 3	Medium: Private lands under local jurisdiction (Tilton Basin, Reservoir Basins, and the	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment	High

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[1] Relative amount of basin affected by action

[2] Expected response of action implementation

[3] Relative certainty that expected results will occur as a result of full implementation of action

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
floodplains, CMZs, wetlands, unstable geology)				mainstem Cowlitz valley from Lake Scanewa to Coal Creek)	supply processes	
U-Cowl 6. Prevent floodplain impacts from new development through land use controls and Best Management Practices	New program or activity	Lewis County, WDOE	2	Medium: Private lands under County jurisdiction (Tilton Basin, Reservoir Basins, and the mainstem Cowlitz valley from Lake Scanewa to Coal Creek)	High: Protection of floodplain function, CMZ processes, and off-channel/side-channel habitat. Prevention of reduced habitat diversity and key habitat availability	High
U-Cowl 7. Manage future growth and development patterns to ensure the protection of watershed processes. This includes limiting the conversion of lands to developed uses through zoning regulations and tax incentives	Expansion of existing program or activity	Lewis County, City of Morton, Town of Mossyrock	2 & 3	Medium: Private lands under County jurisdiction (Tilton Basin, Reservoir Basins, and the mainstem Cowlitz valley from Lake Scanewa to Coal Creek)	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
U–Cowl 8. Implement the prescriptions of the WRIA 25/26 Watershed Planning Unit regarding instream flows	Activity is currently in place	WDOE, WDFW, WRIA 25/26 Planning Unit, Lewis County, City of Morton, Town of Mossyrock	8	High: Entire basin	Medium: Adequate instream flows to support life stages of salmonids and other aquatic biota.	Medium
U-Cowl 9. Increase the level of implementation of voluntary habitat enhancement projects in high priority reaches and subwatersheds. This includes building partnerships, providing incentives to landowners, and increasing funding	Expansion of existing program or activity	LCFRB, BPA (NPCC), NGOs, WDFW, NRCS, Lewis CD, LCFEG	4, 5, 6, 7, 9 & 10	High: Priority stream reaches and subwatersheds throughout the basin	Medium: Improved conditions related to water quality, LWD quantities, bank stability, key habitat availability, habitat diversity, riparian function, floodplain function, sediment availability, & channel migration processes	Medium
U-Cowl 10. Increase technical support and funding to small forest landowners faced with implementation of Forest	Expansion of existing program or	WDNR	2, 3, 5, 6, 7 & 9	Low: Small private timberland owners	High: Reduction in road-related fine sediment delivery; restoration and preservation of fish access to	Medium

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
and Fish requirements for fixing roads and barriers to ensure full and timely compliance with regulations	activity				habitats	
U-Cowl 11. Increase funding available to purchase easements or property in sensitive areas where existing programs may not be able to fully protect watershed function	Expansion of existing program or activity	LCFRB, NGOs, WDFW, USFWS, BPA (NPCC)	2 & 3	Low: Private lands in sensitive areas at risk of further degradation (e.g. small timber parcels in floodplains at risk of development)	High: Protection of riparian function, floodplain function, water quality, wetland function, and runoff and sediment supply processes	High
U-Cowl 12. Increase technical assistance to landowners and increase landowner participation in conservation programs that protect and restore habitat and habitat-forming processes. Includes increasing the incentives (financial or otherwise) and increasing program marketing and outreach	Expansion of existing program or activity	NRCS, Lewis CD, WDNR, WDFW, Lewis County	2, 3, 4, 5, 6, 7, 8, 9 & 10	Medium: Private lands. Applies primarily to lands in agricultural or forestry uses	High: Increased landowner stewardship of habitat. Potential improvement in all factors	Medium
U-Cowl 13. Assess the impact of fish passage barriers throughout the basin and restore access to potentially productive habitats (passage obstruction at mainstem dams is considered in a separate action)	Expansion of existing program or activity	WDFW, WDNR, Lewis County, WSDOT, LCFEG, USFS	9	Medium: There are many artificial barriers throughout the Tilton, Cispus, and Upper Mainstem Cowlitz Basins	Medium: Increased spawning and rearing capacity due to access to blocked habitat. Habitat is believed to be marginal in most cases	High
U-Cowl 14. Conduct forest practices on state lands in accordance with the Habitat Conservation Plan in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	2, 3, 5, 6, 7 & 9	Low: State timber lands in the U. Cowlitz Basin (approximately 2% of the basin area)	Medium: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats. Response is medium because of location and quantity of state lands	Medium
U-Cowl 15. Protect and restore native plant communities from the effects of invasive species	Expansion of existing program or activity	Weed Control Boards (local and state); NRCS, Lewis	2 & 6	Medium: Greatest risk is in agriculture and residential use areas	Medium: restoration and protection of native plant communities necessary to support watershed and riparian function	Low

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
		CD, LCFEG				
U-Cowl 16. Assess, upgrade, and replace on-site sewage systems that may be contributing to water quality impairment	Expansion of existing program or activity	Lewis County, Lewis CD	7	Low: Private agricultural and rural residential lands	Medium: Protection and restoration of water quality (bacteria)	Medium
U-Cowl 17. Monitor an notify FERC of significant license violations, enforce terms and conditions of section 7 consultations on FERC relicensing agreements, and encourage implementation of section 7 conservation recommendations on FERC relicensing agreements	Activity is currently in place	NOAA, USFWS		High: Entire basin	High: Adequate flows for life stage requirements and habitat-forming processes, protection of water quality, increased habitat availability for spawning and rearing	High
U-Cowl 18. Review and adjust operations to ensure compliance with the Endangered Species Act; examples include roads, parks, and weed management	Expansion of existing program or activity	Lewis County, Mossyrock, Morton,	2, 5, 6, & 7	Low: Applies to lands under public jurisdiction	Medium: Protection of water quality, greater streambank stability, reduction in road-related fine sediment delivery, restoration and preservation of fish access to habitats	High

5.5 Hatcheries

5.5.1 *Subbasin Hatchery Strategy*

The desired future state of fish production within the Upper Cowlitz Basin includes natural salmon and steelhead populations that are improving on a trajectory to recovery and hatchery programs that either enhance the natural fish recovery trajectory or are operated to not impede progress towards recovery. Hatchery recovery actions in each subbasin are tailored to the specific ecological and biological circumstances for each species in the subbasin. This often involves substantial changes in many hatchery programs from their historical focus on production for mitigation. The recovery strategy includes a mixture of conservation programs and mitigation programs for lost fishing benefits. Mitigation programs involve areas or practices selected for consistency with natural population conservation and recovery objectives. A summary of the types of natural production enhancement strategies and fishery enhancement strategies to be implemented in the Upper Cowlitz Basin are displayed by species in Table 26. More detailed descriptions and discussion of the regional hatchery strategy can be found in the Regional Recovery and Subbasin Plan Volume I.

Table 26. Summary of natural production and fishery enhancement strategies to be implemented in the Upper Cowlitz River Basin.

		Fall Chinook	Spring Chinook	Coho	Chum	Winter Steelhead
Natural Production Enhancement	**Supplementation**		✓	✓		✓
	Hatch/Nat Conservation [1/]		✓			
	Isolation					✓[2/]
	Refuge					
Fishery Enhancement	**Hatchery Production**					

[1/] Hatchery and natural population management strategy implemented to meet biological recovery objectives. Strategy may include integration and/or isolation over time. Strategy will be unique to biological and ecological circumstances in each watershed.

[2/] Includes isolation from non-indigenous hatchery steelhead stocks only

Conservation-based hatchery programs include strategies and actions which are specifically intended to enhance or protect production of a particular wild fish population within the basin. A unique conservation strategy is developed for each species and watershed depending on the status of the natural population, the biological relationship between the hatchery and natural populations, ecological attributes of the watershed, and logistical opportunities to jointly manage the populations. Four types of hatchery conservation strategies may be employed:

Natural Refuge Watersheds: In this strategy, certain sub-basins are designated as wild-fish-only areas for a particular species. The refuge areas include watersheds where populations have persisted with minimum hatchery influence and areas that may have a history of hatchery production but would not be subjected to future hatchery influence as part of the recovery strategy. More refuge areas may be added over time as wild populations recover. These refugia provide an opportunity to monitor population trends independent of the confounding influence of hatchery fish natural and will be key indicators of natural population status within the ESU. The upper Cowlitz could become a refuge area for spring chinook, coho, or steelhead in the future if natural populations are sustainable without supplementation.

Hatchery Supplementation: This strategy utilizes hatchery production as a tool to assist in rebuilding depressed natural populations. Supplementation would occur in selected areas that are producing natural fish at levels significantly below current capacity or capacity is expected to increase as a result of immediate benefits of habitat or passage improvements. This is intended to be a temporary measure to jump start critically low populations and to bolster natural fish numbers above critical levels in selected areas until habitat is restored to levels where a population can be self sustaining. This strategy would include spring Chinook and coho in the upper Cowlitz Basin.

Hatchery/Natural Isolation: This strategy is focused on physically separating hatchery adult fish from naturally-produced adult fish to avoid or minimize spawning interactions to allow natural adaptive processes to restore native population diversity and productivity. The strategy may be implemented in the entire watershed or more often in a section of the watershed upstream of a barrier or trap where the hatchery fish can be removed. This strategy is currently aimed at hatchery steelhead in watersheds with trapping capabilities. The strategy may also become part of spring and fall chinook as well as coho strategy in certain watersheds in the future as unique wild runs develop. This definition refers only to programs where fish are physically sorted using a barrier or trap. Some fishery mitigation programs, particularly for steelhead, are managed to isolate hatchery and wild stocks based on run timing and release locations. This strategy is currently included for winter steelhead in the upper Cowlitz where early-timed hatchery produced steelhead are not passed upstream of the dams..

Hatchery/Natural Merged Conservation Strategy: This strategy addresses the case where natural and hatchery fish have been homogenized over time such that they are principally all one stock that includes the native genetic material for the basin. Many spring chinook, fall chinook, and coho populations in the lower Columbia currently fall into this category. In many cases, the composite stock productivity is no longer sufficient to support a self-sustaining natural population especially in the face of habitat degradation. The hatchery program will be critical to maintaining any population until habitat can be improved and a strictly natural population can be re-established. This merged strategy is intended to transition these mixed populations to a self-supporting natural population that is not subsidized by hatchery production or subject to deleterious hatchery impacts. Elements include separate management of hatchery and natural subpopulations, regulation of hatchery fish in natural areas, incorporation of natural fish into hatchery broodstock, and annual abundance-driven distribution. Corresponding programs are expected to evolve over time dependent on changes in the populations and in the habitat productivity. This strategy is primarily aimed at chinook salmon in areas where harvest production occurs, which applies to spring Chinook in the upper Cowlitz.

Not every lower Columbia River hatchery program will be turned into a conservation program. The majority of funding for lower Columbia basin hatchery operations is for producing salmon and steelhead for harvest to mitigate for lost harvest of natural production due to hydro development and habitat degradation. Programs for fishery enhancement will continue during the recovery period, but will be managed to minimize risks and ensure they do not compromise recovery objectives for natural populations. It is expected that the need to produce compensatory fish for harvest through artificial production will reduce in the future as natural populations recover and become harvestable. There are fishery enhancement programs for spring Chinook, coho, and winter steelhead in the Upper Cowlitz Basin.

The Cowlitz Complex Hatchery programs will be operated to include natural production enhancement strategies for upper Cowlitz spring Chinook. The Cowlitz Hatchery Complex will continue to support upper Cowlitz spring Chinook, coho, and winter steelhead with hatchery releases in the Upper Cowlitz Basin. Fall Chinook will not be included as a component of the hatchery program in the Upper Cowlitz. There are no new conservation programs for the Upper Cowlitz in this plan.

5.5.2 *Hatchery Measures and Actions*

Hatchery strategies and measures are focused on evaluating and reducing biological risks consistent with the conservation strategies identified for each natural population. Artificial production programs within Upper Cowlitz River facilities have been evaluated in detail through the WDFW Benefit-Risk Assessment Procedure (BRAP) relative to risks to natural populations. The BRAP results were utilized to inform the development of these program actions specific to the Upper Cowlitz River Basin (Table 28). The Sub-Basin plan hatchery recovery actions were developed in coordination with WDFW and at the same time as the Hatchery and Genetic Management Plans (HGMP) were developed by WDFW for each hatchery program. As a result, the hatchery actions represented in this document will provide direction for specific actions which will be detailed in the HGMPs submitted by WDFW for public review and for NOAA fisheries approval. It is expected that the HGMPs and these recovery actions will be complimentary and provide a coordinated strategy for the Upper Cowlitz River Basin hatchery programs. Further explanation of specific strategies and measures for hatcheries can be found in the Regional Recovery and Subbasin Plan Volume I.

Table 27. A summary of conservation and harvest strategies to be implemented through Upper Cowlitz Hatchery programs.

	Conservation Programs				**Harvest Programs**	
Hatchery	**Supplementation**	**Hatchery/Natural Strategy[1/]**	**Isolation**	**Broodstock Development**	**In-Basin Released (final rearing site)**	**Out of Basin Releases (final rearing site)**
Cowlitz Complex	*L. Cowlitz Coho √* ***U. Cowlitz Spring Chinook*** *U. Cowlitz Coho* ***U. Cowlitz Winter Steelhead*** *Lower Columbia Chum √*	*L. Cowlitz Fall Chinook √* ***U. Cowlitz Spring Chinook***	*U. Cowlitz Winter Steelhead* [2/]	*Cowlitz Chum √* ***Cowlitz Late Winter Steelhead***	*Cowlitz Late Coho* ***Cowlitz Fall Chinook*** *Cowlitz Spring Chinook* ***Cowlitz Winter Steelhead*** *Cowlitz Summer Steelhead* ***Cowlitz Sea-run Cutthroat***	

[1/] May include integrated and/or isolated strategy over time.

[2/] Includes isolation from early-timed winter steelhead stocks

√ Denotes new program

Table 28. Hatchery program actions to be implemented in the Upper Cowlitz River Basin.

Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Action	Expected Outcome
** Conservation management strategy implemented for spring chinook hatchery production and upper Cowlitz natural spring chinook. *preclude outside basin transfers of spring chinook, steelhead and coho eggs or juveniles for release into the upper Cowlitz basin	Cowlitz Salmon Hatchery coho, and spring chinook. Cowlitz Trout Hatchery late-winter steelhead.	upper Cowlitz spring chinook, winter steelhead, and coho	Domestication Diversity Abundance	• Non-local genetic traits	• Reintroduction program for spring chinook would include development of a biologically appropriate relationship and management strategy for hatchery and wild brood stock program over time. • Winter steelhead supplementation into the upper basin would only use late-winter Cowlitz Basin brood stock. Early winter stock for lower Cowlitz harvest only. • Coho supplementation into the upper Basin would only utilize Cowlitz late stock coho. • Continue long-standing WDFW policy of	• Increased genetic diversity in natural and hatchery spring chinook populations • Spring chinook, coho, and steelhead stocks are ecologically adapted to upper Cowlitz habitat resulting in adequate productivity and abundance to sustain populations upstream of the hydro system.

Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Action	Expected Outcome
					no outside chinook and coho transfers into the basin	
*Adipose fin-clip mark hatchery produced coho, spring chinook, steelhead, and sea-run cutthroat released in the lower Cowlitz *Blank wire-tag Mayfield Dam collected fish and do not mark or tag natural fish produced upstream of Cowlitz Falls Dam.	Cowlitz Salmon Hatchery fall chinook spring chinook and coho. Cowlitz Trout Hatchery steelhead and cutthroat.	Upper Cowlitz and Cispus spring chinook, coho, and winter steelhead, and Tilton winter steelhead and coho.	Domestication, Diversity, Abundance	• In-breeding • Harvest	• Continue 100 percent mark of hatchery produced steelhead, coho, spring chinook, and sea-run cutthroat released into the lower Cowlitz. • Tag w/o fin-clip mark Mayfield trapped coho, steelhead, and chinook to distinguish from natural production collected upstream at Cowlitz falls and hatchery production released into the lower Cowlitz. • Do not mark or tag (except small experimental groups) natural spring chinook, coho, or steelhead collected at Cowlitz Falls Dam. Unmarked or tagged adults will be identified as natural production from the upper Cowlitz and Cispus basins.	• Maintain selective fishery opportunity for spring chinook, coho, steelhead, and sea-run cutthroat, and only incidental harvest impacts to natural produced fish. • Enable visual identification of hatchery and wild returns to provide the means to account for and manage the hatchery and wild escapement consistent with biological objectives • Enable sorting of upper Cowlitz , Cispus, and Tilton natural produced adults for transport and distribution to appropriate habitats for spawning • Minimize handling impacts to the vast majority of natural produced juveniles, resulting in increased abundance to the most productive habitats in the upper Cowlitz and Cispus rivers.
**Cowlitz Basin hatchery facilities utilized for supplementation and enhancement of natural coho, spring chinook, and late winter steelhead populations	Cowlitz Hatchery late coho, late winter steelhead, and spring chinook.	Upper Cowlitz and Cispus coho, winter steelhead, and spring chinook. Tilton coho and late winter steelhead. c	Abundance, Spatial distribution	• Low numbers of natural spawners • Ecologically appropriate natural brood stock •	• Develop a coho brood stock using the latest (December-January) arriving late hatchery coho. Utilize production from the existing programs and new late program to supplement wild coho production in the upper Cowlitz tributaries and for harvest. • Continue to propagate late returning winter steelhead as brood stock for supplementing upper Cowlitz natural production until a self-sustaining population is established • Utilize current hatchery spring chinook brood stock to supplement upper Cowlitz and Cispus natural production until a self	• Development of a late-timed hatchery brood stock would increase diversity and develop similar to the historical populations in the Cowlitz Basin. Improve abundance and distribution of natural produced coho. • Late winter steelhead self-sustaining population developed that is ecologically adapted to the upper basin habitat. • Spring chinook self-sustaining

Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Action	Expected Outcome
					sustaining population is established. Maintain integrated brood stock in the hatchery indefinitely for risk management purposes.	population developed that is ecologically adapted to the upper basin habitat. • Coho self-sustaining population is ecologically adapted to the watershed. • Hatchery brood stock is available for continued supplementation as needed.
*Evaluate facilities and operations for reintroduction of salmon and steelhead	Spring chinook, steelhead, coho	Spring chinook, steelhead, and coho	Abundance, spatial distribution	• Juvenile collection efficiency • Adult collection and sorting • Handling, transport, stress relief	• Juvenile collection efficiency improvements are made at Cowlitz Falls Dam to ensure replacement of spring chinook, coho, and winter steelhead natural production. • Trapping and sorting facilities at Cowlitz Salmon Hatchery are evaluated to ensure efficient and low stress handling of adults prior to distribution. • Hatchery trucks are adequate in number and capacity to handle peak periods of juvenile and adult transport without overloading. • Pond space and water quality is adequate to supply stress relief for Cowlitz Falls collected juveniles prior to release into the lower Cowlitz River	• Passage survival of adult and juvenile spring chinook, coho, and steelhead produced in the upper Cowlitz basin is high enough to enable a self-sustaining population to be developed. • Handling, sorting, and stress relief facilities provide low impact to the natural produced salmon and steelhead from the upper basin.
** Monitoring and evaluation, adaptive management	All species	All species	Hatchery production performance, Natural production performance	• All of above	• Research, monitoring , and evaluation of performance of the above actions in relation to expected outcomes • Performance standards developed for each actions with measurable criteria to determine success or failure • Adaptive Management applied to adjust or change actions as necessary	• Clear standards for performance and adequate monitoring programs to evaluate actions. • Adaptive management strategy reacts to information and provides clear path for adjustment or change to meet performance standard

* Extension or improvement of existing actions-may require additional funding
** New action-will likely require additional funding

5.6 Harvest

Fisheries are both an impact that reduces fish numbers and an objective of recovery. The long-term vision is to restore healthy, harvestable natural salmonid populations in many areas of the lower Columbia basin. The near-term strategy involves reducing fishery impacts on natural populations to ameliorate extinction risks until a combination of actions can restore natural population productivity to levels where fishing that targets current ESA-listed stocks may resume. The regional strategy for interim reductions in fishery impacts involves: 1) elimination of directed fisheries on natural populations, 2) regulation of mixed stock fisheries for healthy hatchery and natural populations to limit and minimize indirect impacts on natural populations, 3) scaling of allowable indirect impacts for consistency with recovery, 4) annual abundance-based management to provide added protection in years of low abundance while allowing greater fishing opportunity consistent with recovery in years with higher abundance, and 5) mass marking of hatchery fish for identification and selective fisheries.

Actions to address harvest impacts are generally focused at a regional level to cover fishery impacts accrued to lower Columbia salmon as they migrate along the Pacific Coast and through the mainstem Columbia River. Fisheries are no longer directed at weak natural populations but incidentally catch these fish while targeting healthy wild and hatchery stocks. Subbasin fisheries affecting natural populations have been largely eliminated. Fishery management has shifted from a focus on maximum sustainable harvest of the strong stocks to ensuring protection of the weak stocks. Weak stock protections often preclude access to large numbers of otherwise harvestable fish in strong stocks.

Fishery impact limits to protect ESA-listed weak populations are generally based on risk assessments that identify points where fisheries do not pose jeopardy to the continued persistence of a listed group of fish. In many cases, these assessments identify the point where additional fishery reductions provide little reduction in extinction risks. A population may continue to be at significant risk of extinction but those risks are no longer substantially affected by the specified fishing levels. Often, no level of fishery reduction will be adequate to meet naturally-spawning population escapement goals related to population viability. The elimination of harvest will not in itself lead to the recovery of a population. However, prudent and careful management of harvest can help close the gap in a coordinated effort to achieve recovery.

Fishery actions specific to the subbasins are addressed through the Washington State Fish and Wildlife sport fishing regulatory process. This public process includes an annual review focused on emergency type regulatory changes and a comprehensive review of sport fishing regulations which occurs every two years. This regulatory process includes development of fishing rules through the Washington Administrative Code (WAC) which are focused on protecting weak stock populations while providing appropriate access to harvestable populations. The actions consider the specific circumstances in each area of each subbasin and respond with rules that fit the relative risk to the weak populations in a given time and area of the subbasin. Regulatory and protective fishery actions pertaining to salmon and steelhead in the upper Cowlitz are presented in Table 26. Additional sport fishing rule detail can be found in the WDFW sport fishing regulation pamphlet.

Regional actions cover species from multiple watersheds which share the same migration routes and timing, resulting in similar fishery exposure. Regional strategies and measures for harvest are detailed in the Regional Recovery and Subbasin Plan Volume I. A number of regional strategies for harvest involve implementation of actions within specific subbasins. In-basin fishery management is generally applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest actions with significant application to the Upper Cowlitz Subbasin populations are summarized in Table 30.

Table 29. Summary of sport fishing regulatory and protective actions in the Upper Cowlitz.

Species	General Fishing Actions	Explanation	Other Protective Fishery Actions	Explanation
Spring Chinook	Retain only adipose fin-clipped Chinook	Selective fishery for hatchery Chinook, unmarked/ reintroduced wild spring Chinook must be released	Minimum size restrictions	Minimum size protects juveniles
Coho	Retain only adipose fin-clip marked coho	Selective fishery for hatchery coho, unmarked/reintroduced wild coho must be released	Minimum size restrictions. Small tributaries and Upper reaches of Cispus and Cowlitz closed	Closures protect wild spawners in tributary creeks and upper watersheds. Minimum size protects juveniles
Winter steelhead	Retain only fin-clipped steelhead in the Cispus River	Selective fishery for hatchery steelhead in Cispus to protect wild fish produced from the reintroduction program	Steelhead and trout fishing closed in the spring and minimum size restrictions in affect	Spring closure Protects adult wild steelhead during spawning and minimum size protects juvenile steelhead

Table 30. Regional harvest actions from Volume I, Chapter 7 with significant application to the Upper Cowlitz River Subbasin populations.

Action	Description	Responsible Parties	Programs	Comments
*F.A13	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Includes monitoring of naturally-spawning steelhead encounter rates in fisheries and refinement of long-term catch and release handling mortality estimates. Would include assessment of the current monitoring programs and determine their adequacy in formulating naturally-spawning steelhead incidental mortality estimates.
*F.A14	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Regulatory agencies should continue to refine gear, handle and release methods, and seasonal options to minimize mortality of naturally-spawning steelhead in commercial and sport fisheries.
*F.A20	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	WDFW, NOAA, ODFW, USFWS	PFMC, Columbia Compact, BPA Fish and Wildlife Program, WDFW Creel	Mass marking of lower Columbia River coho and steelhead has enabled successful ocean and freshwater selective fisheries to be implemented since 1998. Marking programs should be continued and fisheries monitored to provide improved estimates of naturally-spawning salmon and steelhead release mortality.

* Extension or improvement of existing action
** New action

5.7 Hydropower

The hydropower system is the primary factor for decline in the upper Cowlitz basin. Historically, spawning grounds in the upper basin produced 20% of the fall Chinook and 38% of the steelhead in the Cowlitz basin (Mobrand Biometrics 1999). The hydropower facilities impede volitional access to upstream habitats. Furthermore, over 48 miles of stream habitat was flooded by the Mayfield, Mossyrock, and Cowlitz Falls Dams.

The hatchery Barrier Dam (RM 49) and Mayfield Dam (RM 52) prevent all volitional passage of anadromous fish above RM 52. A facility at the Barrier Dam collects coho, fall chinook, spring chinook, winter steelhead, and coastal cutthroat trout. Spring chinook, coho, and steelhead which originated above the hydro system, are separated from hatchery broodstock and hauled to appropriate locations in the upper Cowlitz basin. Upper Cowlitz Spring chinook are all released above Cowlitz Falls Dam, while coho, winter steelhead and cutthroat trout are identified (by tag or no tag) for release into either the Tilton or above Cowlitz Falls Dam. Outmigrating smolts are collected at the Cowlitz Falls Fish Collection Facility (CFFCF) above Cowlitz Falls Dam and are hauled below the Barrier Dam. Some fish may avoid collection at the CFFCF and pass through the Cowlitz Falls Dam turbines or through the dam spill. Passage of juvenile migrants through Riffe Lake is a major problem for maintaining sustainable anadromous fish runs in the upper basin. A 1999 study revealed that only 63% of radio tagged steelhead smolts traveled successfully from the Cowlitz Falls Dam tailrace to a collection facility at Mossyrock Dam. None of the tagged coho and Chinook were detected at Mossyrock. This study revealed potential problems with migration through the reservoir as well as problems with smolt collection at Mossyrock Dam (Harza 2000). Currently, there is no regular juvenile collection at Mossyrock Dam. Regular collection of downstream migrants was discontinued in 1974. The 606 foot tall Mossyrock Dam prevents access to several Riffe Lake tributaries, including Rainey Creek, which is believed to have a substantial amount of potentially productive habitat (Wade 2000). Radio-telemetry studies of coho and steelhead revealed a low (<50%) survival rate of juvenile migrants negotiating Mayfield Lake. Results could be due to predation, water quality, flow, or monitoring error (Harza 1999 as cited in Wade 2000). There is a juvenile collection facility at Mayfield Dam, where the fish are collected and tagged with a blank-wire to enable identification of the site they were collected as juveniles when they return as adults. Unmarked and untagged adults are released upstream of the Cowlitz Falls Dam, while unmarked and blank wire-tagged adults are released above Mayfield Dam to spawn in the Tilton River

Apart from the mainstem Cowlitz dams, passage problems in the Mayfield Lake basin include numerous culverts and road crossings in the Winston Creek, Connelly Creek, East Fork Tilton, South Fork Tilton, and West Fork Tilton basins. A full description is given in Wade (2000). Passage problems in the Cispus include subsurface flows in Copper Creek, Crystal Creek, and Camp Creek. A culvert in Woods Creek blocks approximately 1 mile of potential anadromous habitat. Subsurface and/or low flow conditions related to excessive sediment aggradation are believed to create passage problems in some areas of the upper Cowlitz basin. Ten such barriers are identified by the USFS (1997a and 1997b). The USFS has also identified several artificial barriers including culverts and other features.

5.8 Mainstem and Estuary Habitat

Upper Cowlitz River anadromous fish populations will also benefit from regional recovery strategies and measures identified to address habitat conditions and threats in the Columbia River mainstem and estuary. Regional recovery plan strategies involve: 1) avoiding large scale habitat changes where risks are known or uncertain, 2) mitigating small-scale local habitat impacts to ensure no net loss, 3) protecting functioning habitats while restoring impaired habitats to functional conditions, 4) striving to understand, protect, and restore habitat-forming processes, 5) moving habitat conditions in the direction of the historical template which is presumed to be more consistent with restoring viable populations, and 6) improving understanding of salmonid habitat use in the Columbia River mainstem and estuary and their response to habitat changes. A series of specific measures are detailed in the regional plan for each of these strategies.

5.9 Ecological Interactions

For the purposes of this plan, ecological interactions refer to the relationships of salmon and steelhead with other elements of the ecosystem. Regional strategies and measures pertaining to exotic or non-native species, effects of salmon on system productivity, and native predators of salmon are detailed and discussed at length in the Regional Recovery and Subbasin Plan Volume I and are not reprised at length in each subbasin plan. Strategies include 1) avoiding, eliminating introductions of new exotic species and managing effects of existing exotic species, 2) recognizing the significance of salmon to the productivity of other species and the salmon themselves, and 3) managing predation by selected species while also maintaining a viable balance of predator populations. A series of specific measures are detailed in the regional plan for each of these strategies. Implementation will occur at the regional and subbasin scale.

5.10 Monitoring, Research, & Evaluation

Biological status monitoring quantifies progress toward ESU recovery objectives and also establishes a baseline for evaluating causal relationships between limiting factors and a population response. Status monitoring involves routine and intensive efforts. Routine monitoring of biological data consists of adult spawning escapement estimates, whereas routine monitoring for habitat data consists of a suite of water quality and quantity measurements.

Intensive monitoring supplements routine monitoring for populations and basins requiring additional information. Intensive monitoring for biological data consists of life-cycle population assessments, juvenile and adult abundance estimates and adult run-reconstruction. Intensive monitoring for habitat data includes stream/riparian surveys, and continuous stream flow assessment. The need for additional water quality sampling may be identified. Rather than prescribing one monitoring strategy, three scenarios are proposed ranging in level of effort and cost from high to low (Level 1-3 respectively). Given the fact that routine monitoring is ongoing, only intensive monitoring varies between each level.

An in-depth discussion of the monitoring, research and evaluation (M, R & E) approach for the Lower Columbia Region is presented in the Regional Recovery and Management Plan. It includes site selection rationale, cost considerations and potential funding sources. The following tables summarize the biological and habitat monitoring efforts specific to the Upper Cowlitz subbasin.

Table 31. Summary of the biological monitoring plan for the upper Cowliltz and Cispus River populations.

Upper Cowlitz/Cispus: Lower Columbia Biological Monitoring Plan			
Monitoring Type	**Spring Chinook**	**Coho**	**Winter Steelhead**
Routine	AA	AA	AA
Intensive			
Level 1	×	×	×
Level 2	×	×	×
Level 3	×	×	×

AA Annual adult abundance estimates
✓ Adult and juvenile intensive biological monitoring occurs periodically on a rotation schedule (every 9 years for 3-year duration)
× Adult and juvenile intensive biological monitoring occurs annually

Table 32. Summary of the biological monitoring plan for the Tilton River populations.

Tilton: Lower Columbia Biological Monitoring Plan		
Monitoring Type	**Coho**	**Winter Steelhead**
Routine	AA	AA
Intensive		
Level 1	×	×
Level 2	×	×
Level 3	×	×

AA Annual adult abundance estimates
✓ Adult and juvenile intensive biological monitoring occurs periodically on a rotation schedule (every 9 years for 3-year duration)
× Adult and juvenile intensive biological monitoring occurs annually

Table 33. Summary of the habitat monitoring plan for the upper Cowliltz and Cispus River populations.

Upper Cowlitz/Cispus : Lower Columbia Habitat Monitoring Plan				
Monitoring Type	**Watershed**	**Existing stream / riparian habitat**	**Water quantity[3] (level of coverage)**	**Water quality [2] (level of coverage)**
Routine [1] (level of coverage)	Baseline complete	Good	Stream Gage-Good IFA-Poor	WDOE-Poor USGS-Moderate Temperature-Good
Intensive				
Level 1		✓		
Level 2				
Level 3				

IFAComprehensive Instream Flow Assessment (i.e. Instream Flow Incremental Methodology)
[1] Routine surveys for habitat data do not imply ongoing monitoring
[2] Intensive monitoring for water quality to be determined
[3] Water quantity monitoring may include stream gauge installation, IFA or low flow surveys

Table 34. Summary of the habitat monitoring plan for the Tilton River populations.

Tilton : Lower Columbia Habitat Monitoring Plan				
Monitoring Type	**Watershed**	**Existing stream / riparian habitat**	**Water quantity (level of coverage)**	**Water quality [2] (level of coverage)**
Routine [1] (level of coverage)	Baseline complete	Poor	Stream Gage-Good IFA-Poor	WDOE-Poor USGS-Poor Temperature-Poor
Intensive				
Level 1				
Level 2				
Level 3				

IFAComprehensive Instream Flow Assessment (i.e. Instream Flow Incremental Methodology)

[1] Routine surveys for habitat data do not imply ongoing monitoring

[2] Intensive monitoring for water quality to be determined

[3] Water quantity monitoring may include stream gauge installation, IFA or low flow surveys

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Subbasin Plan Vol. II.E.
Cowlitz Subbasin – Coweeman

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1.0 Coweeman River – Executive Summary

This plan describes a vision, strategy, and actions for recovery of listed salmon, steelhead, and trout species to healthy and harvestable levels, and mitigation of the effects of the Columbia River hydropower system in Washington lower Columbia River subbasins. Recovery of listed species and hydropower mitigation is accomplished at a regional scale. This plan for the Coweeman River Basin describes implementation of the regional approach within this subbasin, as well as assessments of local fish populations, limiting factors, and ongoing activities that underlie local recovery or mitigation actions. The plan was developed in a partnership between the Lower Columbia Fish Recovery Board (Board), Northwest Power and Conservation Council, federal agencies, state agencies, tribal nations, local governments, and others.

The Coweeman River joins the mainstem Cowlitz River at RM 17. This basin historically supported thousands of fall Chinook, coho, chum, and winter steelhead. Today, numbers of naturally spawning salmon and steelhead are far below historical numbers. Chinook, chum, and winter steelhead have been listed as Threatened under the Endangered Species Act and coho is proposed for listing. The decline has occurred over decades and the reasons are many. Habitat quality has been reduced by a number of land-use practices including forestry, agriculture, and residential development. In the lower mainstem, key habitats have been isolated or eliminated by channel modifications and diking, filling, or draining floodplains and wetlands. Altered habitat conditions have increased predation. Competition and interbreeding with domesticated or nonlocal hatchery fish has reduced productivity. Fish are harvested in fresh and saltwater fisheries.

All Coweeman River salmon and steelhead will need to be restored to a high level of viability to meet regional recovery objectives. This means that the populations are productive, abundant, exhibit multiple life history strategies, and utilize significant portions of the basin.

In recent years, government agencies and other entities have actively addressed threats to salmon and steelhead, but much remains to be done. One thing is clear: no single threat is responsible for the decline in these populations. All threats and limiting factors must be reduced if recovery is to be achieved. An effective recovery plan must also reflect a realistic balance within physical, technical, social, cultural and economic constraints. The decisions that govern how this balance is attained will shape the region's future in terms of watershed health, economic vitality, and quality of life.

This plan represents the current best estimation of necessary actions for recovery and mitigation based on thorough research and analysis of the various threats and limiting factors that impact Coweeman River fish populations. Specific strategies, measures, actions and priorities have been developed to address these threats and limiting factors. The specified strategies identify the best long term and short term avenues for achieving fish restoration and mitigation goals. While it is understood that data, models, and theories have their limitations and growing knowledge will certainly spawn new strategies, the Board is confident that by implementation of the recommended actions in this plan, the population goals in the Coweeman River Basin can be achieved. Success will depend on implementation of these strategies at the program and project level. It remains uncertain what level of effort will need to be invested in each area of impact to ensure the desired result. The answer to the question of precisely how much is enough is currently beyond our understanding of the species and ecosystems and can only be answered through ongoing monitoring and adaptive management against the backdrop of what is socially possible.

1.1 Key Priorities

Many actions, programs, and projects will make necessary contributions to recovery and mitigation in the Coweeman Basin. The following list identifies the most immediate priorities.

1. Manage Subbasin Forests to Restore Watershed Processes

Most of the Coweeman Basin is forested and forest management is critical to fish recovery. Past forest practices have reduced fish habitat quantity and quality by altering stream flow, increasing fine sediment, and degrading riparian zones in much of the basin. In addition, forest road culverts have blocked fish passage in small tributary streams. Effective implementation of new forest practices rules for private timber lands are expected to dramatically improve conditions by restoring passage, protecting riparian conditions, reducing sediment inputs, lowering water temperatures, improving flows, and restoring habitat diversity. Improvements will benefit all species, particularly winter steelhead and coho.

2. Manage Growth and Development to Protect Watershed Processes and Habitat Conditions

The human population in the basin is relatively low, but it is projected to grow by at least twenty percent in the next twenty years. The local economy is also in transition with reduced reliance on forest products and fisheries. These changes will provide a variety of risks and opportunities for preserving the rural character and local economic base while also protecting and restoring natural fish populations and habitats.

3. Restore Lower Mainstem Valley Floodplain Function and Stream Habitat Diversity

The lower stream reaches have been impacted by past agricultural use and are now impacted by residential development, urbanization, and transportation corridors. Dike building and bank stabilization have impacted fish habitat in these areas. Removing or modifying channel control and containment structures to reconnect the stream and its floodplain, where this is feasible and can be done without increasing risks of substantial flood damage, will restore normal habitat-forming processes to reestablish habitat complexity, off-channel habitats, and conditions favorable to fish spawning and rearing. These improvements will be particularly beneficial to fall Chinook, coho, and chum. Potentially restoring normal floodplain functions will also provide wetland and riparian habitats critical to other fish, wildlife, and plant species. Existing floodplain function and habitats will be protected through local land use ordinances, partnerships with landowners, and the acquisition of land, where appropriate. Restoration will be achieved by working with willing landowners, non-governmental organizations, conservation districts, and state and federal agencies. Existing land acquisition efforts along the lower mainstem valley just upstream of Kelso provide great floodplain restoration opportunities.

4. Address Immediate Risks with Short-term Habitat Fixes

Restoration of normal watershed processes that allow a basin to restore itself over time has proven to be the most effective strategy for long term habitat improvements. However, restoration of some critical habitats may take decades to occur. In the near term, it is important to initiate short-term measures to address current critical low numbers of some species. Examples in the Coweeman basin include construction of coho overwinter habitat with alcoves, side channels, or engineered log jams. Benefits will be temporary but will help bridge the period until normal habitat-forming processes are reestablished.

5. Align Hatchery Priorities Consistent with Conservation Objectives

Hatcheries throughout the Columbia basin historically focused on producing fish for fisheries as mitigation for hydropower development and widespread habitat degradation. Emphasis of hatchery production without regard for natural populations can pose risks to natural population viability. Hatchery priorities must be aligned to conserve natural populations, enhance natural fish recovery, and avoid impeding progress toward recovery while continuing to provide fish mitigation benefits. There are no hatcheries operating in the Coweeman Basin, however, a rearing pond on the Coweeman is used to acclimate winter steelhead from the Elochoman Hatchery.

6. Manage Fishery Impacts so they do not Impede Progress Toward Recovery

This near-term strategy involves limiting fishery impacts on natural populations to ameliorate extinction risks until a combination of measures can restore fishable natural populations. There is no ocean, Columbia River, or tributary fisheries that are directed towards harvest of ESA-listed Coweeman River salmon and steelhead This practice will continue until the populations are sufficiently recovered to withstand such pressure and remain self-sustaining. Some Coweeman River salmon and steelhead are incidentally taken in mainstem Columbia River and ocean mixed stock fisheries for strong wild and hatchery runs of fall Chinook and coho. These fisheries will be managed with strict limits to ensure this incidental take is consistent with recovery of Coweeman wild populations. Steelhead will continue to be protected from significant fishery impacts in the Columbia River and are not subject to ocean fisheries. Selective fisheries for marked hatchery steelhead and coho (and fall Chinook after mass marking occurs) will be a critical tool for limiting wild fish impacts. State and federal legislative bodies will be encouraged to develop funding necessary to implement mass-marking of fall Chinook, thus enabling a selective fishery with lower impacts on wild fish. State and federal fisheries managers will better incorporate Lower Columbia indicator populations into fisheries impact models.

7. Reduce Out-of-Subbasin Impacts so that the Benefits of In-Basin Actions can be Realized

Coweeman River salmon and steelhead are exposed to a variety of human and natural threats in migrations outside of the Cowlitz Subbasin. Human impacts include drastic habitat changes in the Columbia River estuary, effects of Columbia Basin hydropower operation on mainstem, estuary, and nearshore ocean conditions, interactions with introduced animal and plant species, and altered natural predation patterns by northern pikeminnow, birds, seals, and sea lions. A variety of restoration and management actions are needed to reduce these out-of-basin effects so that the benefits of in-basin actions can be realized. To ensure equivalent sharing of the recovery and mitigation burden, impacts in each area of effect (habitat, hydropower, etc.) should be reduced in proportion to their significance to species of interest.

2.0 Background

This plan describes a vision and framework for rebuilding salmon and steelhead populations in Washington's Coweeman River Subbasin. The plan addresses subbasin elements of a regional recovery plan for Chinook salmon, chum salmon, coho salmon, steelhead, and bull trout listed or under consideration for listing as Threatened under the federal Endangered Species Act (ESA). The plan also serves as the subbasin plan for the Northwest Power and Conservation Council (NPCC) Fish and Wildlife Program to address effects of construction and operation of the Federal Columbia River Power System.

Development of this plan was led and coordinated by the Washington Lower Columbia River Fish Recovery Board (LCFRB). The Board was established by state statue (RCW 77.85.200) in 1998 to oversee and coordinate salmon and steelhead recovery efforts in the lower Columbia region of Washington. It is comprised of representatives from the state legislature, city and county governments, the Cowlitz Tribe, private property owners, hydro project operators, the environmental community, and concerned citizens. A variety of partners representing federal agencies, Tribal Governments, Washington state agencies, regional organizations, and local governments participated in the process through involvement on the LCFRB, a Recovery Planning Steering Committee, planning working groups, public outreach, and other coordinated efforts.

The planning process integrated four interrelated initiatives to produce a single Recovery/Subbasin Plan for Washington subbasins of the lower Columbia:

- Endangered Species Act recovery planning for listed salmon and trout.
- Northwest Power and Conservation Council (NPCC) fish and wildlife subbasin planning for eight full and three partial subbasins.
- Watershed planning pursuant to the Washington Watershed Management Act, RCW 90-82.
- Habitat protection and restoration pursuant to the Washington Salmon Recovery Act, RCW 77.85.

This integrated approach ensures consistency and compatibility of goals, objectives, strategies, priorities and actions; eliminates redundancy in the collection and analysis of data; and establishes the framework for a partnership of federal, state, tribal and local governments under which agencies can effectively and efficiently coordinate planning and implement efforts.

The plan includes an assessment of limiting factors and threats to key fish species, an inventory of related projects and programs, and a management plan to guide actions to address specific factors and threats. The assessment includes a description of the subbasin, focal fish species, current conditions, and evaluations of factors affecting focal fish species inside and outside the subbasin. This assessment forms the scientific and technical foundation for developing a subbasin vision, objectives, strategies, and measures. The inventory summarizes current and planned fish and habitat protection, restoration, and artificial production activities and programs. This inventory illustrates current management direction and existing tools for plan implementation. The management plan details biological objectives, strategies, measures, actions, and expected effects consistent with the planning process goals and the corresponding subbasin vision.

3.0 Assessment

3.1 Subbasin Description

3.1.1 *Topography & Geology*

The Coweeman basin encompasses approximately 200 mi^2 in Cowlitz County and lies within WRIA 26 of Washington State. The Coweeman River joins the mainstem Cowlitz at RM 17. Principal tributaries include Goble, Mulholland, Baird, O'Neill, and Butler Creeks. Elevations range from just above sea level at the mouth to over 3,000 feet. The basin is comprised of Eocene basalt flows and flow breccia. Glacial activity has influenced valley morphology and soils.

3.1.2 *Climate*

The basin has a typical northwest maritime climate. Summers are dry and warm and winters are cool, wet, and cloudy. Mean monthly precipitation ranges from 1.1 inches (July) to 8.8 inches (November) at Mayfield Dam. Mean annual precipitation is 46 inches near Kelso (WRCC 2003). Most precipitation occurs between October and March. The basin is rain-dominated, with winter snow in the higher elevations.

3.1.3 *Land Use, Ownership, and Cover*

Forestry is the dominant land use in the subbasin. Commercial forestland makes up over 90% of the Coweeman basin. Much of the lower river valleys are in agricultural and residential uses, with substantial impacts to riparian and floodplain areas in places. The largest population center is Kelso, WA, located near the river mouth. Projected population change from 2000 to 2020 for unincorporated areas in WRIA 26 is 22%. The City of Kelso has a projected change of 42% by 2020 (LCFRB 2001). The State of Washington owns, and the Washington State Department of Natural Resources (DNR) manages the beds of all navigable waters within the subbasin. Any proposed use of those lands must be approved in advance by the DNR. A breakdown of land ownership and land cover in the Coweeman basin is presented in Figure 1 and Figure 2.

3.1.4 *Development Trends*

The largest population center in the basin is Kelso, WA, located near the river mouth. Projected population change from 2000 to 2020 for unincorporated areas in WRIA 26 is 22%. The City of Kelso has a projected change of 42% by 2020 (LCFRB 2001). Continued population growth will increase pressures for conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions.

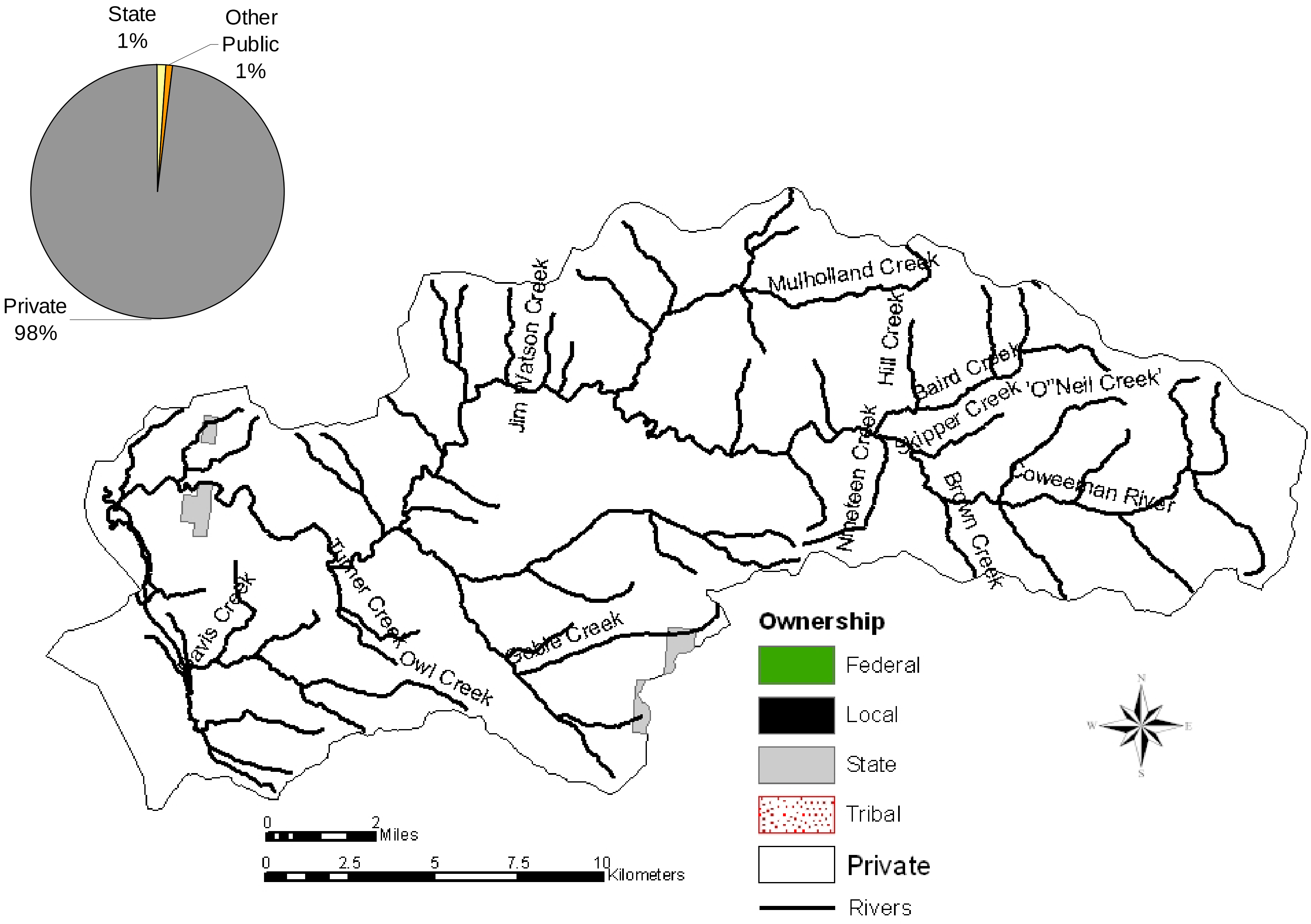


Figure 1.Landownership within the Coweeman Basin. Data is WDNR data that was obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

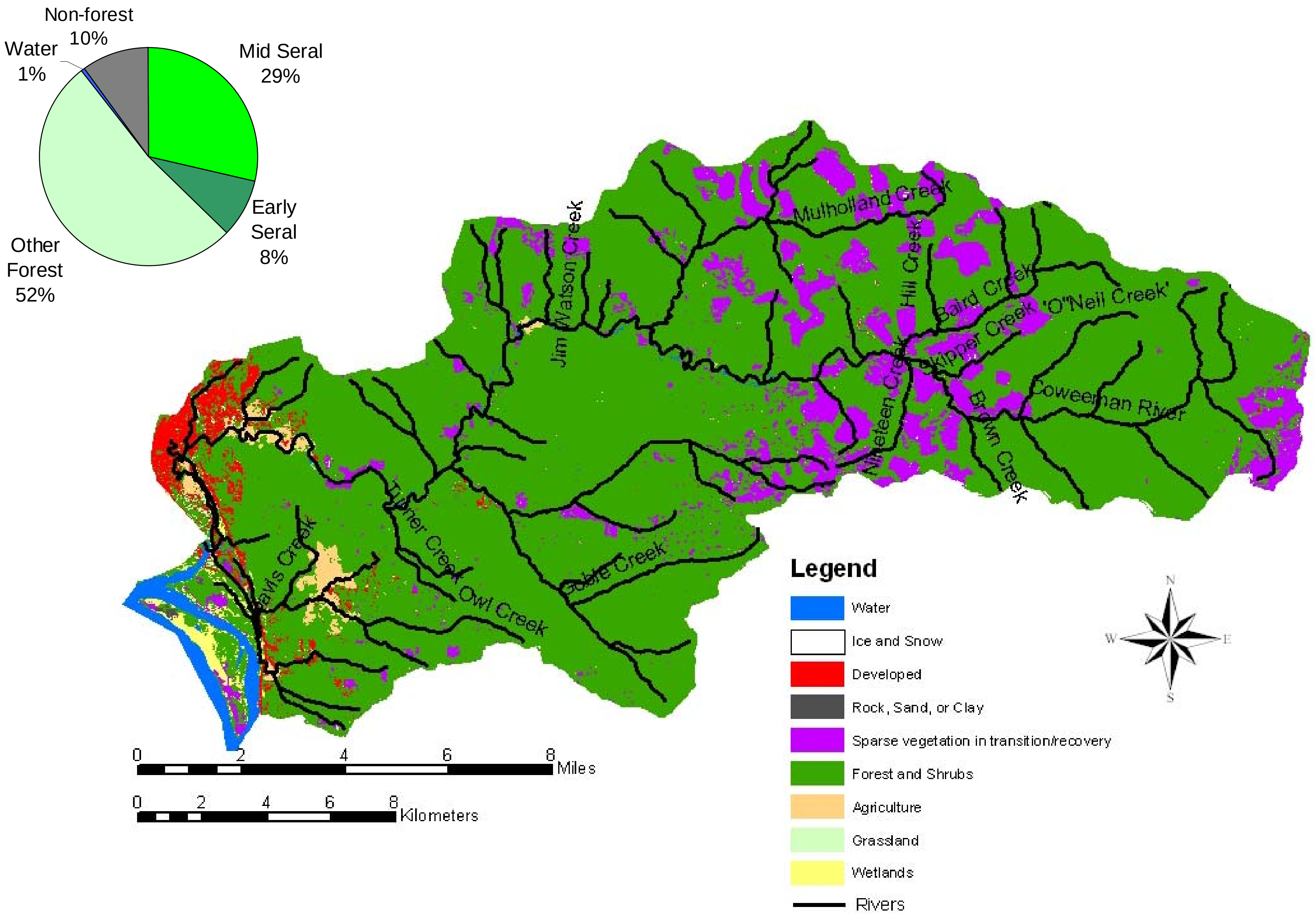


Figure 2. Land cover within the Coweeman basin. Vegetation cover (pie chart) derived from Landsat data based on methods in Lunetta et al. (1997). Mapped data was obtained from the USGS National Land Cover Dataset (NLCD).

3.2 Focal and Other Species of Interest

Listed salmon, steelhead, and trout species are focal species of this planning effort for the Coweeman Basin. Other species of interest were also identified as appropriate. Species were selected because they are listed or under consideration for listing under the U.S. Endangered Species Act or because viability or use is significantly affected by the Federal Columbia Hydropower system. Federal hydropower system effects are not significant within the Coweeman River Basin although anadromous species are subject to effects in the Columbia River, estuary, and nearshore ocean. The Coweeman ecosystem supports and depends on a wide variety of fish and wildlife in addition to designated focal species. A comprehensive ecosystem-based approach to salmon and steelhead recovery will provide significant benefits to other native species through restoration of landscape-level processes and habitat conditions. Other fish and wildlife species not directly addressed by this plan are subject to a variety of other Federal, State, and local planning or management activities.

Focal salmonid species in the Coweeman River watershed includes fall Chinook, coho, chum, and winter steelhead. Bull trout do not occur in the subbasin. Chum are a subset of a larger area population which includes the lower Cowlitz, Toutle, and Coweeman rivers. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 1). Extinction risks are significant for all focal species – the current health or viability of ranges from very low for chum to medium for fall Chinook.

Table 1. Status of focal salmon and steelhead populations in the Coweeman River subbasin.

Focal Species	ESA Status	Hatchery Component[1]	Historical numbers[2]	Recent numbers[3]	Current viability[4]	Extinction risk[5]
Fall Chinook	Threatened	No	4,000-7,000	100-2,100	Medium	20%
Coho	Proposed	No	10,000-25,000	Unknown	Low	70%
Winter Steelhead	Threatened	Yes	3,000-7,000	100-1,100	Low+	30%
Chum (a)	Threatened	No	300,000 500,000[6]	<150	Very Low	70%

(a) Includes lower Cowlitz, Toutle, and Coweeman populations

[1] *Significant numbers of hatchery fish are released in the subbasin.*
[2] *Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NOAA rough calculations..*
[3] *Approximate current annual range in number of naturally-produced fish returning to the subbasin.*
[4] *Propsects for long term persistence based on criteria developed by the NOAA Technical Recovery Team.*
[5] *Probability of extinction within 100 years corresponding to estimated viability.*
[6] *Includes entire Cowlitz subbasin*

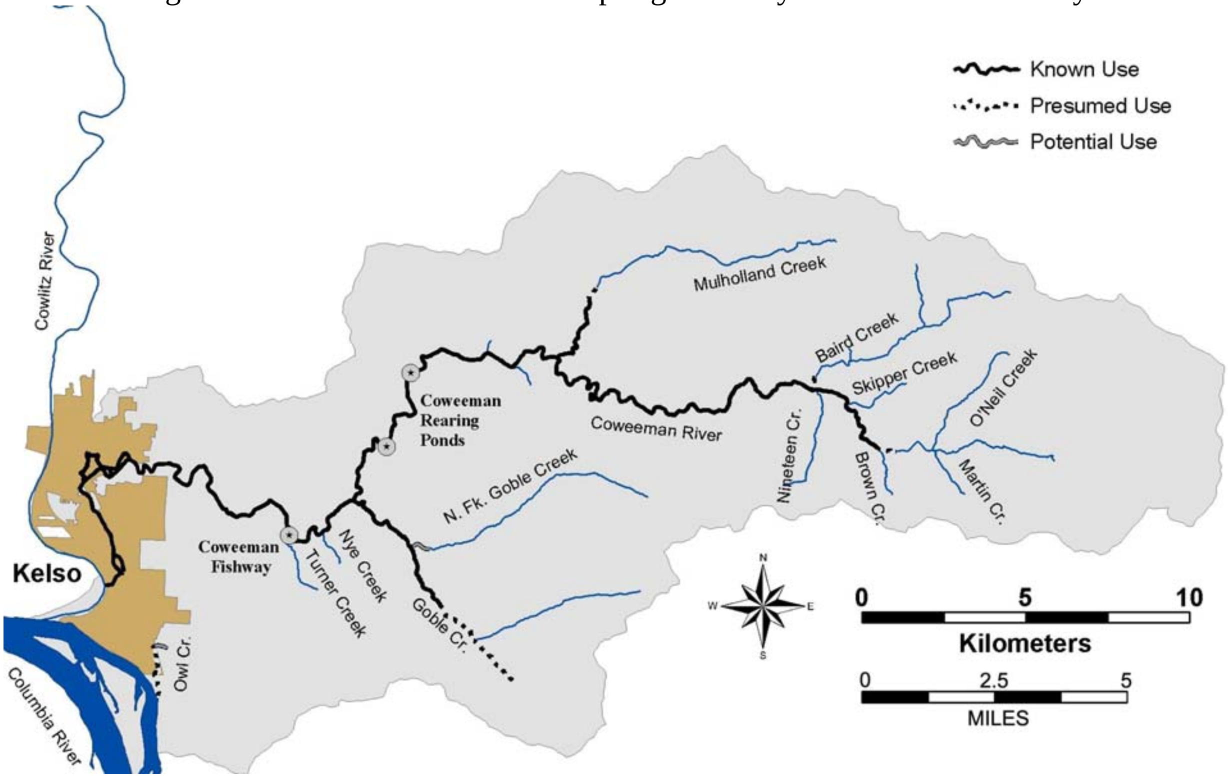
Other species of interest in the Coweeman Subbasin include coastal cutthroat trout and Pacific lamprey. These species have been affected by many of the same habitat factors that have reduced numbers of anadromous salmonids.

Brief summaries of the population characteristics and status follow. Additional information on life history, population characteristics, and status assessments may be found in Appendix A (focal species) and B (other species).

3.2.1 *Fall Chinook—Cowlitz Subbasin (Coweeman)*

ESA: Threatened 1999 **SASSI: Depressed 2002**

The historical adult population is estimated from 4,000-7,000 fish. The current natural spawning returns range from 100-2,100. There is no hatchery fall Chinook production in the Coweeman. Spawning occurs in the mainstem Coweeman, primarily from Mulholland Creek to the Jeep Club Bridge (about 6 miles). Juvenile rearing occurs near and downstream of the spawning areas. Juveniles migrate from the Coweeman in the spring and early summer of their first year.

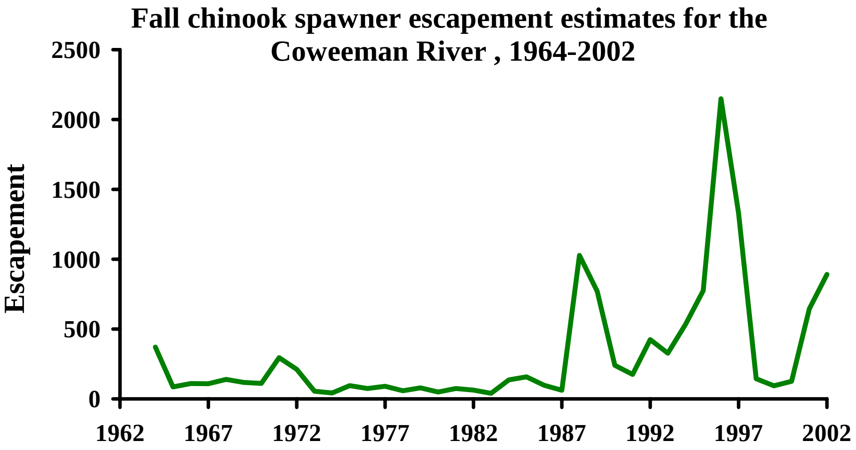


Distribution

- Spawning occurs in the mainstem primarily from Mulholland Creek to the Jeep Club Bridge (~6 mi)

Life History

- Columbia River fall chinook migration occurs from mid August to mid September, depending partly on early fall rain
- Natural spawning occurs between late September and mid November, usually peaking in mid October
- Age ranges from 2-year-old jacks to 6-year-old adults, with dominant adult age of 4
- Fry emerge around early April, depending on time of egg deposition and water temperature; fall chinook fry spend the spring in fresh water, and emigrate in the late spring/summer as sub-yearlings



Diversity

- Considered a component of the tule fall chinook population within the lower Columbia River Evolutionarily Significant Unit (ESU)
- Tule stock designated based on distinct spawning distribution and life history characteristics
- Allozyme analyses from 1996 and 1997 indicate Coweeman River fall chinook are significantly different from all other Columbia River basin chinook stocks, including lower Columbia River hatchery fall chinook (most distinct Washington lower Columbia tule fall chinook)
- Considered wild production with minimum hatchery influence
- Focal species for Endangered Species Act (ESA) monitoring because of minimum hatchery influence

Abundance

- An escapement survey in the late 1930s observed 1,746 chinook in the Coweeman River
- In 1951, WDF estimated fall chinook escapement to the Coweeman River was 5,000 fish
- Coweeman River spawning escapements from 1964-2001 ranged from 40 to 2,148 (average 302)
- Coweeman River current WDFW escapement goal is 1,000 fish; the goal has been met three times since 1986

Productivity & Persistence

- NMFS Status Assessment for the Coweeman River indicated zero risk of 90% decline in 25 years, 90% decline in 50 years, or extinction in 50 years
- Smolt density model predicted natural production potential for the Coweeman River of 602,000 smolts
- One of two self sustaining natural runs in the lower Columbia River; the recent year natural run has been stable at low levels without hatchery influence

Hatchery

- Hatchery releases of fall chinook in the Coweeman River occurred between 1951-1979; releases were from Spring Creek, Washougal, and Toutle Hatcheries; releases were discontinued in 1980

- No hatchery tags have been recovered in Coweeman River natural spawning fall chinook in surveys conducted since 1980, indicating the population is not currently influenced by stray hatchery fish from outside the system

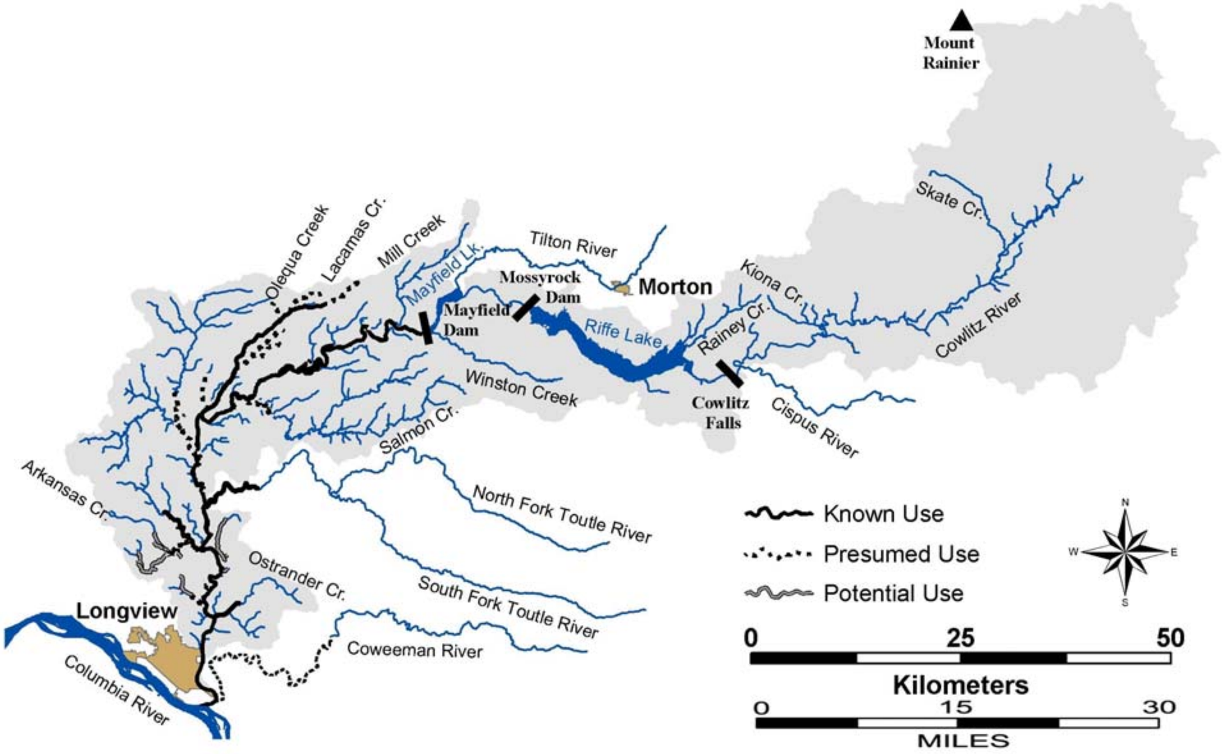
Harvest

- Columbia River fall chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, and in Columbia River commercial gill net and sport fisheries
- Lower Columbia tule fall chinook are an important contributor to Washington Ocean troll and sport fisheries and to the Columbia River estuary sport (Buoy 10) fishery
- Columbia River commercial harvest occurs primarily in September, but tule flesh quality is low once the fish move from salt water; price is low compared to higher quality Upriver Bright chinook
- Tule fall chinook are also important to lower Columbia tributary sport fisheries
- The magnitude of harvest is variable depending on management response to annual abundance
- Coweeman River wild fall chinook are not tagged but likely display an ocean and Columbia River harvest distribution similar to lower Columbia hatchery tule fall chinook
- Coded-wire tag (CWT) analysis of 1989-94 brood North Toutle Hatchery fall chinook (the closest tule population to Coweeman River; adjusted for zero harvest of fall chinook in the Coweeman basin) indicates an ocean and Columbia River combined harvest rate of 28% and a terminal escapement of 72%
- The majority of ocean and Columbia River fishery CWT recoveries of 1992-94 brood North Toutle Hatchery fall chinook (adjusted for zero harvest of Toutle Hatchery fall chinook in the Coweeman basin) were distributed between British Columbia (43%), Alaska (21%), Columbia River (18%), and Washington ocean (15%) sampling areas
- Coweeman River is closed to sport harvest of chinook
- Ocean and Columbia River harvest of Coweeman fall chinook limited to 49% or less by ESA requirements

3.2.2 *Chum—Cowlitz Subbasin*

ESA: Threatened 1999 **SASSI: NA**

The chum population is considered part of the lower Cowlitz population.



Distribution

- Chum were reported to historically utilize the lower Cowlitz River and tributaries downstream of the Mayfield Dam site

Life History

- Lower Columbia River chum salmon run from mid-October through November; peak spawner abundance occurs in late November
- Dominant age classes of adults are 3 and 4
- Fry emerge in early spring; chum emigrate as age-0 smolts generally from March to May

Diversity

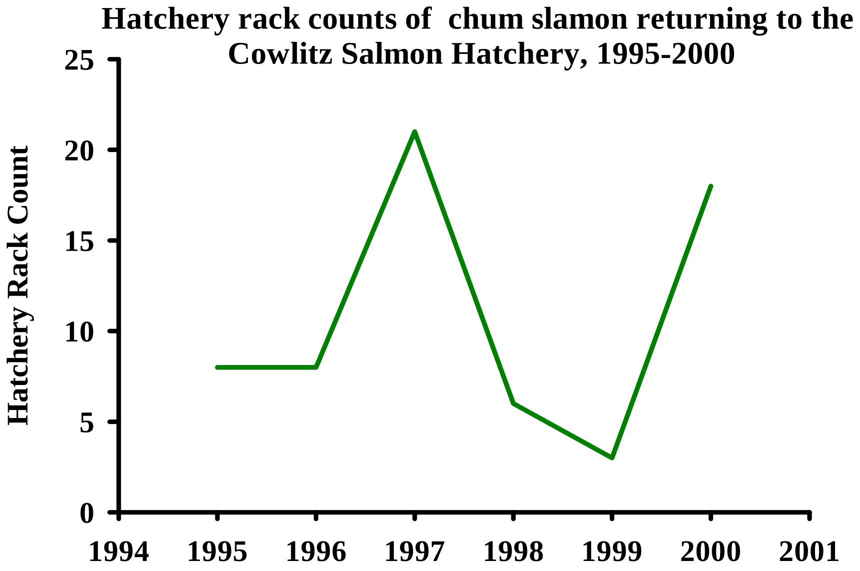
- No hatchery releases of chum have occurred in the Cowlitz basin

Abundance

- Estimated escapement of approximately 1,000 chum in early 1950's
- Between 1961 and 1966, the Mayfield Dam fish passage facility counted 58 chum
- Typically less than 20 adults are collected annually at the Cowlitz Salmon Hatchery

Productivity & Persistence

- Anadromous chum production primarily in lower watershed
- Harvest, habitat degradation, and to some degree construction of Mayfield and Mossyrock Dams contributed to decreased productivity



Hatchery

- Cowlitz Salmon Hatchery does not produce/release chum salmon
- Chum salmon are captured annually in the hatchery rack

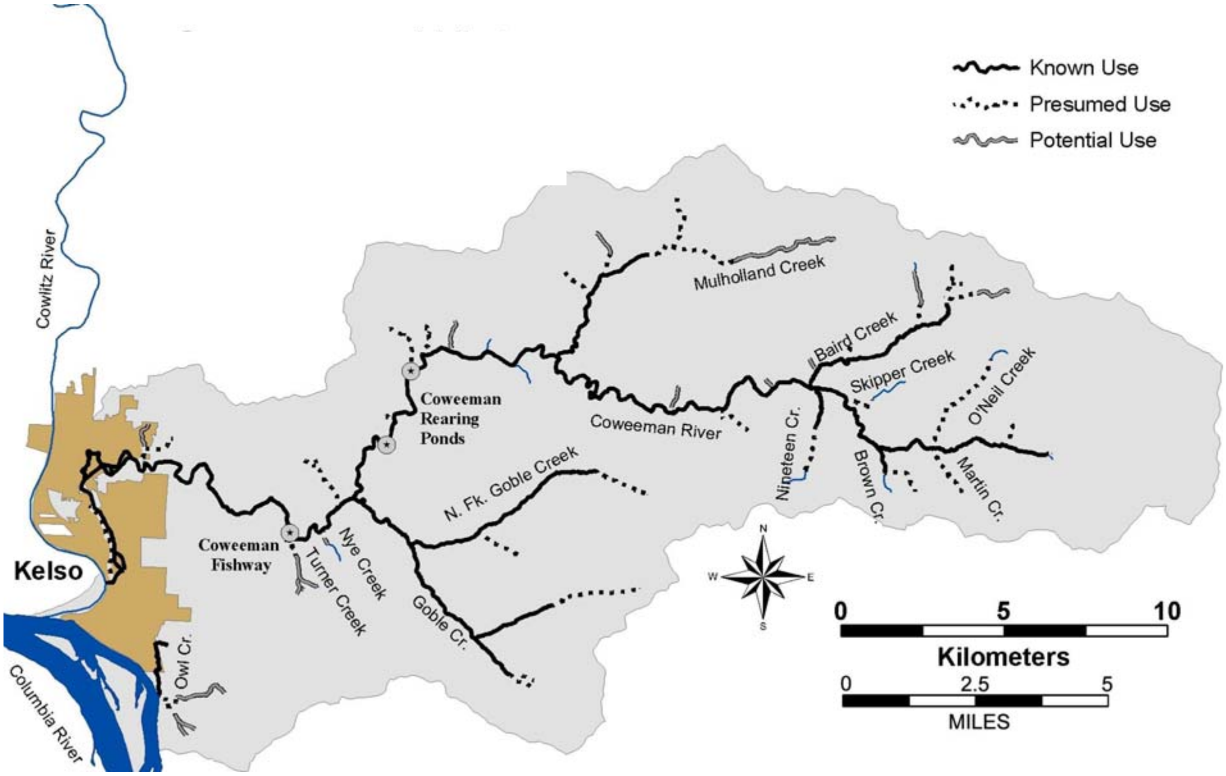
Harvest

- Currently very limited chum harvest occurs in the ocean and Columbia River and is incidental to fisheries directed at other species
- Columbia River commercial fishery historically harvested chum salmon in large numbers (80,000 to 650,000 in years prior to 1943); from 1965-1992 landings averaged less than 2,000 chum, and since 1993 less then 100 chum
- In the 1990s November commercial fisheries were curtailed and retention of chum was prohibited in Columbia River sport fisheries
- The ESA limits incidental harvest of Columbia River chum to less then 5% of the annual return

3.2.3 *Winter Steelhead—Cowlitz Subbasin (Coweeman)*

ESA: Threatened 1998 **SASSI: Depressed 2002**

The historical adult population is estimated from 3,000-7,000 fish. Current natural spawning returns range from 100-1,100. In-breeding with Chambers Creek or Skamania Hatchery produced steelhead is thought to be low because of differences in spawn timing. Spawning occurs primarily in the mainstem Coweeman, and Goble, Mulholland, and Baird creeks. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Coweeman.



Distribution

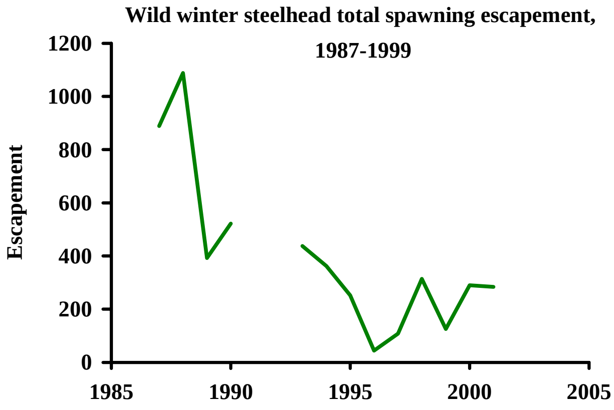
- Winter steelhead are distributed throughout the mainstem Coweeman, Goble Creek, and the lower reaches of Mulholland and Baird Creeks
- The 1980 eruption of Mt. St. Helens had little impact on Coweeman River habitat

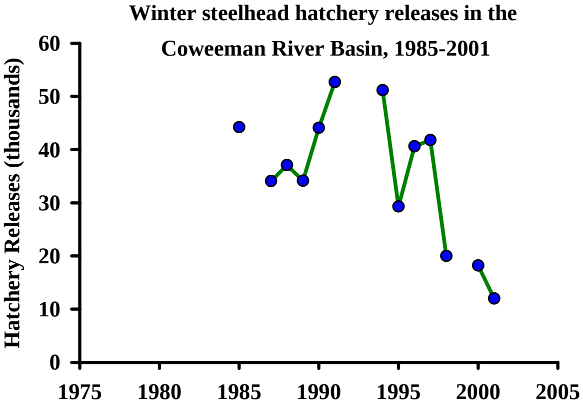
Life History

- Adult migration timing for Coweeman winter steelhead is from December through April
- Spawning timing on the Coweeman is generally from early March to early June
- Age composition data for Coweeman River winter steelhead are not available
- Wild steelhead fry emerge from March through May; juveniles generally rear in fresh water for two years; juvenile emigration occurs from April to May, with peak migration in early May

Diversity

- Coweeman winter steelhead stock designated based on distinct spawning distribution
- Hybridization of wild stock with Chambers Creek hatchery brood stock is unlikely because of about a three month separation in peak spawn timing





Abundance

- In 1936, steelhead were reported in the Coweeman River during escapement surveys
- Coweeman River total escapement counts from 1987-2001 ranged from 44-1,008 (average 393); escapement goal for the Coweeman is 1,064 fish; escapements have been low since 1989

Productivity & Persistence

- Estimated potential winter steelhead smolt production for the Coweeman River is 38,229

Hatchery

- The Cowlitz Trout Hatchery, located on the mainstem Cowlitz at RM 42, is the only hatchery in the basin producing winter steelhead
- Hatchery winter steelhead have been planted in the Coweeman River basin since 1957; broodstock from the Elochoman and Cowlitz Rivers and Chambers Creek have been used, but most releases have been from Chambers Creek; release data are displayed from 1985-2001
- Hatchery fish comprise most of the winter steelhead run in the Coweeman River basin; hatchery fish escapements from 1986-1990 ranged from 1,795 to 2,427; however, hatchery fish contribute little to natural production

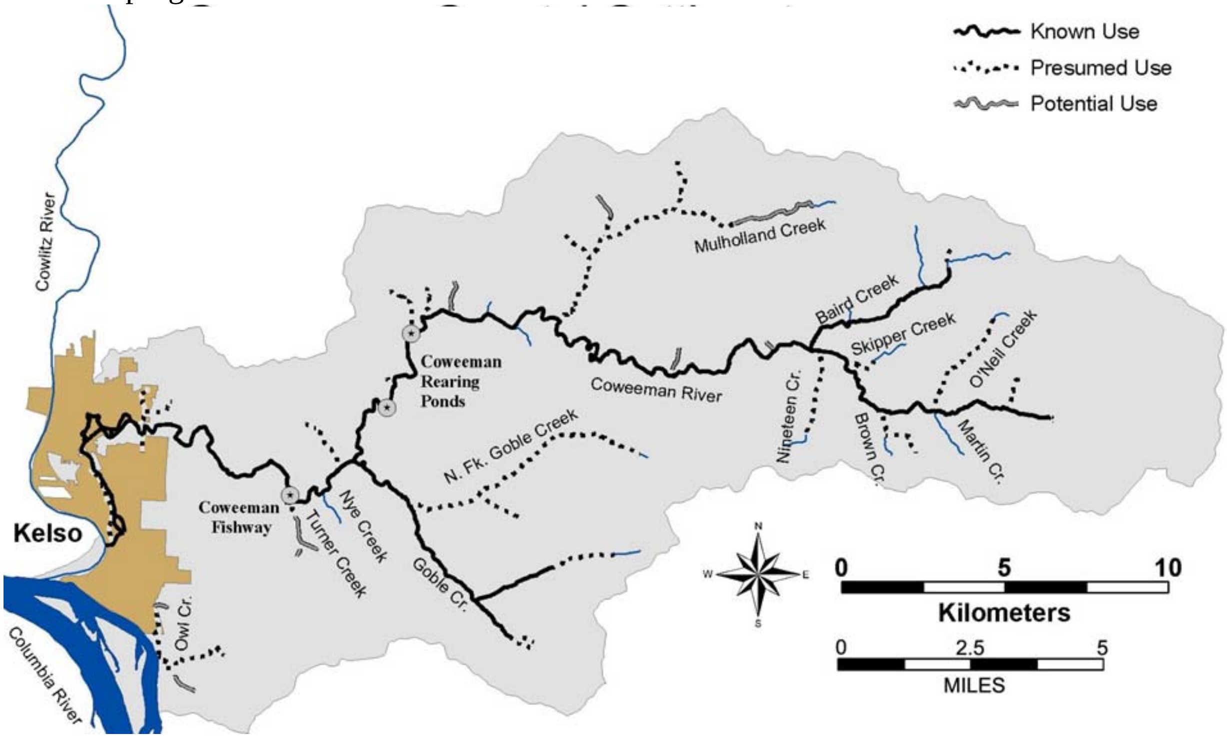
Harvest

- No directed commercial or tribal fisheries target Coweeman winter steelhead; incidental mortality currently occurs during the lower Columbia River spring chinook tangle net fisheries
- Treaty Indian harvest does not occur in the Coweeman River
- Approximately 6.2% of returning Cowlitz River hatchery steelhead are harvested in the Columbia River sport fishery
- Winter steelhead sport harvest (hatchery and wild) in the Coweeman River from 1986-1989 ranged averaged 241 fish; since 1990, regulations limit harvest to hatchery fish only
- ESA limits fishery impact of wild winter steelhead in the mainstem Columbia River and in the Coweeman River as per the Fishery Management and Evaluation Plan submitted by WDFW to NOAA Fisheries in 2003.

3.2.4 *Cutthroat Trout—Cowlitz River Subbasin (Coweeman)*

ESA: Not Listed **SASSI: Depressed 2000**

Coastal cutthroat abundance in the Coweeman has not been quantified but the population is considered depressed. Both anadromous and resident forms of cutthroat trout are found in the basin. Anadromous forms have access upstream to Washboard Falls (RM 31). Anadromous cutthroat trout enter the Coweeman from July-December and spawn from December through June. Most juveniles rear 2-4 years before migrating from their natal stream. A hatchery cutthroat program was discontinued in 1993.



Distribution

- Anadromous forms have access to most of the watershed except above Washboard Falls (RM 31)

Life History

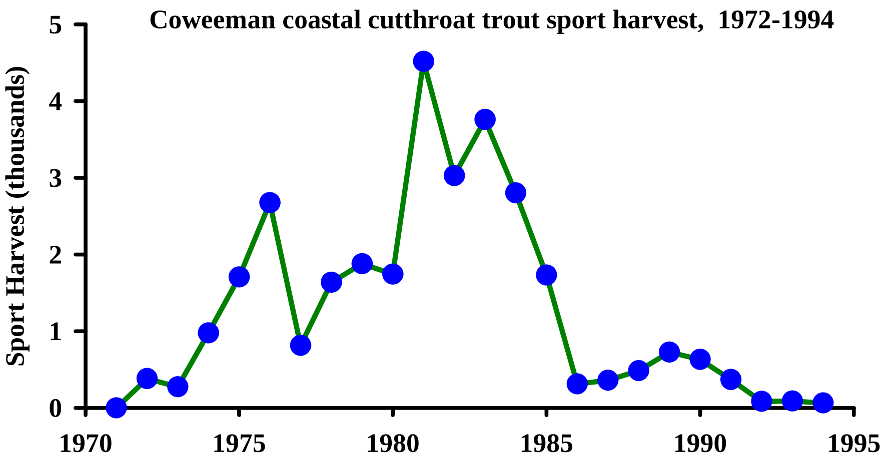
- Anadromous, fluvial and resident forms are present
- Anadromous river entry is from August through March, with peak entry in the fall
- Anadromous spawning occurs from January through mid-April
- Fluvial and resident spawn timing is not documented but is believed to be similar to anadromous timing

Diversity

- Distinct stock based on geographic distribution of spawning areas
- No genetic sampling has been conducted

Abundance

- No abundance information exists for resident and fluvial forms
- Anadromous forms are considered depressed due to long term negative decline in the lower Columbia River cutthroat catch
- The early 1990s harvest data are less than 5% of peak harvest counts in the early 1980s



Hatchery

- No hatcheries exist on the Coweeman River
- From 1989 to 1993 12,000 anadromous cutthroat from Beaver Creek Hatchery were released into the Coweeman River annually
- Hatchery cutthroat releases into the Coweeman River were discontinued
- Hatchery steelhead smolts are released into the Coweeman River

Harvest

- Not harvested in ocean commercial or recreational fisheries
- Angler harvest for adipose fin clipped hatchery fish occurs in mainstem Columbia River summer fisheries downstream of the Cowlitz River
- Wild Coweeman River cutthroat (unmarked fish) are released in mainstem Columbia River and Coweeman River sport fisheries

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3.2.5 *Other Species*

Pacific lamprey – Information on lamprey abundance is limited and does not exist for the Coweeman population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have declined in the Coweeman River also. The adult lamprey return from the ocean to spawn in the spring and summer. Spawning likely occurs in the small to mid-size streams of the Coweeman Basin. Juveniles rear in freshwater up to 6 years before migrating to the ocean.

3.3 Subbasin Habitat Conditions

This section describes the current condition of aquatic and terrestrial habitats within the subbasin. Descriptions are included for habitat features of particular significance to focal salmonid species including watershed hydrology, passage obstructions, water quality, key habitat availability, substrate and sediment, woody debris, channel stability, riparian function, and floodplain function. These descriptions will form the basis for subsequent assessments of the effects of habitat conditions on focal salmonids and opportunities for improvement.

3.3.1 *Watershed Hydrology*

Runoff is predominantly generated by rainfall, with a portion of spring flows coming from snowmelt in the upper elevations and occasional winter peaks related to rain-on-snow events. Streamflows are primarily the result of winter rainfall.

The Integrated Watershed Assessment (IWA), which is presented in greater detail later in this chapter, indicates that runoff properties are 'impaired' throughout most of the basin, with 'moderately impaired' hydrologic conditions only in the headwaters subwatersheds. High road densities and young forest stands are the primary causes of hydrologic impairment. These conditions create a risk of increased peak flow volumes.

Low flows in the Coweeman have been responsible for impeding chinook and coho migrations as well as limiting juvenile rearing habitat. Using the Toe-Width method to assess flow suitability in 1998, it was determined that flows for fall spawning were less than optimal until November, and flows for juvenile rearing were less than optimal from mid-July through September (Caldwell et al. 1999).

Watershed Planning Assessments conducted by the Lower Columbia Fish Recovery Board (LCFRB) and Ecology indicate that the current and future projected groundwater demand in the Coweeman could exceed a one to two percent habitat impact in the Coweeman River. The draft Watershed Plan recommends domestic well use only within the basin or use of tidally-influenced waters (or City of Kelso) near the confluence with the Cowlitz River.

3.3.2 *Passage Obstructions*

Numerous culverts present full or partial barriers to anadromous fish passage in the watershed. A detailed description of the type and location of natural and artificial passage barriers is given in the Washington Conservaton Commission's WRIA 26 Limiting Factors Analysis (Wade 2000).

3.3.3 *Water Quality*

The lower Coweeman was listed on the 1998 303(d) list for exceedance of temperature standards (WDOE 1998). Temperatures measured in the Coweeman near Kelso from 1950 to 1967 consistently exceeded 18ºC (64°F) June through September and often exceeded 25ºC (77°F) in July and August (Wade 2000). The Coweeman has been listed as "temperature sensitive" due to logging (WDW 1990). The tributaries Baird, Mulholland, and Goble Creeks were also listed on the 1998 303(d) list due to temperature problems. Nutrient deficits are an assumed problem due to low escapement levels of winter steelhead, coho, and chum (Wade 2000). A TMDL for fecal coliform was initiated in 1999 on Gibbons Creek.

3.3.4 *Key Habitat Availability*

The upper Coweeman has low pool frequencies and depths that are considered a concern for fish (Weyerhaeuser 1996). Information on pool habitat elsewhere in the Coweeman is lacking.

3.3.5 *Substrate & Sediment*

WDFW noted in 1990 that substrate conditions limit production of coastal cutthroat, winter steelhead, fall chinook, and coho. The low gradient between RM 17-26 on the Coweeman contributes a large amount of persistent sediment due to the underlying parent material containing a high fraction of fines. For this reason, the area also experiences frequent mass failures and bank erosion. Sediment production in this reach is apparent as chocolate brown stormflow and as fine sediment accumulation on channel margins, backwater areas, and in side-channels. Historical splash dams throughout the Coweeman basin accumulated sediments, which the channels incised; these continue to deliver fines to downstream areas (Weyerhaeuser 1996).

Sediment supply conditions were evaluated as part of the IWA watershed process modeling, which is presented later in this chapter. The model indicates that sediment supply conditions are ‘moderately impaired’ throughout most of the basin, with ‘impaired’ conditions in the lower basin near the town of Kelso. The only ‘functional’ subwatersheds are located in the headwaters of Baird and Mulholland Creeks.

Sediment supply impairments are mostly the result of the forest road network within the basin. With an average road density of 6.54 mi/mi2 and over 69 miles of stream-adjacent roads, roads in the Coweeman basin are believed to increase sediment production. Several roads contributing fine sediment to streams were identified in the upper Coweeman basin as part of the watershed analysis (Weyerhaeuser 1996).

Sediment production from private forest roads is expected to decline over the next 15 years as roads are updated to meet the new forest practices standards, which include ditchline disconnect from streams and culvert upgrades. The frequency of mass wasting events should also decline due to the new regulations, which require geotechnical review and mitigation measures to minimize the impact of forest practices activities on unstable slopes.

3.3.6 *Woody Debris*

As part of the Upper Coweeman Watershed Analysis conducted by Weyerhaeser in 1996, approximately half of the surveyed streams had high near-term LWD recruitment potential and about one-third had low near-term recruitment potential.

3.3.7 *Channel Stability*

The Coweeman River between RM 4 – 7.5 has bank stability problems associated with adjacent agricultural uses. From RM 17 – 26, lateral bank stability is a problem. The upper Coweeman has experienced mass wasting related to roads. Pin Creek and Goble Creek (Coweeman tributaries) have some stability problems in their upper reaches (Weyerhaeuser 1996).

3.3.8 *Riparian Function*

According to IWA watershed process modeling, which is presented in greater detail later in this chapter, the Coweeman basin suffers from ‘moderately impiared’ riparian conditions throughout the basin. The only exceptions are the mainstem headwaters, which is rated as 'functional', and the lowermost portion of the basin, which is rated as 'impaired'. This pattern of riparian impairment is supported by an assessment by Lewis County GIS (2000), which identified poor riparian conditions on over 40% of stream miles in the lower Coweeman basin compared to less than 15% in the upper basin. A contributing factor to riparian impairment is the large amount of valley bottom roads (over 69 miles) that reduce or eliminate riparian function. Cattle grazing between RM 4 – 7.5 is also a concern (Wade 2000).

Riparian function is expected to improve over time on private forestlands. This is due to the requirements under the Washington State Forest Practices Rules (Washington Administrative Code Chapter 222). Riparian protection has increased dramatically today compared to past regulations and practices..

3.3.9 *Floodplain Function*

The lower four miles has been diked as part of industrial and commercial development in the Kelso area, limiting access to over-wintering habitat for juveniles. RM 4 – 7.5 provides some decent off-channel habitats, as does a small portion of floodplain habitat below RM 1. Above RM 17 are a few unconfined reaches that historically may have provided off-channel habitats but are now incised to the point that accessible off-channel areas no longer exist (Wade 2000).

3.4 Stream Habitat Limitations

A systematic link between habitat conditions and salmonid population performance is needed to identify the net effect of habitat changes, specific stream sections where problems occur, and specific habitat conditions that account for the problems in each stream reach. In order to help identify the links between fish and habitat conditions, the Ecosystem Diagnosis and Treatment (EDT) model was applied to Coweeman River fall Chinook, coho, and winter steelhead. A thorough description of the EDT model, and its application to lower Columbia salmonid populations, can be found in Appendix E.

Three general categories of EDT output are discussed in this section: population analysis, reach analysis, and habitat factor analysis. Population analysis has the broadest scope of all model outputs. It is useful for evaluating the reasonableness of results, assessing broad trends in population performance, comparing among populations, and for comparing past, present, and desired conditions against recovery planning objectives. Reach analysis provides a greater level of detail. Reach analysis rates specific reaches according to how degradation or restoration within the reach affects overall population performance. This level of output is useful for identifying general categories of management (i.e. preservation and/or restoration), and for focusing recovery strategies in appropriate portions of a subbasin. The habitat factor analysis section provides the greatest level of detail. Reach specific habitat attributes are rated according to their relative degree of impact on population performance. This level of output is most useful for practitioners who will be developing and implementing specific recovery actions.

3.4.1 *Population Analysis*

Population assessments under different habitat conditions are useful for comparing fish trends and establishing recovery goals. Fish population levels under current and potential habitat conditions were inferred using the EDT model based on habitat characteristics of each stream reach and a synthesis of habitat effects on fish life cycle processes.

Habitat-based assessments were completed in the Coweeman basin for fall Chinook, chum, coho and winter steelhead. Model results indicate an estimated 60- 86% decline in adult productivity for all species compared to historical estimates (Table 2). Modeled historical adult abundance of coho and winter steelhead was nearly three times greater than current estimates (Figure 3). Current abundance of adult fall Chinook is estimated at 56% of historical levels, while the current abundance of chum is estimated at only 8% of historical levels (Figure 3). Diversity (as measured by the diversity index) is estimated to have remained relatively constant for fall chinook, chum, and winter steelhead. However, diversity has declined by approximately 40% for coho (Table 2).

Smolt productivity has also declined from historical levels for each species in the Coweeman basin (Table 2). For fall Chinook and chum, smolt productivity has decreased by 57% and 42%, respectively. For both coho and winter steelhead the decrease was estimated as approximately 74%. Smolt abundance in the Coweeman clearly declines most dramatically for chum and coho, with respective 79% and 81% changes from historical levels. Current fall Chinook and steelhead smolt abundance levels are modeled at approximately half of historical numbers.

Model results indicate that restoration of properly functioning habitat conditions (PFC) would achieve significant benefits for all species (Table 2). Adult returns of both chum and coho would increase by greater than 230%. Adult returns of both fall chinook and winter steelhead would increase by greater than 50%. Smolt numbers are also estimated to increase dramatically for all species, especially for coho, which shows a 288% increase in smolt abundance with restoration of PFC

Table 2. Population productivity, abundance, and diversity (of both smolts and adults) based on EDT analysis of current (P or patient), historical (T or template)[1], and properly functioning (PFC) habitat conditions.

	Adult Abundance			Adult Productivity			Diversity Index			Smolt Abundance			Smolt Productivity		
Species	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**
Fall Chinook	1,839	2,877	3,270	4.3	8.6	11.0	1.00	1.00	1.00	218,075	324,661	374,482	480	879	1,115
Chum	277	932	3,217	2.1	7.0	10.0	0.97	1.00	1.00	132,516	340,763	636,146	667	1,023	1,152
Coho	1,873	6,225	8,434	3.4	8.1	12.5	0.51	0.82	0.87	33,578	130,350	178,656	65	165	253
Winter Steelhead	653	1,017	2,423	3.9	9.0	28.2	0.86	0.98	1.00	11,599	18,040	22,929	73	165	275

[1] Estimate represents historical conditions in the subbasin and current conditions in the mainstem and estuary.

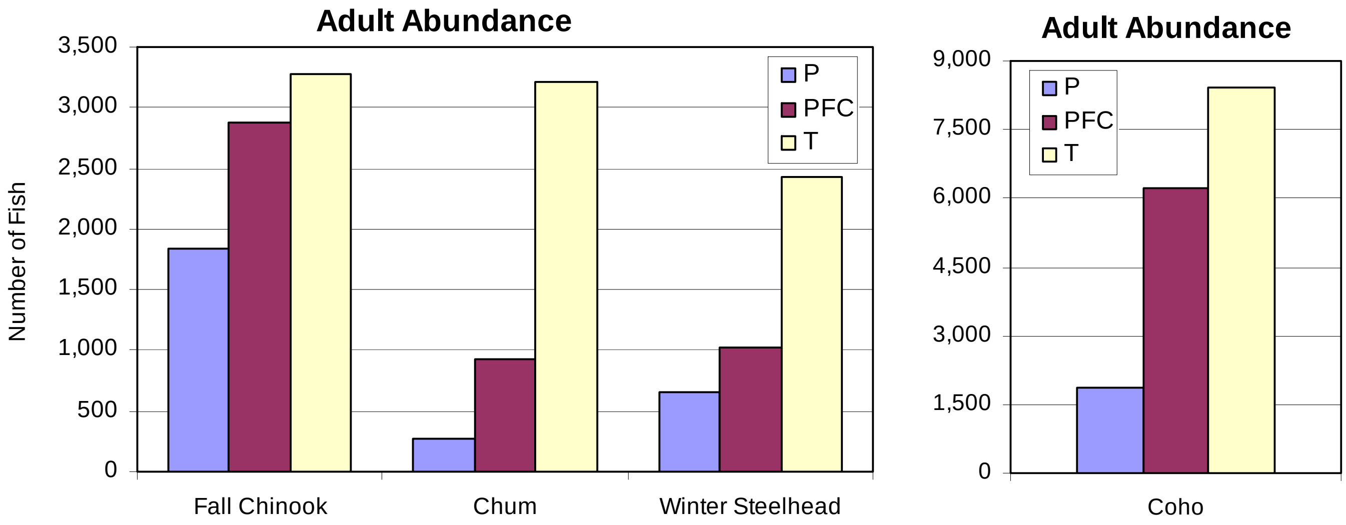


Figure 3. Adult abundance of Coweeman River fall chinook, coho, winter steelhead and chum based on EDT analysis of current (P or patient), historical (T or template), and properly functioning (PFC) habitat conditions.

3.4.2 *Stream Reach Analysis*

Habitat conditions and suitability for fish are better in some portions of a subbasin than in others. The reach analysis of the EDT model uses estimates of the difference in projected population performance between current/patient and historical/template habitat conditions to identify core and degraded fish production areas. Core production areas, where habitat degradation would have a large negative impact on the population, are assigned a high value for preservation. Likewise, currently degraded areas that provide significant potential for restoration are assigned a high value for restoration. Collectively, these values are used to prioritize the reaches within a given subbasin.

For the purposes of the EDT model, the Coweeman basin was divided into approximately 40 reaches that are used by salmon and steelhead (Figure 4). Winter steelhead utilize all of these reaches, whereas fall chinook and coho use primarily just the mainstem reaches, and chum use only the first few mainstem reaches. Reaches 1-4 are low gradient reaches that course through Kelso and the agricultural land upstream of town. In general, reaches 5 and up are moderately confined, with forestry, and in some cases residential development, as the primary impacts.

For fall Chinook, high priority reaches include the middle mainstem (Canyon 2 and 3, Coweeman 5, 8, 10 and 11) and the upper Coweeman (Coweeman 16) (Figure 5). Both the canyon and upper reaches show a preservation only emphasis while the other middle reaches show a combined preservation and restoration emphasis (Figure 5).

Current conditions are poor for chum in the lower mainstem, however, the one high priority reach for chum, Coweeman 4, shows a preservation emphasis (Figure 6). High priority reaches for coho include Coweeman 4-5, 8-11, 16-18, and Canyon 3 (Figure 7). With the exception of Coweeman 16, which has a combined preservation and restoration emphasis, all other high priority reaches for coho show a restoration emphasis.

Winter steelhead reaches with a high priority ranking include those in the upper basin (Coweeman 15-16), and headwaters (Coweeman 17-22) (Figure 8). The upper sections, including the headwaters and the headwater tributaries, represent primary steelhead spawning and rearing areas, while the middle tributaries have rearing but limited spawning potential. Therefore, almost all of these reaches have a combined preservation and restoration emphasis.

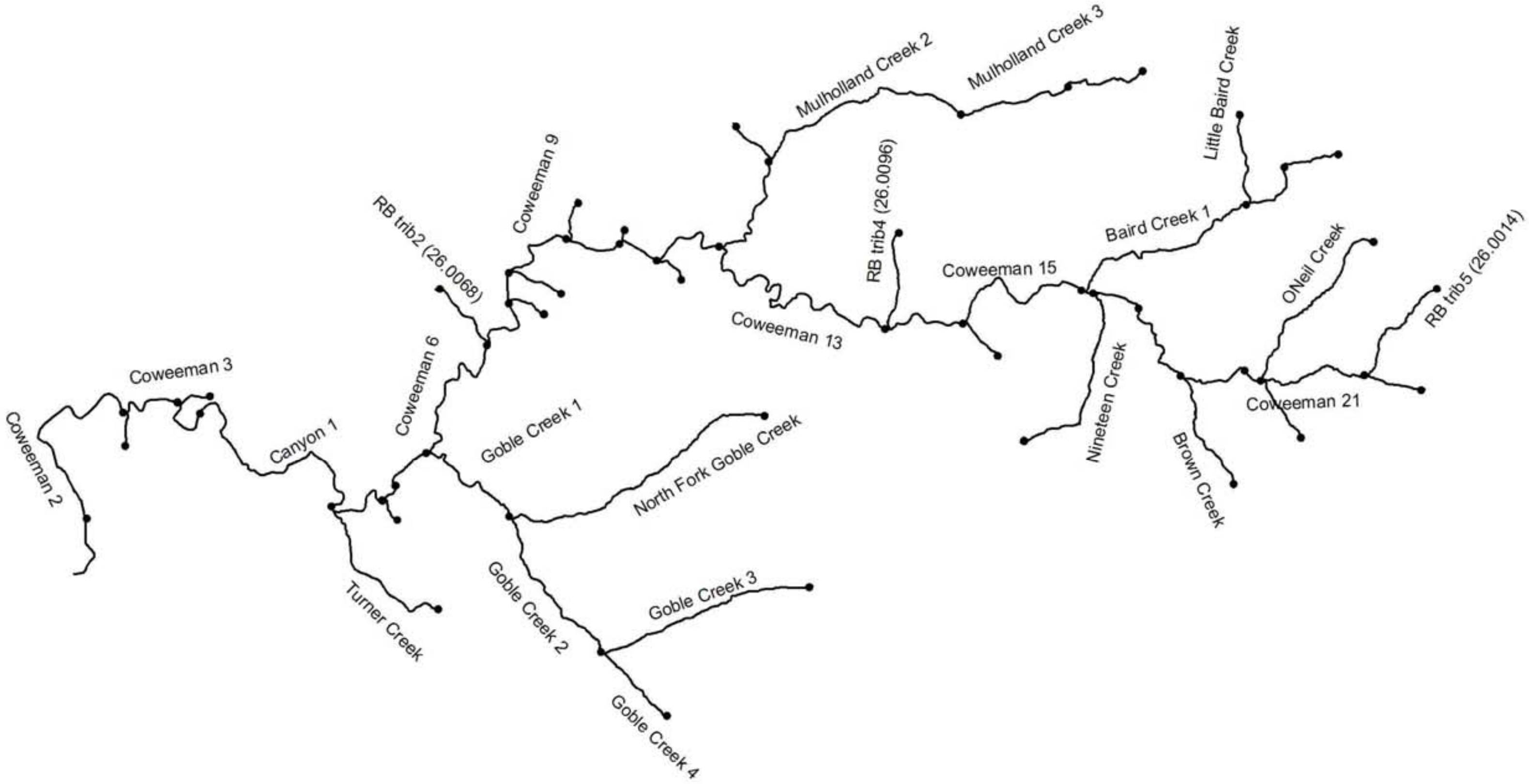


Figure 4. Coweeman subbasin with EDT reaches identified. For readability, not all reaches are labeled.

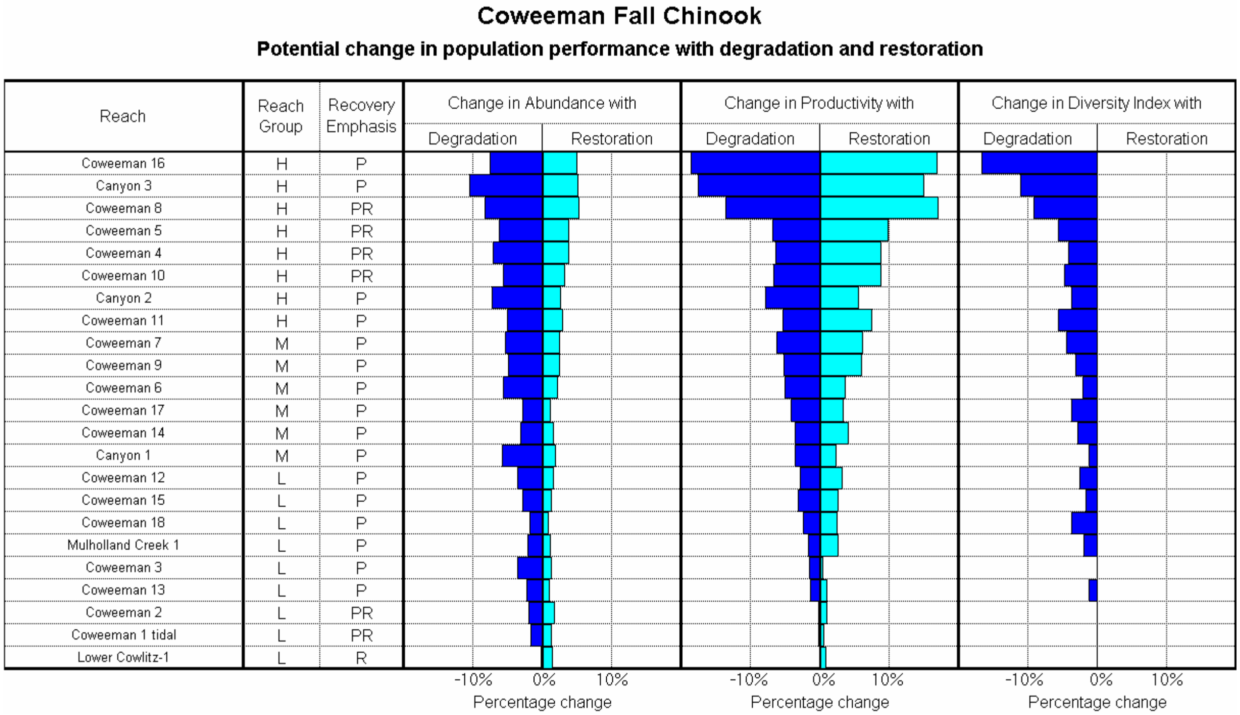


Figure 5. Coweeman basin fall chinook ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphasis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams. Some low priority reaches are not included for display purposes.

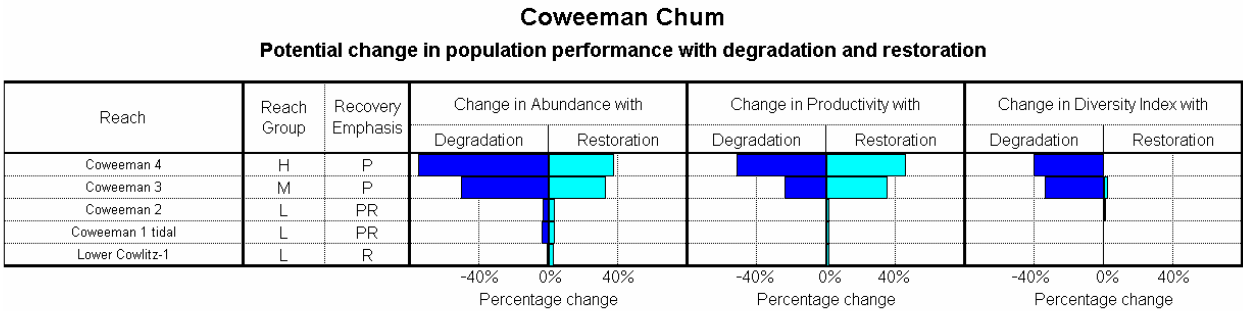
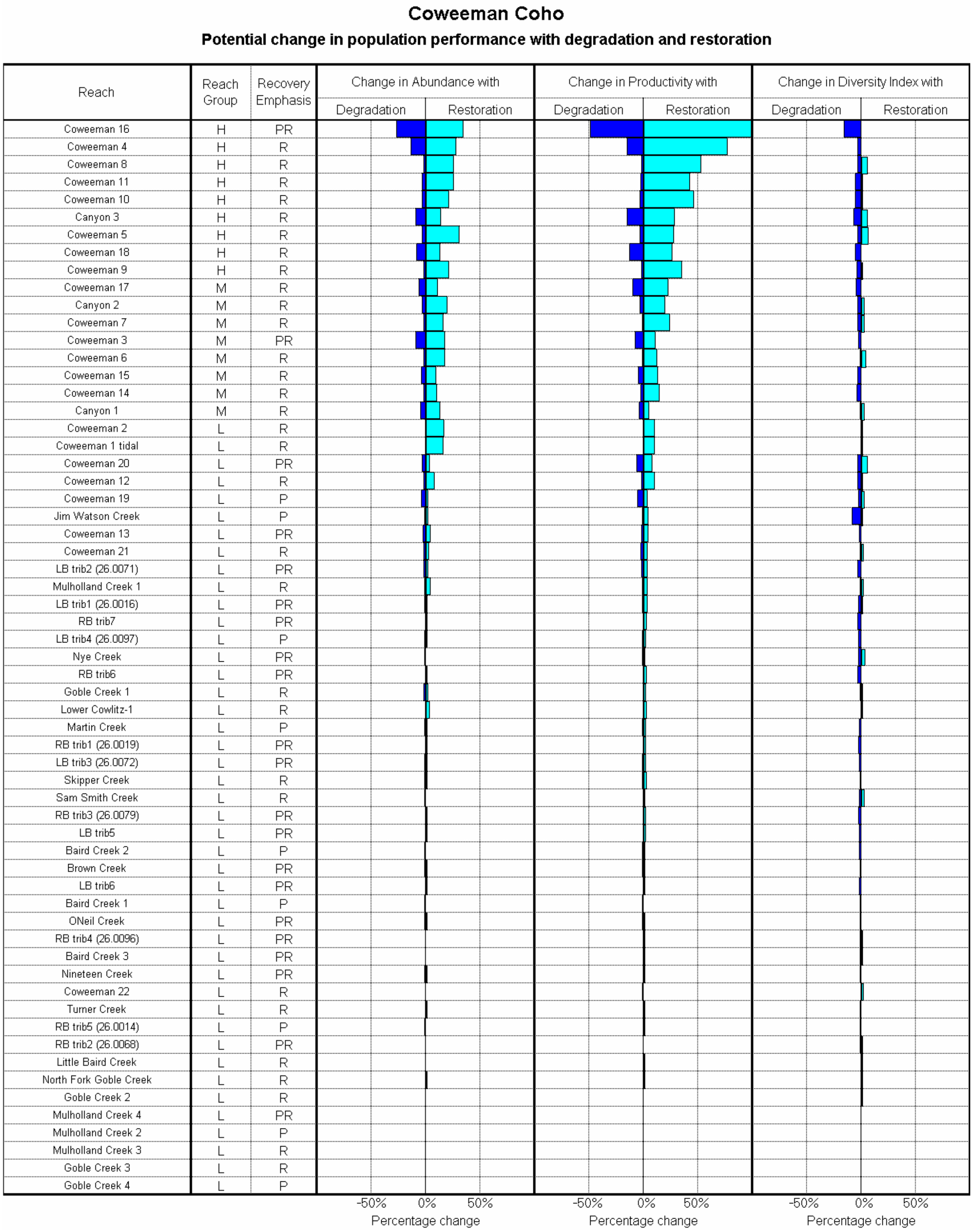
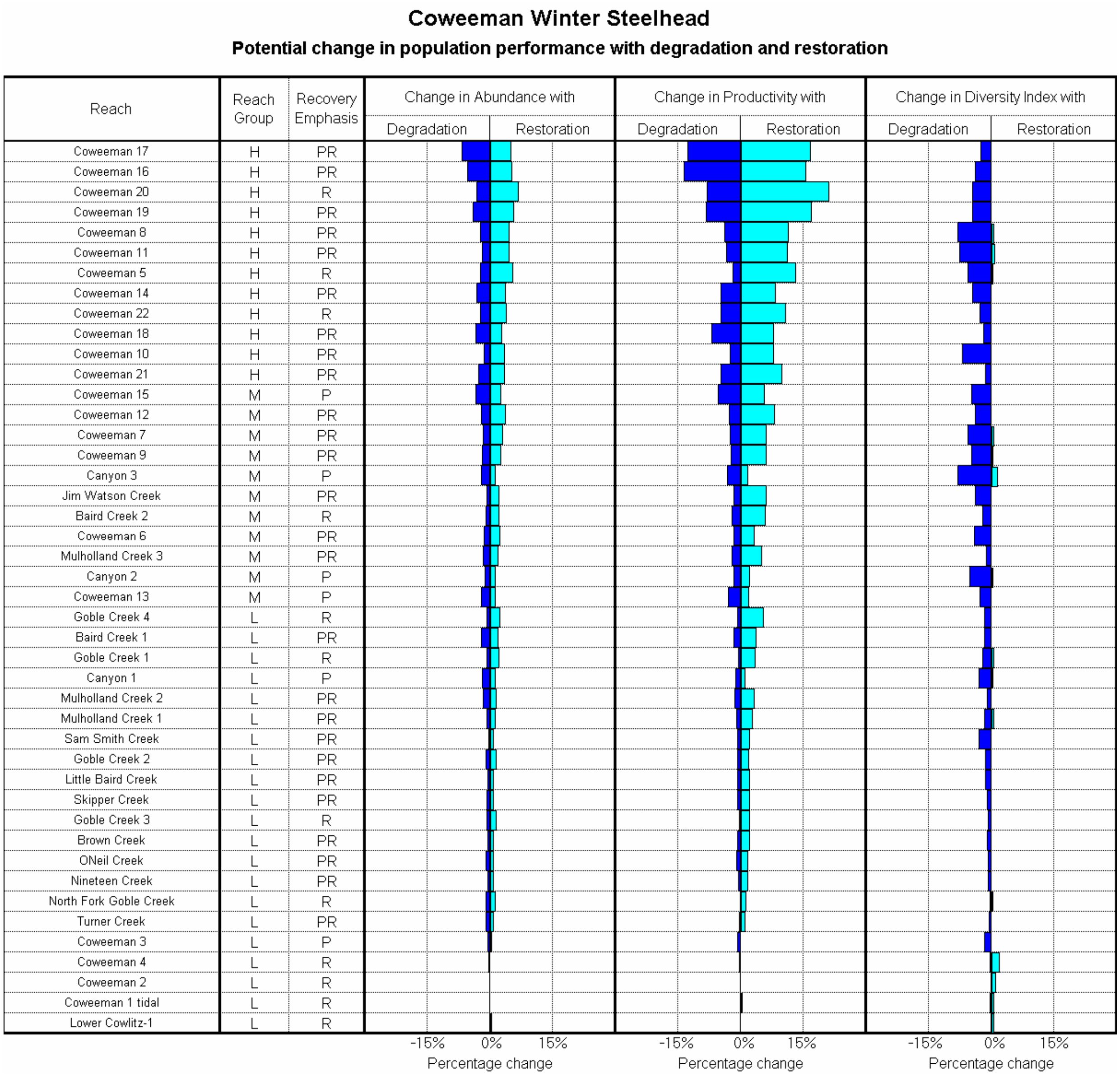


Figure 6. Coweeman basin chum ladder diagram.



Reach	Reach Group	Recovery Emphasis
Coweeman 16	H	PR
Coweeman 4	H	R
Coweeman 8	H	R
Coweeman 11	H	R
Coweeman 10	H	R
Canyon 3	H	R
Coweeman 5	H	R
Coweeman 18	H	R
Coweeman 9	H	R
Coweeman 17	M	R
Canyon 2	M	R
Coweeman 7	M	R
Coweeman 3	M	PR
Coweeman 6	M	R
Coweeman 15	M	R
Coweeman 14	M	R
Canyon 1	M	R
Coweeman 2	L	R
Coweeman 1 tidal	L	R
Coweeman 20	L	PR
Coweeman 12	L	R
Coweeman 19	L	P
Jim Watson Creek	L	P
Coweeman 13	L	PR
Coweeman 21	L	R
LB trib2 (26.0071)	L	PR
Mulholland Creek 1	L	R
LB trib1 (26.0016)	L	PR
RB trib7	L	PR
LB trib4 (26.0097)	L	P
Nye Creek	L	PR
RB trib6	L	PR
Goble Creek 1	L	R
Lower Cowlitz-1	L	R
Martin Creek	L	P
RB trib1 (26.0019)	L	PR
LB trib3 (26.0072)	L	PR
Skipper Creek	L	R
Sam Smith Creek	L	R
RB trib3 (26.0079)	L	PR
LB trib5	L	PR
Baird Creek 2	L	P
Brown Creek	L	PR
LB trib6	L	PR
Baird Creek 1	L	P
ONeil Creek	L	PR
RB trib4 (26.0096)	L	PR
Baird Creek 3	L	PR
Nineteen Creek	L	PR
Coweeman 22	L	R
Turner Creek	L	R
RB trib5 (26.0014)	L	P
RB trib2 (26.0068)	L	PR
Little Baird Creek	L	R
North Fork Goble Creek	L	R
Goble Creek 2	L	R
Mulholland Creek 4	L	PR
Mulholland Creek 2	L	P
Mulholland Creek 3	L	R
Goble Creek 3	L	R
Goble Creek 4	L	P

Figure 7. Coweeman basin coho ladder diagram.



Reach	Reach Group	Recovery Emphasis
Coweeman 17	H	PR
Coweeman 16	H	PR
Coweeman 20	H	R
Coweeman 19	H	PR
Coweeman 8	H	PR
Coweeman 11	H	PR
Coweeman 5	H	R
Coweeman 14	H	PR
Coweeman 22	H	R
Coweeman 18	H	PR
Coweeman 10	H	PR
Coweeman 21	H	PR
Coweeman 15	M	P
Coweeman 12	M	PR
Coweeman 7	M	PR
Coweeman 9	M	PR
Canyon 3	M	P
Jim Watson Creek	M	PR
Baird Creek 2	M	R
Coweeman 6	M	PR
Mulholland Creek 3	M	PR
Canyon 2	M	P
Coweeman 13	M	P
Goble Creek 4	L	R
Baird Creek 1	L	PR
Goble Creek 1	L	R
Canyon 1	L	P
Mulholland Creek 2	L	PR
Mulholland Creek 1	L	PR
Sam Smith Creek	L	PR
Goble Creek 2	L	PR
Little Baird Creek	L	PR
Skipper Creek	L	PR
Goble Creek 3	L	R
Brown Creek	L	PR
ONeil Creek	L	PR
Nineteen Creek	L	PR
North Fork Goble Creek	L	R
Turner Creek	L	PR
Coweeman 3	L	P
Coweeman 4	L	R
Coweeman 2	L	R
Coweeman 1 tidal	L	R
Lower Cowlitz-1	L	R

Figure 8. Coweeman River subbasin winter steelhead ladder diagram.

3.4.3 *Habitat Factor Analysis*

The Habitat Factor Analysis of EDT identifies the most important habitat factors affecting fish in each reach. Whereas the EDT reach analysis identifies reaches where changes are likely to significantly affect the fish, the Habitat Factor Analysis identifies specific stream reach conditions that may be modified to produce an effect. Like all EDT analyses, the habitat factor analysis compares current/patient and historical/template habitat conditions. For each reach, EDT generates what is refered to as a “consumer reports diagram”, which identifies the degree to which individual habitat factors are acting to suppress population performance. The effect of each habitat factor is identified for each life stage that occurs in the reach and the relative importance of each life stage is indicated. For additional information and examples of this analysis, see Appendix E. Inclusion of the consumer report diagram for each reach is beyond the scope of this document. A summary of the most critical life stages and the habitat factors affecting them are displayed for each species in Table 3.

Table 3. Summary of the primary limiting factors affecting life stages of focal salmonid species. Results are summarized from EDT Analysis.

Species and Lifestage		***Primary factors***	***Secondary factors***	***Tertiary factors***
Coweeman Fall Chinook				
most critical	Egg incubation	sediment, channel stability	temperature	
second	Spawning	temperature	habitat diversity	
third	Fry colonization	habitat diversity	flow	key habitat, channel stability
Coweeman Chum				
most critical	Egg incubation	sediment	channel stability	
second	Prespawning holding	habitat diversity, key habitat	flow	
third	Spawning	habitat diversity		
Coweeman Coho				
most critical	Egg incubation	sediment	channel stability	
second	0-age winter rearing	habitat diversity	flow	channel stability
third	0-age summer rearing	habitat diversity, temperature		
Coweeman Winter Steelhead				
most critical	Egg incubation	sediment	temperature	
second	0-age summer rearing	habitat diversity	flow, temperature	
third	0,1-age winter rearing	flow, habitat diversity		

The consumer reports diagrams have also been summarized to show the relative importance of habitat factors by reach. The summary figures are referred to as habitat factor analysis diagrams and are displayed for each species below. The reaches are ordered according to their combined restoration and preservation rank. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to historical conditions.

Restoration priorities for fall Chinook in the middle mainstem include sediment, habitat diversity, temperature, channel stability, and key habitat (Figure 9). Sediment in spawning gravels is a major concern and is mostly related to basin forestry activities as described above for steelhead. Modification of historical channel morphologies as a result of flow, sediment, and riparian changes is reflected in the channel stability attribute and also contributes to loss of key habitat. The lower reaches also have high restoration priority for fall chinook and are impacted by sediment and temperature, with lesser habitat diversity, channel stability, and key habitat impacts.

Attributes with a high impact to chum (Figure 10) are found in the lower reaches and include habitat diversity, key habitat, and sediment, with moderate channel stability, flow, and food effects. Habitat diversity is reduced by a loss of instream LWD and an increase in channel confinement. Sediment accumulates readily in the lower reaches, especially in reaches 3 and 4 as the gradient drops considerably once exiting the canyon. Reaches 1 and 2 have experienced extensive diking in this urban area (Kelso), whereas reaches 3 and 4 are bordered by agricultural lands. Reaches 3 and 4 are fairly unconstrained reaches that have adjacent abandoned oxbows and wetland habitat that may provide good restoration opportunities. Restoration efforts focused on the unconfined reaches 3 and 4 may increase the quality of spawning habitats.

Coho in the Coweeman basin are affected by adverse habitat conditions primarily in the middle and upper mainstem reaches (Figure 11). In these locations, habitat diversity and sediment appear to be the habitat factors with the highest impacts on coho. Other contributing factors include channel stability, temperature, flow, and key habitat. Causes for the observed impacts are similar to those discussed above for winter steelhead.

The top priority restoration area for winter steelhead is the upper mainstem (Figure 12). These reaches suffer from high impacts related to habitat diversity, sediment, and flow, with moderate impacts from temperature and channel stability. These impacts are mostly the result of forestry operations throughout the basin. Sediment and flow problems are related to high road densities and early seral vegetation. Road densities in upper basin subwatersheds range from 4.5 to 6.4 mi/mi^2. Habitat diversity is due to loss of instream LWD. Temperature and channel stability problems are related to loss of riparian forest structure. Over 30% of riparian buffer cover along the upper mainstem is in ‘other forest’ conditions, which implies shrub-like or grass conditions. Minor predation and pathogen impacts are due to the hatchery steelhead program. A few middle mainstem reaches (Coweeman 5, 8, 10, and 11) are also ranked as high priority. These reaches have high impacts related to temperature, sediment, flow, and habitat diversity. Riparian conditions in the middle mainstem are poor, with over 75% of riparian cover in early seral or ‘other forest’ vegetation conditions. The highway, which parallels the river in the upstream portion of this segment, contributes to riparian degradation. In addition, the road network in the middle mainstem subwatershed is extensive, with over 7.5 mi/mi^2. This is one of the most densely roaded forested subwatersheds in the region. Influence from hatchery operations is represented in the pathogen and predation impacts.

Coweeman Fall Chinook

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Coweeman 16	●	⬤	●						●	⬤	•					●
Canyon 3	●	●	⬤	•					•	⬤	•					●
Coweeman 8	●	●	⬤						●	⬤	•					●
Coweeman 5	●	●	●						•	⬤	•					●
Coweeman 4	●	●	⬤						•	⬤	•					●
Coweeman 10	●	●	●						●	⬤	•					●
Canyon 2	●	●	●						•	⬤	•					●
Coweeman 11	●	●	●						•	⬤	•					●
Coweeman 7	●	●	●						•	⬤	•					●
Coweeman 9	•	●	●						•	⬤	•					●
Coweeman 6	●	●	•						•	●	•					●
Coweeman 17	•	●	•						•	⬤	•					•
Coweeman 14	•	●	•						•	⬤	•					•
Canyon 1	•	●	•						•	●	•					●
Coweeman 12	•	●	•						•	⬤	•					●
Coweeman 15	•	●	•						•	●	•					●
Coweeman 18	•	●	•						•	⬤	•					•
Mulholland Creek 1	•	●	•						•	⬤	•					•
Coweeman 3	•	●	•			•			•	•	•					●
Coweeman 13	•	●	•						•	●	•					•
Coweeman 2	•	●	•	•	•	•			•	•	•			•	•	●
Coweeman 1 tidal	•	●	•	•					•	•	•			•	•	●
Lower Cowlitz-1	•	●	•	•		•			•	•	•			•	•	•

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

Figure 9. Coweeman basin fall Chinook habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to template conditions. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams. Some low priority reaches are not included for display purposes.

Coweeman Chum

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Coweeman 4	●	⬤							●	⬤	●					⬤
Coweeman 3	●	⬤							●	⬤	●					⬤
Coweeman 2	•	•		•					•		•				•	•
Coweeman 1 tidal	•	•		•					•		•				•	•
Lower Cowlitz-1	•	•							•		•					•

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

Figure 10. Coweeman basin chum habitat factor analysis diagram.

Coweeman Coho

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Coweeman 16	●	⬤	●	•					⬤	⬤	●					●
Coweeman 4	⬤	⬤	⬤	•		•		•	●	⬤	●			•		●
Coweeman 8	●	⬤	●						●	⬤	•					●
Coweeman 11	●	⬤	●	•					●	⬤	•					●
Coweeman 10	●	⬤	●	•					●	⬤	•					●
Canyon 3	●	⬤	●	•					•	⬤	•					•
Coweeman 5	⬤	⬤	●	•		•			●	●	•			•		●
Coweeman 18	•	⬤	•						●	⬤	•					●
Coweeman 9	●	⬤	●	•					●	●	•					●
Coweeman 17	•	⬤	•						●	⬤	•					●
Canyon 2	●	⬤	●	•		•			•	●	•			•		●
Coweeman 7	●	⬤	●						●	●	•					●
Coweeman 3	●	⬤	●	•		•		•	●	•	●			•		•
Coweeman 6	•	⬤	●	•		•			●	●	•			•		●
Coweeman 15	•	⬤	•						●	●	•					●
Coweeman 14	•	⬤	•						●	●	•					●
Canyon 1	•	⬤	●	•		•			•	●	•			•		●
Coweeman 2	•	⬤	●	●	•	•			●	•	•			•		⬤
Coweeman 1 tidal	•	⬤	●	●	•	•			•	•	•			•		⬤
Coweeman 20	•	●							•	●	•					•
Coweeman 12	•	⬤	•						•	●	•					•
Coweeman 19	•	●							•	•	•					•
Jim Watson Creek	•	•	•						•	●	•					✛
Coweeman 13	•	●	•						•	●	•					•
Coweeman 21	•	●							•	•	•					•
LB trib2 (26.0071)	•	•							•	●						✛
Mulholland Creek 1	•	●	•						•	•	•					●
LB trib1 (26.0016)	•	•							•	●	•					•
RB trib7	•	•							•	•	•					✛
LB trib4 (26.0097)	•	•							•	●	•					✛
Nye Creek	•	•								•						+
RB trib6	•	•							•	•	•					✛
Goble Creek 1	•	●	•						•	•						•
Lower Cowlitz-1	•	●		•		•			•	•	•			•		•
Martin Creek	•	•							•	•	•					✛
RB trib1 (26.0019)	•	•							•	•						✛
LB trib3 (26.0072)	•	•							•	•						✛
Skipper Creek	•	•							•	•						•
Sam Smith Creek		•								•						+
RB trib3 (26.0079)	•	•							•	•						✛
LB trib5	•	•							•	•						✛
Baird Creek 2	•	•								•						
Brown Creek		•							•	•						✛
LB trib6	•	•							•	•						✛
Baird Creek 1		•								•						
ONeil Creek		•							•	•	•					✛

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

Figure 11. Coweeman basin coho habitat factor analysis diagram. Some low priority reaches are not included for display purposes

Coweeman Winter Steelhead

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Coweeman 17	•	⬤	•	•					⬤	⬤	●			•		+
Coweeman 16	•	⬤	●	•					⬤	⬤	●			•		+
Coweeman 20	●	⬤	●	•					⬤	⬤	●					+
Coweeman 19	●	⬤	•	•					⬤	⬤	●					+
Coweeman 8	•	⬤	●	•					●	⬤	•			•		+
Coweeman 11	•	⬤	●	•					●	●	•			•		+
Coweeman 5	●	⬤	●	•		•			●	●	•			•		+
Coweeman 14	•	⬤	●	•					●	●	•			•		+
Coweeman 22	•	⬤	•	•					●	⬤	•					╋
Coweeman 18	•	●	•	•					●	⬤	•					+
Coweeman 10	•	⬤	●	•					●	●	•			•		
Coweeman 21	•	●	•	•					●	⬤	•					+
Coweeman 15	•	●	•	•					●	●	•					
Coweeman 12	•	⬤	●	•					●	●	•			•		
Coweeman 7	•	●	●	•					●	●	•			•		
Coweeman 9	•	●	●	•					●	●	•			•		
Canyon 3	•	●	●	•					•	●				•		
Jim Watson Creek		•	●	•					•	⬤	•			•		╋
Baird Creek 2	•	●	●	•		•			●	⬤	•			•		+
Coweeman 6	•	●	●	•					●	●	•			•		
Mulholland Creek 3	•	•	●	•					•	⬤	•			•		╋
Canyon 2	•	●	•	•					•	•				•		
Coweeman 13	•	●	•						•	●	•			•		
Goble Creek 4	•	●	•						●	●	•			•		╋
Baird Creek 1	•	●	●	•					●	●	•			•		+
Goble Creek 1	•	●	•						●	●	•			•		+
Canyon 1	•	●	•	•					•	•				•		
Mulholland Creek 2		•	●	•					•	●	•			•		+
Mulholland Creek 1	•	●	●						•	●	•			•		+
Sam Smith Creek	•	•	•						•	⬤	•					+
Goble Creek 2	•	●	•						●	●	•			•		+
Little Baird Creek	•	•	•						•	●	•					+
Skipper Creek	•	●	•						•	●	•					+

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ╋ High Positve Impact ✚

Figure 12. Coweeman River subbasin winter steelhead habitat factor analysis diagram.

3.5 Watershed Process Limitations

This section describes watershed process limitations that contribute to stream habitat conditions significant to focal fish species. Reach level stream habitat conditions are influenced by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input, and large woody debris recruitment are often affected by upstream conditions and by contributing landscape factors. Accordingly, restoration of degraded channel habitat may require action outside the targeted reach, often extending into riparian and hillslope (upland) areas that are believed to influence the condition of aquatic habitats.

Watershed process impairments that affect stream habitat conditions were evaluated using a watershed process screening tool termed the Integrated Watershed Assessment (IWA). The IWA is a GIS-based assessment that evaluates watershed impairments at the subwatershed scale (3,000 to 12,000 acres). The tool uses landscape conditions (i.e. road density, impervious surfaces, vegetation, soil erodability, and topography) to identify the level of impairment of 1) riparian function, 2) sediment supply conditions, and 3) hydrology (runoff) conditions. For sediment and hydrology, the level of impairment is determined for local conditions (i.e. within subwatersheds, not including upstream drainage area) and at the watershed level (i.e. integrating the entire drainage area upstream of each subwatershed). See Appendix E for additional information on the IWA.

For the purpose of recovery planning, the Coweeman River watershed has been divided into 18 subwatersheds totaling 129,544 acres. Principal tributaries to the Coweeman River include Goble, Mulholland, Baird, O'Neil, and Butler creeks. Note that three subwatersheds within the watershed, one encompassing Stratton Creek (80201) and the other two Ostrander Creek (80101 and 80102), do not drain to the Coweeman River, but are tributary to the lower mainstem Cowlitz. A reference map showing the location of each subwatershed in the basin is presented in Figure 13. Maps of the distribution of local and watershed level IWA results are displayed in Figure 14.

3.5.1 *Hydrology*

Current Conditions.— Viewed at the local scale, most (78%) of the subwatersheds are hydrologically impaired; the rest are moderately impaired. One subwatershed (80303) shifts from impaired to moderately impaired when upstream (i.e., watershed-level) effects are taken into account. This subwatershed is located on the upper Coweeman River mainstem immediately downstream of a cluster of four (hydrologically) moderately impaired subwatersheds. Hydrologic conditions worsen progressively on a downstream gradient. The least impaired subwatersheds (note that none receive a “functional” rating) are situated in the upper Coweeman, Baird Creek, and Mulholland Creek drainages. All of the subwatersheds downstream of the junction of the Coweeman River and Baird Creek are hydrologically impaired.

Most of the upper basin subwatersheds have been extensively logged. Furthermore, several subwatersheds in the upper basin fall within the rain-on-snow zone and present steep aspects, making them more susceptible to hydrologic disturbance.

The lower elevation subwatersheds have been heavily logged and roaded, and in some cases developed for agriculture and residential purposes, resulting in degraded hydrologic (as well as sediment and riparian conditions) throughout. These subwatersheds are also influenced by hydrologic impairments from upstream areas, which further impacts watershed conditions.

Wetlands are an uncommon feature of the Coweeman watershed other than in the lower floodplain areas. Most of the wetlands are found at lower elevations and may be classified as “riverine”, that is, in close proximity and hydraulically linked to the active river channel. Subwatershed 80407, located at the mouth of the Coweeman River, contains 67% of the known wetland area delineated in the Coweeman watershed. The frequency and degree of inundation of riverine wetlands is directly linked to water table levels and seepage, channel-floodplain configuration, and streambank heights.

The effects of reduced hydrologic buffering by headwater subwatersheds are apparent. Lower than normal seasonal flows have been recorded in recent years in the lower Coweeman mainstem. Low streamflow conditions during the summer through October period are thought to limit the physical space for juvenile rearing and to reduce travel speeds of migrating chinook and coho salmon, reducing their growth and survival (WDW 1990). Caldwell et al. (1999) reported suboptimal flows during the fall spawning period.

Predicted Future Trends.— Headwaters subwatersheds with a high percentage of mature forest cover and lower road densities are less likely to be degraded hydrologically than are areas downstream. Nevertheless, timber harvest is likely to occur on these lands over the next 20 years. Roads, already fairly extensive in portions of the upper watershed, will likely increase concomitant with timber extraction. The effect of future forest practices will be mitigated to some degree by road construction and maintenance requirements under the new Forest Practices regulations. Considering these factors, hydrologic conditions in high elevation subwatersheds are expected to remain stable over the next 20 years.

In lower and mid elevation subwatersheds, it is expected that some of the current forestland will be converted to private and commercially developed land. Despite these land-use changes, timber harvest is expected to remain the predominant land use and hydrologic conditions are expected to remain relatively stable.

In the lower, floodplain areas of the lower Coweeman River, development is increasing and the development trend is likely to continue. Hydrologic condition is expected to decline in these newly developed areas.

Table 4. IWA results for the Coweeman River Watershed

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
80401	I	M	M	I	M	80301,80302, 80303, 80304, 80305, 80306, 80307, 80404, 80405
80102	I	M	M	I	M	80101, Coweeman
80301	I	M	M	I	M	80302, 80303, 80304, 80305, 80306, 80307
80302	I	M	M	I	M	80306
80303	I	M	M	I	M	80304, 80305, 80307
80304	M	F	M	M	F	none
80305	M	M	M	M	M	none
80307	M	M	M	M	M	80305
80401	I	M	M	I	M	80301,80302, 80303, 80304, 80305, 80306, 80307, 80404, 80405
80402	I	I	I	I	M	80301,80302, 80303, 80304, 80305, 80306, 80307, 80401,80403, 80404, 80405
80403	I	M	M	I	M	80301,80302, 80303, 80304, 80305, 80306, 80307, 80401, 80404, 80405
80405	I	M	M	I	M	80404
80407	I	M	I	I	M	80301,80302, 80303, 80304, 80305, 80306, 80307, 80401,80403, 80404, 80405
80101	I	M	M	I	M	None
80102	I	M	M	I	M	None
80306	M	F	M	M	F	None
80404	I	M	M	I	M	None
80406	I	M	M	I	M	None

Notes:

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170800030#####.

[b] IWA results for watershed processes at the subwatershed level (i.e., not considering upstream effects). This information is used to identify areas that are potential sources of degraded conditions for watershed processes, abbreviated as follows: F: Functional, M: Moderately impaired, I: Impaired

[c] IWA results for watershed processes at the watershed level (i.e., considering upstream effects). These results integrate the contribution from all upstream subwatersheds to watershed processes and are used to identify the probable condition of these processes in subwatersheds where key reaches are present.

[d] Subwatersheds upstream from this subwatershed.

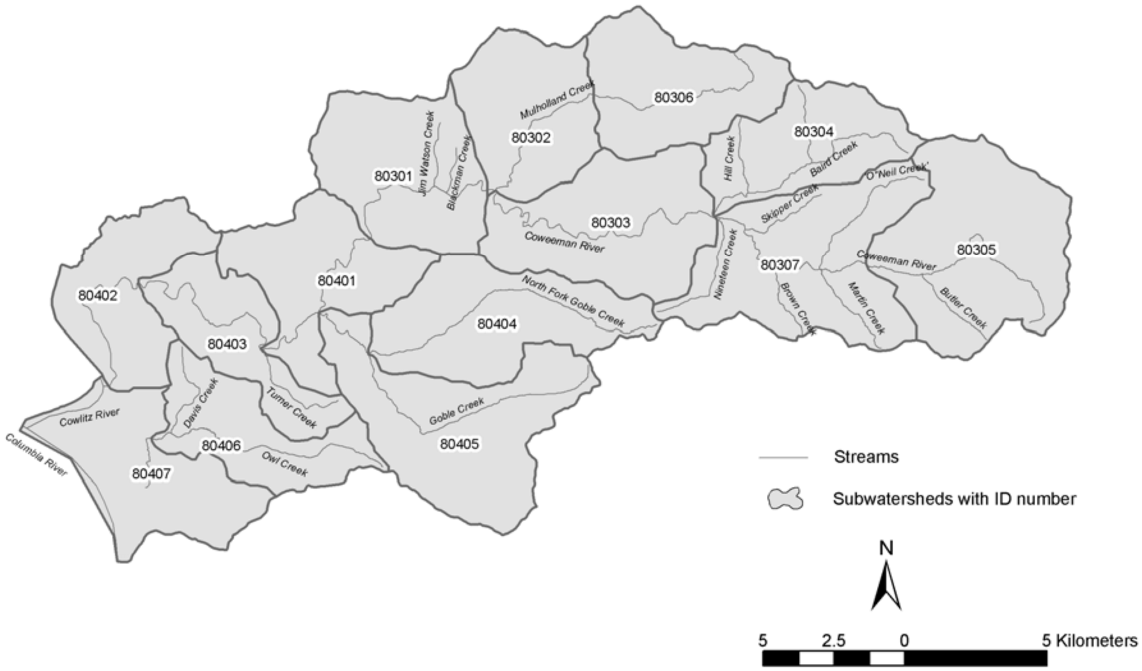


Figure 13. Map of the Coweeman Basin showing the location of the IWA subwatersheds.

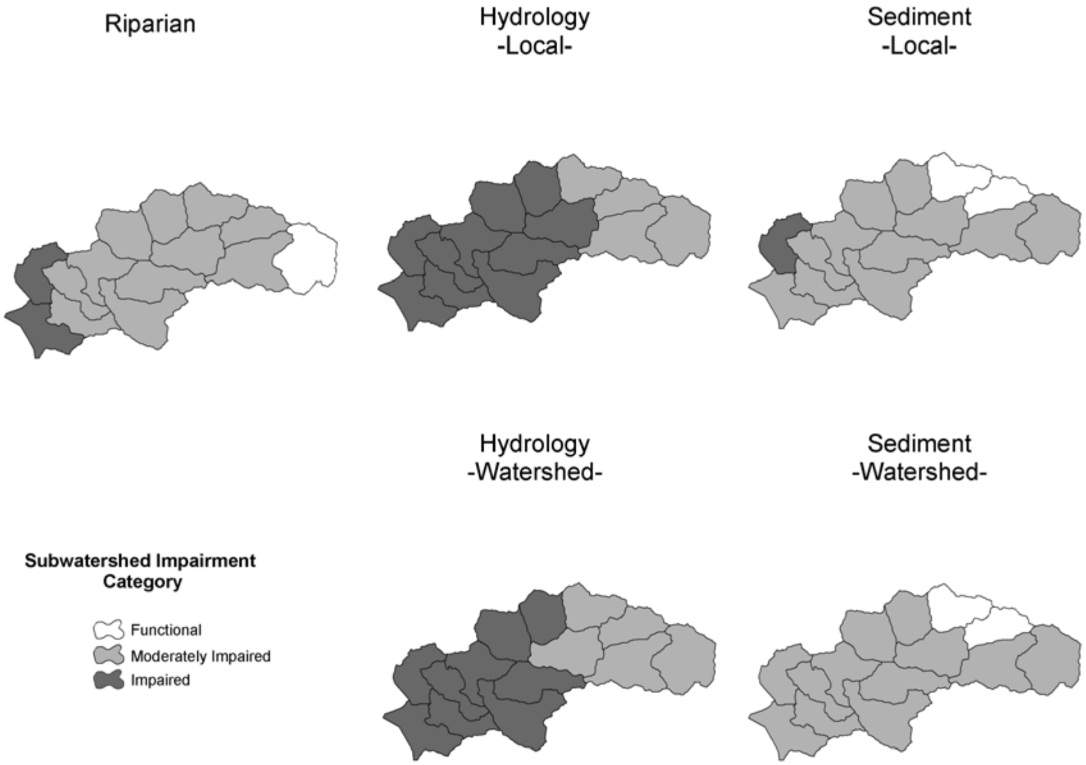


Figure 14. IWA subwatershed impairment ratings by category for the Coweeman basin

3.5.2 *Sediment Supply*

Current Conditions.— Sediment conditions throughout the Coweeman watershed are generally rated as moderately impaired. Functional conditions (local and watershed level) are found only in the upper subwatersheds of Baird and Mulholland Creeks (80304 and 80306). The one subwatershed found to be locally impaired was 80402, located near the mouth of the Coweeman River.

The underlying geologic material of the upper Coweeman watershed consists primarily of resistant volcanic rocks with local deposits of erodable alluvium. The geology in lower elevation areas of the Coweeman watershed consists of sedimentary/metamorphic rock overlain in many places by a mixture of gravel, sand, and silt alluvial deposits. These materials are highly erodable, particularly in steep terrain. The subwatersheds in this watershed are densely forested, with relatively high proportions of mature coniferous vegetation under natural conditions. Commercial forestry and road building on unstable slopes is the primary cause of human-induced sediment supply impairments.

There is evidence of sediment contribution to the mainstem Coweeman between RMs 17 and 26 (Wade 2000). Sediment delivery to this reach is apparent as turbidity during flood flows and as sediment deposits in slackwater areas after flows recede. Fine sediment accumulations in this reach are thought to limit production of coastal cutthroat, winter steelhead, fall chinook, and coho.

Predicted Future Trends.— Because the majority of the Coweeman watershed is owned and managed by large industrial timber companies, high levels of timber harvests are likely to continue under typical harvest rotation schedules for the foreseeable future. The widespread implementation of improved forestry and road management practices is expected to mitigate timber harvest impacts on sediment supply to stream channels. Given these factors, sediment conditions are predicted to trend stable over the next 20 years.

3.5.3 *Riparian Condition*

Current Conditions.— The index of riparian condition is based on the proportion of streamside vegetation within different vegetation classes. The riparian condition analysis was applied only at the subwatershed level. Dense forests, some of old growth, cover the steep topography of the upper Coweeman drainage. Commercial forestland makes up over 90% of the watershed. Much of the harvestable timber has been cut at some point in the past, resulting in a patchwork of logged and unlogged areas intersected by logging roads. Areas logged in the past currently comprise immature stands of young coniferous and/or deciduous vegetation.

Riparian conditions in the Coweeman River watershed are generally rated as moderately impaired, although two of the 18 subwatersheds are rated as fully impaired. Both are the most downstream areas of the watershed and encompass development around the cities of Kelso and Longview. The lower four miles of the Coweeman (80407) are tidally influenced and contain riparian habitats of low quality due to extensive channelization and bank modifications. The Coweeman headwaters (80305) is the only subwatershed rated as functional for riparian conditions.

Predicted Future Trends.— Riparian systems are considered highly vulnerable to human-caused disturbance (Naiman et al. 1993). Land uses alter riparian systems and associated processes in ways that can profoundly alter aquatic and riparian habitat (Montgomery and

Buffington 1993). Because riparian systems influence the structure and function of small streams more than large streams, their condition in headwater areas is critical to watershed health.

Riparian conditions were assessed using the subwatershed-level IWA metrics in conjunction with additional landscape scale data. As noted previously, the majority of Coweeman subwatersheds were rated as moderately impaired, with two subwatersheds in the developed areas of the lower watershed rated as fully impaired. There is only one subwatershed rated as functional, located in the Coweeman headwaters.

Based on future trend data, riparian conditions are likely to remain stable with a trend towards gradual improvment in the upper watershed. However, the re-establishment of native vegetation in the middle and upper watershed may be hampered by degraded hydrologic conditions. In contrast, conditions are likely to degrade further in more downstream subwatersheds as development pressures expand. In these low-lying areas, encroachment and riparian degradation resulting from construction of roads, stream crossings, and buildings is expected to increase over time.

The most impaired ratings are found in the estuary and lower river (30406, 30401), where the majority of the mainstem has been channelized through diking and most side-channel habitat has been lost. The presence of dikes and other channel revetments reduces the potential for riparian recovery. However, conservation easements and other public-private partnerships (such as those already being developed by the Columbia Trust) offer some promise that floodplain dynamics and riparian conditions in this estuarine area may improve over the next 20 years.

3.6 Other Factors and Limitations

3.6.1 *Hatcheries*

Hatcheries currently release over 50 million salmon and steelhead per year in Washington lower Columbia River subbasins. Many of these fish are released to mitigate for loss of habitat. Hatcheries can provide valuable mitigation and conservation benefits but may also cause significant adverse impacts if not prudently and properly employed. Risks to wild fish include genetic deterioration, reduced fitness and survival, ecological effects such as competition or predation, facility effects on passage and water quality, mixed stock fishery effects, and confounding the accuracy of wild population status estimates. This section describes hatchery programs in the Coweeman Basin and discusses their potential effects.

There are no hatcheries operating in the Coweeman Basin. A rearing pond on the Coweeman is used to acclimate winter steelhead transfers from the Elochoman Hatchery as pre-smolts. The winter steelhead program provides for harvest opportunity in the Coweeman River. Elochoman Hatchery early timed winter steelhead are a composite stock and are genetically different from the naturally produced steelhead in the Coweeman. The main threats from hatchery steelhead are potential domestication of the naturally produced steelhead as a result of adult interactions or ecological interactions between natural juvenile salmon and hatchery released juvenile steelhead.

Table 5. Current Coweeman subbasin hatchery production.

Hatchery	Release Location	Winter Steelhead
Elochoman	Coweeman	20,000

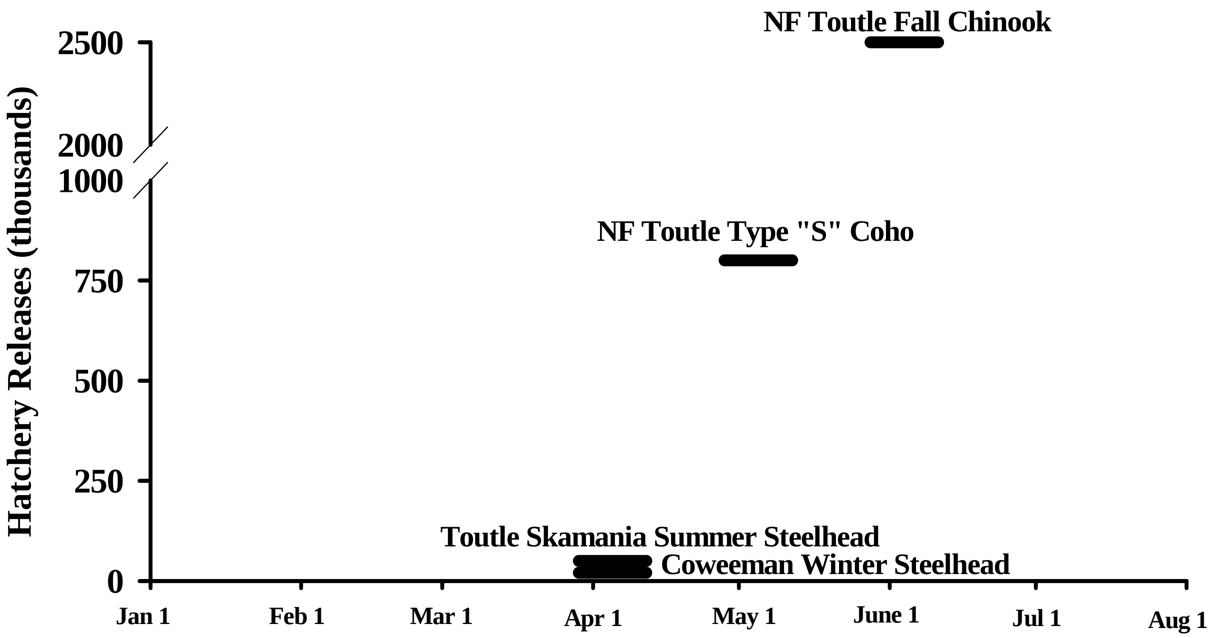


Figure 15. Magnitude and timing of hatchery releases in the Toutle and Coweeman River basins by species, based on 2003 brood production goals.

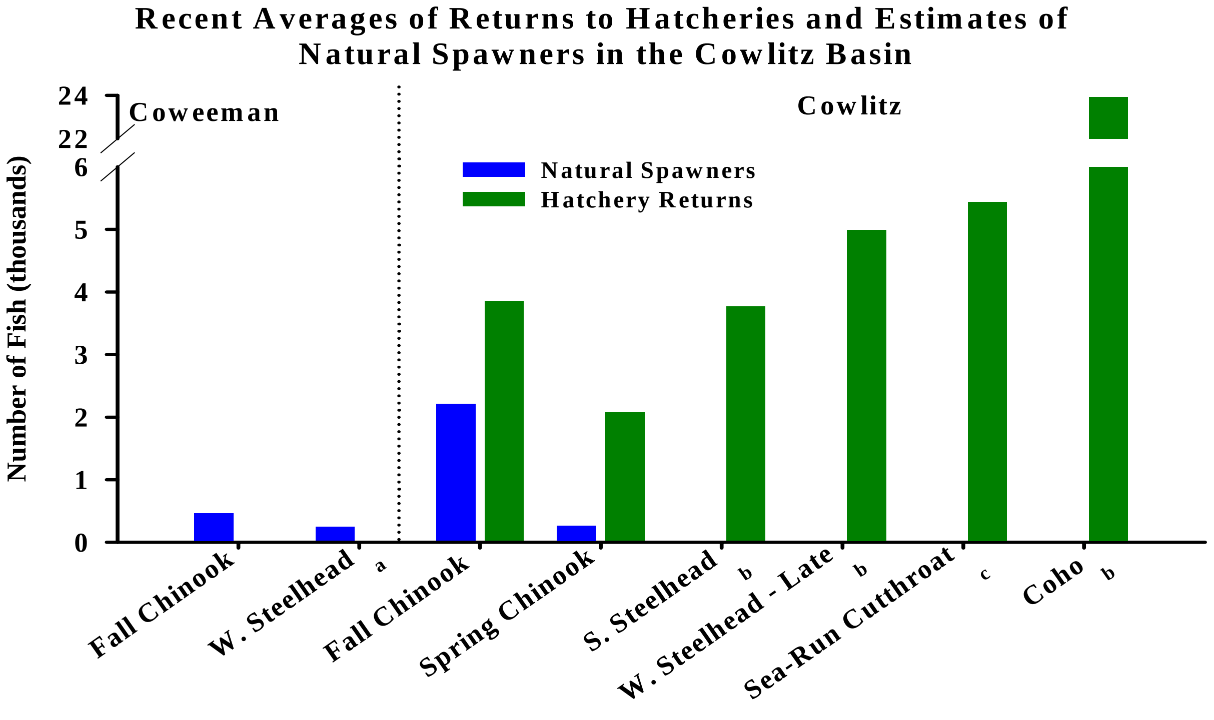


Figure 16. Recent average hatchery returns and estimates of natural spawning escapement in the Coweeman and Cowlitz River basins by species. The years used to calculate averages varied by species, based on available data. The data used to calculate average hatchery returns and natural escapement for a particular species and basin were derived from the same years in all cases. All data were from 1992 to the present. Calculation of each average utilized a minimum of 5 years of data, except for Grays chum (1998–2000) and Grays winter steelhead (1998 and 2000).

Biological Risk Assessment

The evaluation of hatchery programs and implementation of hatchery reform in the Lower Columbia is occurring through several processes. These include: 1) the LCFRB recovery planning process; 2) Hatchery Genetic Management Plan (HGMP) preparation for ESA permitting; 3) FERC related plans on the Cowlitz River and Lewis River; and 4) the federally mandated Artificial Production Review and Evaluation (APRE) process. Through each of these processes, WDFW is applying a consistent framework to identify the hatchery program enhancements that will maximize fishing-related economic benefits and promote attainment of regional recovery goals. Developing hatcheries into an integrated, productive, stock recovery tool requires a policy framework for considering the acceptable risks of artificial propagation, and a scientific assessment of the benefits and risks of each proposed hatchery program. WDFW developed the Benefit-Risk Assessment Procedure (BRAP) to provide that framework. The BRAP evaluates hatchery programs in the ecological context of the watershed, with integrated assessment and decisions for hatcheries, harvest, and habitat. The risk assessment procedure consists of five basic steps, grouped into two blocks:

Policy Framework

- Assess population status of wild populations
- Develop risk tolerance profiles for all stock conditions
- Assign risk tolerance profiles to all stocks

Risk Assessment

- Conduct risk assessments for all hatchery programs
- Identify appropriate management actions to reduce risk

Following the identification of risks through the assessment process, a strategy is developed to describe a general approach for addressing those risks. Building upon those strategies, program-specific actions and an adaptive management plan are developed as the final steps in the WDFW framework for hatchery reform.

Table 6 identifies hazards levels associated with risks involved with hatchery programs in the Coweeman Basin. Table 7 identifies preliminary strategies proposed to address risks identified in the BRAP for the same populations.

The BRAP risk assessments and strategies to reduce risk have been key in providing the biological context to develop the hatchery recovery measures for lower Columbia River sub-basins.

Table 6. Preliminary BRAP for hatchery programs affecting populations in the Coweeman River Basin.

Symbol	Description
○	Risk of hazard consistent with current risk tolerance profile.
?	Magnitude of risk associated with hazard unknown.
●	Risk of hazard exceeds current risk tolerance profile.
▨	Hazard not relevant to population

	Hatchery Program		Risk Assessment of Hazards											
			Genetic			Ecological			Demographic		Facility			
Coweeman Population	Name	Release (millions)	Effective Population Size	Domestication	Diversity	Predation	Competition	Disease	Survival Rate	Reproductive Success	Catastrophic Loss	Passage	Screening	Water Quality
Fall Chinook	Coweeman Early W. Sthd. Acc.	0.005	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	Coweeman Early W. Sthd.	0.015	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
Winter Steelhead	Coweeman Early W. Sthd. Acc.	0.005	○	○	?	?	?	○	▨	▨	▨	○	○	○
	Coweeman Early W. Sthd.	0.015	○	○	?	?	?	○	▨	▨	▨	○	○	○

Table 7. Preliminary strategies proposed to address risks identified in the BRAP for Coweeman River Basin populations.

	Hatchery Program		Risk Assessment of Hazards															
			Address Genetic Risks					Address Ecological Risks				Address Demographic Risks		Address Facility Risks			
Coweeman Population	Name	Release (millions)	Mating Procedure	Integrated Program	Segregated Program	Research/ Monitoring	Broodstock Source	Number Released	Release Procedure	Disease Containment	Research/ Monitoring	Culture Procedure	Research/ Monitoring	Reliability	Improve Passage	Improve Screening	Pollution Abateme
Fall Chinook	Early W. Steelhead Acclimated	0.005	▨	▨	▨	▨	▨	●	●		●	▨	▨	▨			
	Early W. Steelhead 1+	0.015	▨	▨	▨	▨	▨	●	●		●	▨	▨	▨			

Impact Assessment

The potential significance of negative hatchery impacts within the subbasin on natural populations was estimated with a simple index based on: 1) intra-specific effects resulting from depression in wild population productivity that can result from interbreeding with less fit hatchery fish and 2) inter-specific effects resulting from predation of juvenile salmonids of other species. The index reflects only a portion of net hatchery effects but can provide some sense of the magnitude of key hatchery risks relative to other limiting factors. Fitness effects are among the most significant intra-specific hatchery risks and can also be realistically quantified based on hatchery fraction in the natural spawning population and assumed fitness of the hatchery fish relative to the native wild population. Predation is among the most significant inter-specific effects and can be estimated from hatchery release numbers by species. This index assumed that equilibrium conditions have been reached for the hatchery fraction in the wild and for relative fitness of hatchery and wild fish. This simplifying assumption was necessary because more detailed information is lacking on how far the current situation is from equilibrium. The index does not consider the numerical benefits of hatchery spawners to natural population numbers, ecological interactions between hatchery and wild fish other than predation, or out-of-basin interactions, all of which are difficult to quantify. Appendix E contains a detailed description of the method and rationale behind this index.

The fitness impact is low for coho (11%) and higher for winter steelhead (17%) where hatchery and wild fish are segregated by differences in spawn timing (competition effects are not assessed). There are no fitness impacts of hatchery releases on fall Chinook or chum in the Coweeman Basin. Interspecific impacts from predation appear to be less then 1% for all species.

Table 8. Presumed reductions in wild population fitness as a result of natural hatchery spawners and survival as a result of interactions with other hatchery species for Coweeman River salmon and steelhead populations.

Population	Annual releases[a]	Hatchery fraction[b]	Fitness category[c]	Assumed fitness[d]	Fitness impact[e]	Interacting releases[f]	Interspecies impact[g]
Fall Chinook	0[h]	0.00	0	--	0.00	20,000	0.001
Chum	0[i]	0	--	--	0	20,000	0.001
Coho	0[j]	0.38	2	0.7	0.11	20,000	0.0003
Winter steelhead	20,000	0.23	4	0.3	0.161	0	0

[a] Annual release goals.

[b] Proportion of natural spawners that are first generation hatchery fish.

[c] Broodstock category: 1 = derived from native local stock, 2 = domesticated stock of native local origin, 3 = originates from same ESU but substantial divergence may have occurred, 4 = out-of-ESU origin or origin uncertain

[d] Productivity of naturally-spawning hatchery fish relative to native wild fish prior to significant hatchery influence. Because population-specific fitness estimates are not available for most lower Columbia River populations, we applied hypothetical rates comparable to those reported in the literature and the nature of local hatchery program practices.

[e] Index based on hatchery fraction and assumed fitness.

[f] Number of other hatchery releases with a potential to prey on the species of interest. Includes steelhead and coho for fall chinook and coho. Includes steelhead for chum.

[g] Predation impact based on interacting releases and assumed species-specific predation rates. Chum interaction assumed to occur in lower Cowlitz River from Cowlitz Hatchery releases

[h] Hatchery fall chinook have not been released in the Coweeman River basin since the early 1980s and tagged hatchery strays have not been recovered during spawning surveys since that time.

[i] There are no records of hatchery chum releases in the basin.

[j] Hatchery coho salmon are no longer released in the basin; hatchery fish in these basins appear to be strays from other programs. [g] Predation impact based on interacting releases and assumed species-specific predation rates.

3.6.2 *Harvest*

Fishing generally affects salmon populations through directed and incidental harvest, catch and release mortality, and size, age, and run timing alterations because of uneven fishing on different run components. From a population biology perspective, this causes reduced spawners and can alter age, size, run timing, fecundity, and genetic characteristics. Fewer spawners result in fewer eggs for future generations and diminish marine-derived nutrients delivered via dying adults, now known to be significant to the growth and survival of juvenile salmon in aquatic ecosystems. The degree to which harvest-related limiting factors influence productivity varies by species and location.

Most harvest of wild Columbia River salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. Fish are caught in the Canada/Alaska ocean, U.S. West Coast ocean, lower Columbia River commercial and recreational, tributary recreational, and in-river treaty Indian (including commercial, ceremonial, and subsistence) fisheries. Total exploitation rates have decreased for lower Columbia salmon and steelhead, especially since the 1970s as increasingly stringent protection measures were adopted for declining natural populations.

Current fishing impact rates on lower Columbia River naturally-spawning salmon populations ranges from 2.5% for chum salmon to 45% for tule fall Chinook (Table 9). These rates include estimates of direct harvest mortality as well as estimates of incidental mortality in catch and release fisheries. Fishery impact rates for hatchery produced chum, coho, and steelhead are higher than for naturally-spawning fish of the same species because of selective fishing regulations. These rates generally reflect recent year (2001-2003) fishery regulations and quotas controlled by weak stock impact limits and annual abundance of healthy targeted fish. Actual harvest rates will vary for each year dependent on annual stock status of multiple west coast salmon populations, however, these rates generally reflect expected impacts of harvest on lower Columbia naturally-spawning and hatchery salmon and steelhead under current harvest management plans.

Table 9. Approximate annual exploitation rates (% harvested) for naturally-spawning lower Columbia salmon and steelhead under current management controls (represents 2001-2003 fishing period).

	AK./Can. Ocean	West Coast Ocean	Col. R. Comm.	Col. R. Sport	Trib. Sport	**Wild Total**	Hatchery Total	Historic Highs
Fall Chinook (Tule)	15	15	5	5	5	**45**	45	80
Fall Chinook (Bright)	19	3	6	2	10	**40**	Na	65
Chum	0	0	1.5	0	1	**2.5**	2.5	60
Coho	<1	9	6	2	1	**18**	51	85
Steelhead	0	<1	3	0.5	5	**8.5**	70	75

Columbia River fall Chinook are subject to freshwater and ocean fisheries from Alaska to their rivers of origin in fisheries targeting abundant Chinook stocks originating from Alaska, Canada, Washington, Oregon, and California. Columbia tule fall Chinook harvest is constrained by a Recovery Exploitation Rate (RER) developed by NOAA Fisheries for management of Coweeman naturally-spawning fall Chinook. Some tributary sport fisheries (like the Coweeman) are closed to the retention of Chinook to protect wild chinook populations. Harvest of lower Columbia bright wild fall Chinook is managed to achieve an escapement goal of 5,700 natural spawners in the North Fork Lewis.

Rates are very low for chum salmon, which are not encountered by ocean fisheries and return to freshwater in late fall when significant Columbia River commercial fisheries no longer occur. Chum are no longer targeted in Columbia commercial seasons and retention of chum is prohibited in Columbia River and Coweeman River sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead.

Harvest of Coweeman coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River as well as recreational fisheries in the Coweeman Basin. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish.

Steelhead, like chum, are not encountered by ocean fisheries and non-Indian commercial steelhead fisheries are prohibited in the Columbia River. Incidental mortality of steelhead occurs in freshwater commercial fisheries directed at Chinook and coho and freshwater sport fisheries directed at hatchery steelhead and salmon. All recreational fisheries are managed to selectively harvest fin-marked hatchery steelhead and commercial fisheries cannot retain hatchery or wild steelhead.

Access to harvestable surpluses of strong stocks in the Columbia River and ocean is regulated by impact limits on weak populations mixed with the strong. Weak stock management of Columbia River fisheries became increasingly prevalent in the 1960s and 1970s in response to continuing declines of upriver runs affected by mainstem dam construction. In the 1980s coordinated ocean and freshwater weak stock management commenced. More fishery restrictions followed ESA listings in the 1990s. Each fishery is controlled by a series of regulating factors. Many of the regulating factors that affect harvest impacts on Columbia River stocks are associated with treaties, laws, policies, or guidelines established for the management of other stocks or combined stocks, but indirectly control impacts of Columbia River fish as well. Listed fish generally comprise a small percentage of the total fish caught by any fishery. Every listed fish may correspond to tens, hundreds, or thousands of other stocks in the total catch. As a result of weak stock constraints, surpluses of hatchery and strong naturally-spawning runs often go unharvested. Small reductions in fishing rates on listed populations can translate to large reductions in catch of other stocks and recreational trips to communities which provide access to fishing, resulting in significant economic consequences to those communities.

Selective fisheries for adipose fin-clipped hatchery spring Chinook (since 2001), coho (since 1999), and steelhead (since 1984) have substantially reduced fishing mortality rates for naturally-spawning populations and allowed concentration of fisheries on abundant hatchery fish. Selective fisheries occur in the Columbia River and tributaries, for spring Chinook and steelhead, and in the ocean, Columbia River, and tributaries for coho. Columbia River hatchery fall Chinook are not marked for selective fisheries, but likely will be in the future because of recent legislation enacted by Congress.

3.6.3 *Mainstem and Estuary Habitat*

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. Juvenile and adult salmon may be found in the mainstem and estuary at all times of the year, as different species, life history strategies and size classes continually rear or move through these waters. A variety of human activities in the mainstem and estuary have decreased both the quantity and quality of habitat used by juvenile salmonids. These include floodplain development; loss of side channel habitat, wetlands and marshes; and alteration of flows due to upstream hydro operations and irrigation withdrawals.

Effects on salmonids of habitat changes in the mainstem and estuary are complex and poorly understood. Effects are similar for Coweeman populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook which rear for extended periods in the mainstem and estuary than for steelhead and coho which move through more quickly. Estimates of the impacts of human-caused changes in mainstem and estuary habitat conditions are available based on changes in river flow, temperature, and predation as represented by EDT analyses for the NPCC Multispecies Framework Approach (Marcot et al. 2002). These estimates generally translate into a 10-60% reduction in salmonid productivity depending on species (Appendix E). Estuary effects are described more fully in the estuary subbasin volume of this plan (Volume II-A).

3.6.4 *Hydropower Construction and Operation*

There are no hydro-electric dams in the Coweeman River Basin. However, Coweeman species are affected by changes in Columbia River mainstem and estuary related to Columbia basin hydropower development and operation. The mainstem Columbia River and estuary provide important habitats for anadromous species during juvenile and adult migrations between spawning and rearing streams and the ocean where they grow and mature. These habitats are particularly important for fall Chinook and chum, which rear extensively in the Columbia mainstem and estuary. Aquatic habitats have been fundamentally altered throughout the Columbia River basin by the construction and operation of a complex of tributary and mainstem dams and reservoirs for power generation, navigation, and flood control.

The hydropower infrastructure and flow regulation affects adult migration, juvenile migration, mainstem spawning success, estuarine rearing, water temperature, water clarity, gas supersaturation, and predation. Dams block or impede passage of anadromous juveniles and adults. Columbia River spring flows are greatly reduced from historical levels as water is stored for power generation and irrigation, while summer and winter flows have increased. These flow changes affect juvenile and adult migration, and have radically altered habitat forming processes. Flow regulation and reservoir construction have increased average water temperature in the Columbia River mainstem and summer temperatures regularly exceed optimums for salmon. Supersaturation of water with atmospheric gases, primarily nitrogen, when water is spilled over high dams causes gas bubble disease. Predation by fish, bird, and marine mammals has been exacerbated by habitat changes. The net effect of these direct and indirect effects is difficult to quantify but is expected to be less significant for populations originating from lower Columbia River subbasins than for upriver salmonid populations. Additional information on hydropower effects can be found in the Regional Recovery and Subbasin Plan Volume I.

3.6.5 *Ecological Interactions*

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Salmon and steelhead are affected throughout their lifecycle by ecological interactions with non native species, food web components, and predators. Each of these factors can be exacerbated by human activities either by direct actions or indirect effects of habitat alternation. Effects of non-native species on salmon, effects of salmon on system productivity, and effects of native predators on salmon are difficult to quantify. Strong evidence exists in the scientific literature on the potential for significant interactions but effects are often context- or case-specific.

Predation is one interaction where effects can be estimated although interpretation can be complicated. In the lower Columbia River, northern pikeminnow, Caspian tern, and marine mammal predation on salmon has been estimated at approximately 5%, 10-30%, and 3-12%, respectively of total salmon numbers (see Appendix E for additional details). Predation has always been a source of salmon mortality but predation rates by some species have been exacerbated by human activities.

3.6.6 *Ocean Conditions*

Salmonid numbers and survival rates in the ocean vary with ocean conditions and low productivity periods increase extinction risks of populations stressed by human impacts. The ocean is subject to annual and longer-term climate cycles just as the land is subject to periodic droughts and floods. The El Niño weather pattern produces warm ocean temperatures and warm, dry conditions throughout the Pacific Northwest. The La Niña weather patterns is typified by cool ocean temperatures and cool/wet weather patterns on land. Recent history is dominated by a high frequency of warm dry years, along with some of the largest El Niños on record—particularly in 1982-83 and 1997-98. In contrast, the 1960s and early 1970s were dominated by a cool, wet regime. Many climatologists suspect that the conditions observed since 1998 may herald a return to the cool wet regime that prevailed during the 1960s and early 1970s.

Abrupt declines in salmon populations throughout the Pacific Northwest coincided with a regime shift to predominantly warm dry conditions from 1975 to 1998 (Beamish and Bouillon 1993, Hare et al 1999, McKinnell et al. 2001, Pyper et al. 2001). Warm dry regimes result in generally lower survival rates and abundance, and they also increase variability in survival and wide swings in salmon abundance. Some of the largest Columbia River fish runs in recorded history occurred during 1985–1987 and 2001–2002 after strong El Niño conditions in 1982–83 and 1997–98 were followed by several years of cool wet conditions.

The reduced productivity that accompanied an extended series of warm dry conditions after 1975 has, together with numerous anthropogenic impacts, brought many weak Pacific Northwest salmon stocks to the brink of extinction and precipitated widespread ESA listings. Salmon numbers naturally ebb and flow as ocean conditions vary. Healthy salmon populations are productive enough to withstand these natural fluctuations. Weak salmon populations may disappear or lose the genetic diversity needed to withstand the next cycle of low ocean productivity (Lawson 1993).

Recent improvements in ocean survival may portend a regime shift to generally more favorable conditions for salmon. The large spike in recent runs and a cool, wet climate would provide a respite for many salmon populations driven to critical low levels by recent conditions. The National Research Council (1996) concluded: "*Any favorable changes in ocean conditions—which could occur and could increase the productivity of some salmon populations for a time—should be regarded as opportunities for improving management techniques. They should not be regarded as reasons to abandon or reduce rehabilitation efforts, because conditions will change again*". Additional details on the nature and effects of variable ocean conditions on salmonids can be found in the Regional Recovery and Subbasin Plan Volume I.

3.7 Summary of Human Impacts on Salmon and Steelhead

Stream habitat, estuary/mainstem habitat, harvest, hatchery and ecological interactions have all contributed to reductions in productivity, numbers, and population viability. Pie charts in Figure 17 describe the relative magnitude of potentially-manageable human impacts in each category of limiting factor for Coweeman Basin salmon and steelhead. Impact values were developed for a base period corresponding to species listing dates. This depiction is useful for identifying which factors are most significant for each species and where improvements might be expected to provide substantial benefits. Larger pie slices indicate greater significance and scope for improvement in an impact for a given species. These numbers also serve as a working hypothesis for factors limiting salmonid numbers and viability. Chum pie charts are not included in this report but can be found in the lower Cowlitz River report.

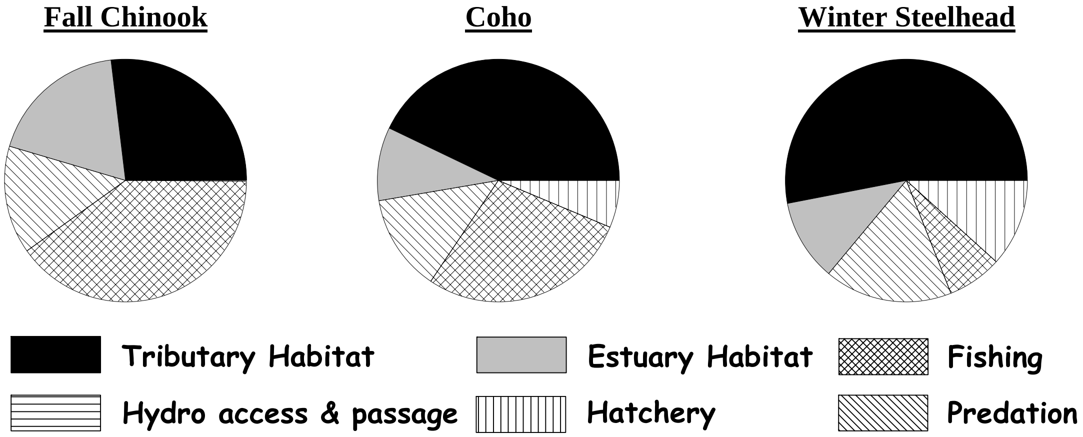


Figure 17. Relative contribution of potentially manageable impacts on Coweeman River salmonid populations.

This assessment indicates that current salmonid status is the result of large impacts distributed among several factors. No single factor accounts for a majority of effects on all species. Thus, substantial improvements in salmonid numbers and viability will require significant improvements in several factors. Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species. Predation is also relatively important for all species. Harvest has a sizeable effect on fall Chinook and coho in the Coweeman Basin. Hatchery impacts are moderate for winter steelhead, relatively low for coho and insignificant for fall Chinook. Loss of estuary habitat quality and quanity has the greatest impact on fall Chinook and moderately affects coho and winter steelhead. Hydrosystem access and passage impacts appear to be relatively minor for all species.

Impacts were defined as the proportional reduction in average numbers or productivity associated with each effect. Tributary and estuary habitat impacts are the differences between the pre-development historical baseline and current conditions. Hydro impacts identify the percentage of historical habitat blocked by impassable dams and the mortality associated with juvenile and adult passage of other dams. Fishing impacts are the direct and indirect mortality in ocean and freshwater fisheries. Hatchery impacts include the equilibrium effects of reduced natural population productivity caused by natural spawning of less-fit hatchery fish and also effects of inter-specific predation by larger hatchery smolts on smaller wild juveniles. Hatchery impacts do not include other potentially negative indirect effects or potentially beneficial effects of augmentation of natural production. Predation includes mortality from northern pikeminnow, Caspian terns, and marine mammals in the Columbia River mainstem and estuary. Predation is not a direct human impact but was included because of widespread interest in it's relative significance. Methods and data for these analyses are detailed in Appendix E.

Potentially-manageable human impacts were estimated for each factor based on the best available scientific information. Proportions are standardized to a total of 1.0 for plotting purposes. The index is intended to illustrate order-of-magnitude rather than fine-scale differences. Only the subset of factors we can potentially manage were included in this index – natural mortality factors beyond our control (e.g. naturally-occuring ocean mortality) are excluded. Not every factor of interest is included in this index – only readily-quantifiable impacts are included.

4.0 Key Programs and Projects

This section provides brief summaries of current federal, state, local, and non-governmental programs and projects pertinent to recovery, management, and mitigation measures and actions in this subbasin. These descriptions provide a context for descriptions of specific actions and responsibilities in the management plan portion of this subbasin plan. More detailed descriptions of these programs and projects can be found in the Comprehensive Program Directory (Appendix C).

4.1 Federal Programs

4.1.1 *NOAA Fisheries*

NOAA Fisheries is responsible for conserving, protecting and managing pacific salmon, ground fish, halibut, marine mammals and habitats under the Endangered Species Act, the Marine Mammal Protection Act, the Magnuson-Stevens Act, and enforcement authorities. NOAA administers the ESA under Section 4 (listing requirements), Section 7 (federal actions), and Section 10 (non-federal actions).

4.1.2 *US Army Corps of Engineers*

The U.S. Army Corps of Engineers (USACE) is the Federal government’s largest water resources development and management agency. USACE programs applicable to Lower Columbia Fish & Wildlife include: 1) Section 1135 – provides for the modification of the structure or operation of a past USACE project, 2) Section 206 – authorizes the implementation of aquatic ecosystem restoration and protection projects, 3) Hydroelectric Program – applies to the construction and operation of power facilities and their environmental impact, 4) Regulatory Program – administration of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act.

4.1.3 *Environmental Protection Agency*

The Environmental Protection Agency (EPA) is responsible for the implementation of the Clean Water Act (CWA). The broad goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation’s waters so that they can support the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water. The CWA requires that water quality standards (WQS) be set for surface waters. WQS are aimed at translating the broad goals of the CWA into waterbody-specific objectives and apply only to the surface waters (rivers, lakes, estuaries, coastal waters, and wetlands) of the United States.

4.1.4 *Natural Resources Conservation Service*

Formerly the Soil Conservation Service, the USDA Natural Resources Conservation Service (NRCS) works with landowners to conserve natural resources on private lands. The NRCS accomplishes this through various programs including, but not limited to, the Conservation Technical Assistance Program, Soil Survey Program, Conservation Reserve Enhancement Program, and the Wetlands Reserve Program. The NRCS works closely with local Conservation Districts; providing technical assistance and support.

4.1.5 *Northwest Power and Conservation Council*

The Northwest Power and Conservation Council, an interstate compact of Idaho, Montana, Oregon, and Washington, has specific responsibility in the Northwest Power Act of 1980 to mitigate the effects of the hydropower system on fish and wildlife of the Columbia River

Basin. The Council does this through its Columbia River Basin Fish and Wildlife Program, which is funded by the Bonneville Power Administration. Beginning in Fiscal Year 2006, funding is guided by locally developed subbasin plans that are expected to be formally adopted in the Council's Fish and Wildlife Program in December 2004.

4.2 State Programs

4.2.1 *Washington Department of Natural Resources*

The Washington Department of Natural Resources governs forest practices on non-federal lands and is steward to state owned aquatic lands. Management of DNR public forest lands is governed by tenets of their proposed Habitat Conservation Plan (HCP). Management of private industrial forestlands is subject to Forest Practices regulations that include both protective and restorative measures.

4.2.2 *Washington Department of Fish & Wildlife*

WDFW's Habitat Division supports a variety of programs that address salmonids and other wildlife and resident fish species. These programs are organized around habitat conditions (Science Division, Priority Habitats and Species, and the Salmon and Steelhead Habitat Inventory and Assessment Program); habitat restoration (Landowner Incentive Program, Lead Entity Program, and the Conservation and Reinvestment Act Program, as well as technical assistance in the form of publications and technical resources); and habitat protection (Landowner Assistance, GMA, SEPA planning, Hydraulic Project Approval, and Joint Aquatic Resource Permit Applications).

4.2.3 *Washington Department of Ecology*

The Department of Ecology (DOE) oversees: the Water Resources program to manage water resources to meet current and future needs of the natural environment and Washington's communities; the Water Quality program to restore and protect Washington's water supplies by preventing and reducing pollution; and Shoreline and the Environmental Assistance program for implementing the Shorelines Management Act, the State Environmental Protection Act, the Watershed Planning Act, and 401 Certification of ACOE Permits.

4.2.4 *Washington Department of Transportation*

The Washington State Department of Transportation (WSDOT) must ensure compliance with environmental laws and statutes when designing and executing transportation projects. Programs that consider and mitigate for impacts to salmonid habitat include: the Fish Passage Barrier Removal program; the Regional Road Maintenance ESA Section 4d Program, the Integrated Vegetation Management & Roadside Development Program; Environmental Mitigation Program; the Stormwater Retrofit Program; and the Chronic Environmental Deficiency Program.

4.2.5 *Interagency Committee for Outdoor Recreation*

Created through the enactment of the Salmon Recovery Act (Washington State Legislature, 1999), the Salmon Recovery Funding Board provides grant funds to protect or restore salmon habitat and assist related activities with local watershed groups known as lead entities. SRFB has helped finance over 500 salmon recovery projects statewide. The Aquatic Lands Enhancement Account (ALEA) was established in 1984 and is used to provide grant support for the purchase, improvement, or protection of aquatic lands for public purposes, and for providing and improving access to such lands. The Washington Wildlife and Recreation

Program (WWRP), established in 1990 and administered by the Interagency Committee for Outdoor Recreation, provides funding assistance for a broad range of land protection, park development, preservation/conservation, and outdoor recreation facilities.

4.2.6 *Lower Columbia Fish Recovery Board*

The Lower Columbia Fish Recovery Board encompasses five counties in the Lower Columbia River Region. The 15-member board has four main programs, including habitat protection and restoration activities, watershed planning for water quantity, quality, habitat, and instream flows, facilitating the development of an integrated recovery plan for the Washington portion of the lower Columbia Evolutionarily Significant Units, and conducting public outreach activities.

4.3 Local Government Programs

4.3.1 *Cowlitz County*

Cowlitz County updated its Comprehensive Plan to the minimum requirements of the Growth Management Act (GMA) by adding a Critical Areas Ordinance (CAO) in 1996, but it is not fully planning under the GMA. Cowlitz County manages natural resources primarily through its CAO.

4.3.2 *City of Kelso*

The City of Kelso’s Comprehensive Plan was adopted in 1980. Natural resource impacts are managed primarily through critical areas protections, shorelines management, and floodplain management.

4.3.3 *Cowlitz / Wahkiakum Conservation District*

The Cowlitz/Wahkiakum CD provides technical assistance, cost-share assistance, project and water quality monitoring, community involvement and education, and support of local stakeholder groups within the two county service area. The CD is involved in a variety of projects, including fish passage, landowner assistance an environmental incentive program an education program, and water quality monitoring.

4.4 Non-governmental Programs

4.4.1 *Columbia Land Trust*

The Columbia Land Trust is a private, non-profit organization founded in 1990 to work exclusively with willing landowners to find ways to conserve the scenic and natural values of the land and water. Landowners donate the development rights or full ownership of their land to the Land Trust. CLT manages the land under a stewardship plan and, if necessary, will legally defend its conservation values.

4.4.2 *Lower Columbia Fish Enhancement Group*

The Washington State Legislature created the Regional Fisheries Enhancement Group Program in 1990 to involve local communities, citizen volunteers, and landowners in the state’s salmon recovery efforts. RFEGs help lead their communities in successful restoration, education and monitoring projects. Every group is a separate, nonprofit organization led by their own board of directors and operational funding from a portion of commercial and recreational fishing license fees administered by the WDFW, and other sources. The mission of the Lower Columbia

RFEG (LCFEG) is to restore salmon runs in the lower Columbia River region through habitat restoration, education and outreach, and developing regional and local partnerships.

4.5 NPCC Fish & Wildlife Program Projects

There are no NPCC Fish & Wildlife Program Projects in the Coweeman Basin.

4.6 Washington Salmon Recovery Funding Board Projects

Type	Project Name	Subbasin
Restoration	Skook Creek Blockage	Lower Cowlitz
Restoration	Baxter Creek Culvert Replacement	Lower Cowlitz
Restoration	Lambert Creek Barrier Removal	Lower Cowlitz
Restoration	Curtis Creek Culvert Upgrade	Lower Cowlitz
Study	Monahan Creek Blockage	Lower Cowlitz

5.0 Management Plan

5.1 Vision

Washington lower Columbia salmon, steelhead, and bull trout are recovered to healthy, harvestable levels that will sustain productive sport, commercial, and tribal fisheries through the restoration and protection of the ecosystems upon which they depend and the implementation of supportive hatchery and harvest practices.

The health of other native fish and wildlife species in the lower Columbia will be enhanced and sustained through the protection of the ecosystems upon which they depend, the control of non-native species, and the restoration of balanced predator/prey relationships.

The Coweeman Subbasin will play a key role in the regional recovery of salmon and steelhead. Natural populations of fall Chinook, coho, and winter steelhead will be restored to high levels of viability by significant reductions in human impacts throughout the lifecycle. Coweeman chum, which are part of the Lower Cowlitz population, will be restored to a medium viability level. Salmonid recovery efforts will provide broad ecosystem benefits to a variety of subbasin fish and wildlife species. Recovery will be accomplished through a combination of improvements in subbasin, Columbia River mainstem, and estuary habitat conditions as well as careful management of hatcheries, fisheries, and ecological interactions among species.

Habitat protection or restoration will involve a wide range of Federal, State, Local, and non-governmental programs and projects. Success will depend on effective programs as well as a dedicated commitment to salmon recovery across a broad section of society.

Some hatchery programs will be realigned to focus on protection, conservation, and recovery of native fish. The need for hatchery measures will decrease as productive natural habitats are restored. Where consistent with recovery, other hatchery programs will continue to provide fish for fishery benefits for mitigation purposes in the interim until habitat conditions are restored to levels adequate to sustain healthy, harvestable natural populations.

Directed fishing on sensitive wild populations will be eliminated and incidental impacts of mixed stock fisheries in the Columbia River and ocean will be regulated and limited consistent with wild fish recovery needs. Until recovery is achieved, fishery opportunities will be focused on hatchery fish and harvestabable surpluses of healthy wild stocks.

This plan uses a planning period or horizon of 25 years. The goal is to achieve recovery of the listed salmon species and the biological objectives for other fish and wildlife species of interest within this time period. It is recognized, however, that sufficient restoration of habitat conditions and watershed processes for all species of interest will likely take 75 years or more.

5.2 Biological Objectives

Biological objectives for Coweeman subbasin salmonid populations are based on recovery criteria developed by scientists on the Willamette/Lower Columbia Technical Recovery Team convened by NOAA Fisheries. Criteria involve a hierarchy of ESU, Strata (i.e. ecosystem areas within the ESU – Coast, Cascade, and Gorge), and Population standards. A recovery scenario describing population-scale biological objectives for all species in all three strata in the lower Columbia ESUs was developed through a collaborative process with stakeholders based on biological significance, expected progress as a result of existing programs, the absence of apparent impediments, and the existence of other management opportunities. Under the preferred alternative, individual populations will variously contribute to recovery according to habitat quality and the population's perceived capacity to rebuild. Criteria, objectives, and the regional recovery scenario are described in greater detail in the Regional Recovery and Subbasin Plan Volume I.

Focal populations in the Coweeman subbasin are targeted to improve to a level that contributes to recovery of the species. The scenario differentiates the role of populations by designating primary, contributing and stabilizing categories. *Primary populations* are those that would be restored to high or better probabilities of persistence. *Contributing populations* are those where low to medium improvements will be needed to achieve stratum-wide average of moderate persistence probability. *Stabilizing populations* are those maintained at current levels.

The Coweeman subbasin was identified as one of the most significant areas for salmon recovery among Washington Cascade strata subbasins based on fish population significance and realistic prospects for restoration. Recovery goals call for restoring all anadromous salmonid populations, except chum, to a high or better viability level. This level will provide for a 95% or better probability of population survival over 100 years. Chum, which are part of the Lower Cowlitz population, will be restored to a medium viability level. Cutthroat will benefit from improvements in stream habitat conditions for anadromous species. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and Coweeman subbasin although specific spawning and rearing habitat requirements are not well known. Bull trout do not occur in the subbasin.

Table 10. Current viability status of Coweeman populations and the biological objective status that is necessary to meet the recovery criteria for the Cascade strata and the lower Columbia ESU.

	ESA	Hatchery	Current		Objective	
Species	**Status**	**Component**	**Viability**	**Numbers**	**Viability**	**Numbers**
Fall Chinook	Threatened	No	Medium	100-2,100	High+[P]	3,000-4,100
Coho	Proposed	No	Low	unknown	High[P]	600
Winter steelhead	Threatened	Yes	Low+	100-1,100	High[P]	800
Chum (a)	Threatened	No	Very Low	<150	Med[C]	150-1,100

(a) includes chum populations in the lower Cowlitz, Toutle, and Coweeman rivers
P = primary population in recovery scenario
C = contributing population in recovery scenario
S = stabilizing population in recovery scenario

5.3 Integrated Strategy

An Integrated Regional Strategy for recovery emphasizes that: 1) it is feasible to recover Washington lower Columbia natural salmon and steelhead to healthy and harvestable levels; 2) substantial improvements in salmon and steelhead numbers, productivity, distribution, and diversity will be required; 3) recovery cannot be achieved based solely on improvements in any one factor; 4) existing programs are insufficient to reach recovery goals, 5) all manageable effects on fish and habitat conditions must contribute to recovery, 6) actions needed for salmon recovery will have broader ecosystem benefits for all fish and wildlife species of interest, and 7) strategies and measures likely to contribute to recovery can be identified but estimates of the incremental improvements resulting from each specific action are highly uncertain. The strategy is described in greater detail in the Regional Recovery and Subbasin Plan Volume I.

The Integrated Strategy recognizes the importance of implementing measures and actions that address each limiting factor and risk category, prescribing improvements in each factor/threat category in proportion to its magnitude of contribution to salmon declines, identifying an appropriate balance of strategies and measures that address regional, upstream, and downstream threats, and focusing near term actions on species at-risk of extinction while also ensuring a long term balance with other species and the ecosystem.

Population productivity improvement increments identify proportional improvements in productivity needed to recover populations from current status to medium, high, and very high levels of population viability consistent with the role of the population in the recovery scenario. Productivity is defined as the inherent population replacement rate and is typically expressed as a median rate of population increase (as in the Population Change Criteria Model) or a recruit per spawner rate (as in the EDT Model). Corresponding improvements in spawner numbers, juvenile outmigrants, population spatial structure, genetic and life history diversity, and habitat are implicit in productivity improvements.

Improvement targets were developed for each impact factor based on desired population productivity improvements and estimates of potentially manageable impacts (see Section 3.7). Impacts are estimates of the proportional reduction in population productivity associated with human-caused and other potentially manageable impacts from stream habitats, estuary/mainstem habitats, hydropower, harvest, hatcheries, and selected predators. Reduction targets were driven by the regional strategy of equitably allocating recovery responsibilities among the six manageable impact factors. Given the ultimate uncertainty in the effects of recovery actions and the need to implement an adaptive recovery program, this approximation should be adequate for developing order-of-magnitude estimates to which recovery actions can be scaled consistent with the current best available science and data. Objectives and targets will be need to be confirmed or refined during plan implementation based on new information and refinements in methodology.

The following table identifies population and factor-specific improvements consistent with the biological objectives for this subbasin. Per factor increments are less than the population net because factor affects are compounded at different life stages and density dependence is largely limited to freshwater tributary habitat. For example, productivity of Coweeman River fall Chinook must increase by 200% to reach population viability goals. This requires impact reductions equivalent to a 40% improvement in productivity or survival for each of six factor categories. Thus, tributary habitat impacts on fall Chinook must decrease from a 44% to a 22%

impact in order to achieve the required 40% increase in tributary habitat productivity from the current 56% of the historical potential to 78% of the historical potential.

Table 11. Productivity improvements consistent with biological objectives for the Coweeman subbasin.

Species	Net increase	Per factor	Baseline impacts Trib.	Estuary	Hydro.	Pred.	Harvest	Hatch.
Fall Chinook	200%	40%	0.44	0.30	0.00	0.23	0.65	0.00
Chum (a)	40%	2%	0.96	0.59	0.00	0.23	0.05	0.11
Coho	na	na	na	na	na	na	na	na
Winter Steelhead	30%	9%	0.73	0.15	0.00	0.24	0.10	0.16

(a) Data is from the lower Cowlitz River

5.4 Tributary Habitat

Habitat assessment results were synthesized in order to develop specific prioritized measures and actions that are believed to offer the greatest opportunity for species recovery in the subbasin. As a first step toward measure and action development, habitat assessment results were integrated to develop a multi-species view of 1) priority areas, 2) factors limiting recovery, and 3) contributing land-use threats. For the purpose of this assessment, limiting factors are defined as the biological and physical conditions serving to suppress salmonid population performance, whereas threats are the land-use activities contributing to those factors. Limiting Factors refer to local (reach-scale) conditions believed to be directly impacting fish. Threats, on the other hand, may be local or non-local. Non-local threats may impact instream limiting factors in a number of ways, including: 1) through their effects on habitat-forming processes – such as the case of forest road impacts on reach-scale fine sediment loads, 2) due to an impact in a contributing stream reach – such as riparian degradation reducing wood recruitment to a downstream reach, or 3) by blocking fish passage to an upstream reach.

Priority areas and limiting factors were determined through the technical assessment, including primarily EDT analysis and the Integrated Watershed Assessment (IWA). As described later in this section, priority areas are also determined by the relative importance of subbasin focal fish populations to regional recovery objectives. This information allows for scaling of subbasin recovery effort in order to best accomplish recovery at the regional scale. Land-use threats were determined from a variety of sources including Washington Conservation Commission Limiting Factors Analyses, the IWA, the State 303(d) list, air photo analysis, the Barrier Assessment, personal knowledge of investigators, or known cause-effect relationships between stream conditions and land-uses.

Priority areas, limiting factors and threats were used to develop a prioritized suite of habitat measures. Measures are based solely on biological and physical conditions. For each measure, the key programs that address the measure are identified and the sufficiency of existing programs to satisfy the measure is discussed. The measures, in conjunction with the program sufficiency considerations, were then used to identify specific actions necessary to fill gaps in measure implementation. Actions differ from measures in that they address program deficiencies as well as biophysical habitat conditions. The process for developing measures and actions is illustrated in Figure 18 and each component is presented in detail in the sections that follow.

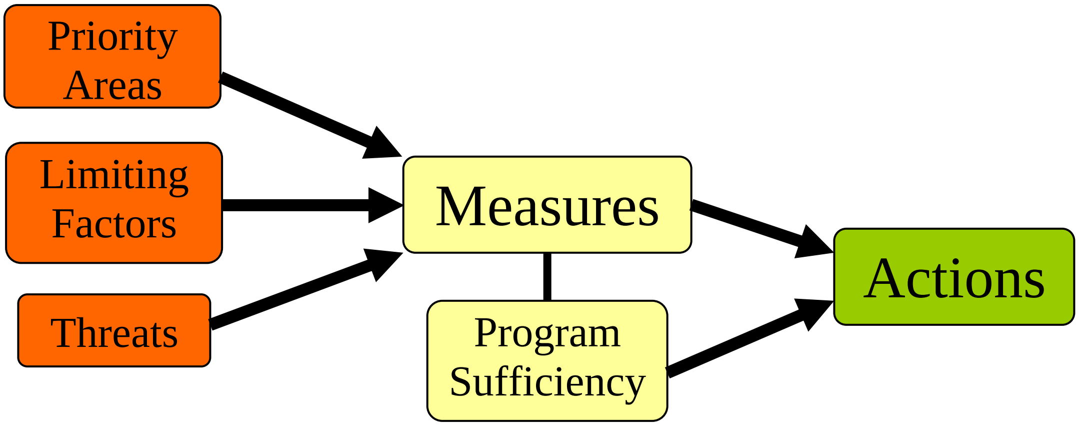


Figure 18. Flow chart illustrating the development of subbasin measures and actions.

5.4.1 *Priority Habitat Factors and Areas*

Priority habitat areas and factors in the subbasin are discussed below in two sections. The first section contains a generalized (coarse-scale) summary of conditions throughout the basin. The second section is a more detailed summary that presents specific reach and subwatershed priorities.

Summary

Decades of human activity in the Coweeman River Basin have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Moreover, with the exception of fall Chinook, stream habitat conditions within the Coweeman Basin have a high impact on the health and viability of salmon and steelhead relative to other limiting factors. The following bullets provide a brief overview of each of the priority areas in the basin. These descriptions are a summary of the reach-scale priorities that are presented in the next section. These descriptions summarize the species most affected, the primary limiting factors, the contributing land-use threats, and the general type of measures that will be necessary for recovery. A tabular summary of the key limiting factors and land-use threats can be found in Table 12.

- **Lower mainstem** *(reaches Coweeman 1-4)* – The lower mainstem reaches contain potentially productive habitat for chum, coho, and fall Chinook, especially reach Coweeman 4, which is just downstream of the Canyon reach. This reach is impacted by changes to the channel, riparian area, and floodplain due primarily to agricultural uses. Reaches 1-3 are impacted by development around the outskirts of Kelso, WA. These reaches have preservation as well as restoration value. The most effective recovery measures will involve riparian and floodplain restoration.
- **Middle mainstem and Goble Creek** *(Canyon 1-2; Coweeman 5-12; Goble Creek 1, 4)* – The middle mainstem reaches and Goble Creek are utilized most by winter steelhead, fall Chinook, and coho. They are impacted mostly by forest practices and to a limited degree by agriculture and rural residential uses. These reaches have preservation as well as restoration value. The most effective recovery measures will include riparian restoration and recovery of basin-wide watershed processes.
- **Upper mainstem and tributaries** *(Coweeman 13 – 22; Mulholland 2-3; Baird 1)* – The upper Coweeman reaches (including Mulholland and Baird Creeks) contain potentially

productive habitat for coho, winter steelhead, and fall Chinook. These reaches have preservation as well as restoration value. They are heavily impacted by forest practices occurring throughout the upper Coweeman Basin. Restoration of basin-wide runoff and sediment supply conditions will yield the greatest benefits to fish habitat.

Table 12. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem (LM), middle mainstem and Goble Creek (MM), and upper mainstem and tributaries (UM) portions of the Coweeman Basin. Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	LM	MM	UM
Habitat diversity			
Lack of stable instream woody debris	✓	✓	✓
Altered habitat unit composition	✓	✓	✓
Loss of off-channel and/or side-channel habitats	✓	✓	
Channel stability			
Bed and bank erosion		✓	
Riparian function			
Reduced stream canopy cover	✓	✓	
Reduced bank/soil stability	✓	✓	
Exotic and/or noxious species	✓	✓	
Reduced wood recruitment	✓	✓	
Floodplain function			
Altered nutrient exchange processes	✓	✓	
Reduced flood flow dampening	✓	✓	
Restricted channel migration	✓	✓	
Disrupted hyporheic processes	✓	✓	
Stream flow			
Altered magnitude, duration, or rate of change	✓	✓	✓
Water quality			
Altered stream temperature regime	✓	✓	
Bacteria	✓		
Substrate and sediment			
Excessive fine sediment	✓	✓	✓
Embedded substrates	✓	✓	✓

Threats	LM	MM	UM
Agriculture/ grazing			
Clearing of vegetation	✓	✓	
Riparian grazing	✓	✓	
Floodplain filling	✓	✓	
Rural development			
Clearing of vegetation		✓	
Roads – riparian/floodplain impacts		✓	
Forest practices			
Timber harvests –sediment supply impacts	✓	✓	✓
Timber harvests – impacts to runoff	✓	✓	✓
Riparian harvests (historical)		✓	✓
Forest roads – impacts to sediment supply	✓	✓	✓
Forest roads – impacts to runoff	✓	✓	✓
Forest roads – riparian/floodplain impacts			✓
Splash-dam logging (historical)	✓	✓	✓
Channel manipulations			
Bank hardening	✓		
Channel straightening	✓		
Artificial confinement	✓		

Specific Reach and Subwatershed Priorities

Specific reaches and subwatersheds have been prioritized based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Reaches have been placed into Tiers (1-4), with Tier 1 reaches representing the areas where recovery measures would yield the greatest benefits towards accomplishing the biological objectives. The reach tiering factors in each fish population's importance relative to regional recovery objectives, as well as the relative importance of reaches within the populations themselves. Reach tiers are most useful for identifying habitat recovery measures in channels, floodplains, and riparian areas. Reach-scale priorities were initially identified within individual populations (species) through the EDT Restoration and Preservation Analysis. This resulted in reaches grouped into categories of high, medium, and low priority for each population (see Stream Habitat Limitations section). Within a subbasin, reach rankings for all of the modeled populations were combined, using population designations as a weighting factor. Population designations for this subbasin are described in the Biological Objectives section. The population designations are 'primary', 'contributing', and 'stabilizing'; reflecting the level of emphasis that needs to be placed on population recovery in order to meet ESA recovery criteria.

Spatial priorities were also identified at the subwatershed scale. Subwatershed-scale priorities were directly determined by reach-scale priorities, such that a Group A subwatershed contains one or more Tier 1 reaches. Scaling up from reaches to the subwatershed level was done in recognition that actions to protect and restore critical reaches might need to occur in adjacent and/or upstream upland areas. For example, high sediment loads in a Tier 1 reach may originate in an upstream contributing subwatershed where sediment supply conditions are impaired because of current land use practices. Subwatershed-scale priorities can be used in conjunction with the IWA to identify watershed process restoration and preservation opportunities. The specific rules for designating reach tiers and subwatershed groups are presented in Table 14. Reach tier designations for this basin are included in Table 14. Reach tiers and subwatershed groups are displayed on a map in Figure 19. A summary of reach- and-subwatershed-scale limiting factors is included in Table 15.

Table 13. Rules for designating reach tier and subwatershed group priorities. See Biological Objectives section for information on population designations.

Designation	Rule
Reaches	
Tier 1:	All high priority reaches (based on EDT) for one or more primary populations.
Tier 2:	All reaches not included in Tier 1 and which are medium priority reaches for one or more primary species and/or all high priority reaches for one or more contributing populations.
Tier 3:	All reaches not included in Tiers 1 and 2 and which are medium priority reaches for contributing populations and/or high priority reaches for stabilizing populations.
Tier 4:	Reaches not included in Tiers 1, 2, and 3 and which are medium priority reaches for stabilizing populations and/or low priority reaches for all populations.
Subwatersheds	
Group A:	Includes one or more Tier 1 reaches.
Group B:	Includes one or more Tier 2 reaches, but no Tier 1 reaches.
Group C:	Includes one or more Tier 3 reaches, but no Tier 1 or 2 reaches.
Group D:	Includes only Tier 4 reaches.

Table 14. Reach Tiers in the Coweeman River Basin

Tier 1	Tier 2	Tier 4	
Canyon 3	Baird Creek 1	Baird Creek 3	Mulholland Creek 1
Coweeman 10	Baird Creek 2	Brown Creek	Mulholland Creek 4
Coweeman 11	Canyon 1	Goble Creek 2	Nineteen Creek
Coweeman 14	Canyon 2	Goble Creek 3	North Fork Goble Creek
Coweeman 16	Coweeman 1 tidal	LB trib1 (26.0016)	Nye Creek
Coweeman 17	Coweeman 12	LB trib2 (26.0071)	ONeil Creek
Coweeman 18	Coweeman 13	LB trib3 (26.0072)	RB trib1 (26.0019)
Coweeman 19	Coweeman 15	LB trib4 (26.0097)	RB trib2 (26.0068)
Coweeman 20	Coweeman 2	LB trib5	RB trib3 (26.0079)
Coweeman 22	Coweeman 21	LB trib6	RB trib4 (26.0096)
Coweeman 4	Coweeman 3	Little Baird Creek	RB trib5 (26.0014)
Coweeman 5	Coweeman 6	Lower Cowlitz-1	RB trib6
Coweeman 8	Coweeman 7	Martin Creek	RB trib7
	Coweeman 9		Sam Smith Creek
	Goble Creek 1		Skipper Creek
	Goble Creek 4		Turner Creek
	Jim Watson Creek		
	Mulholland Creek 2		
	Mulholland Creek 3		

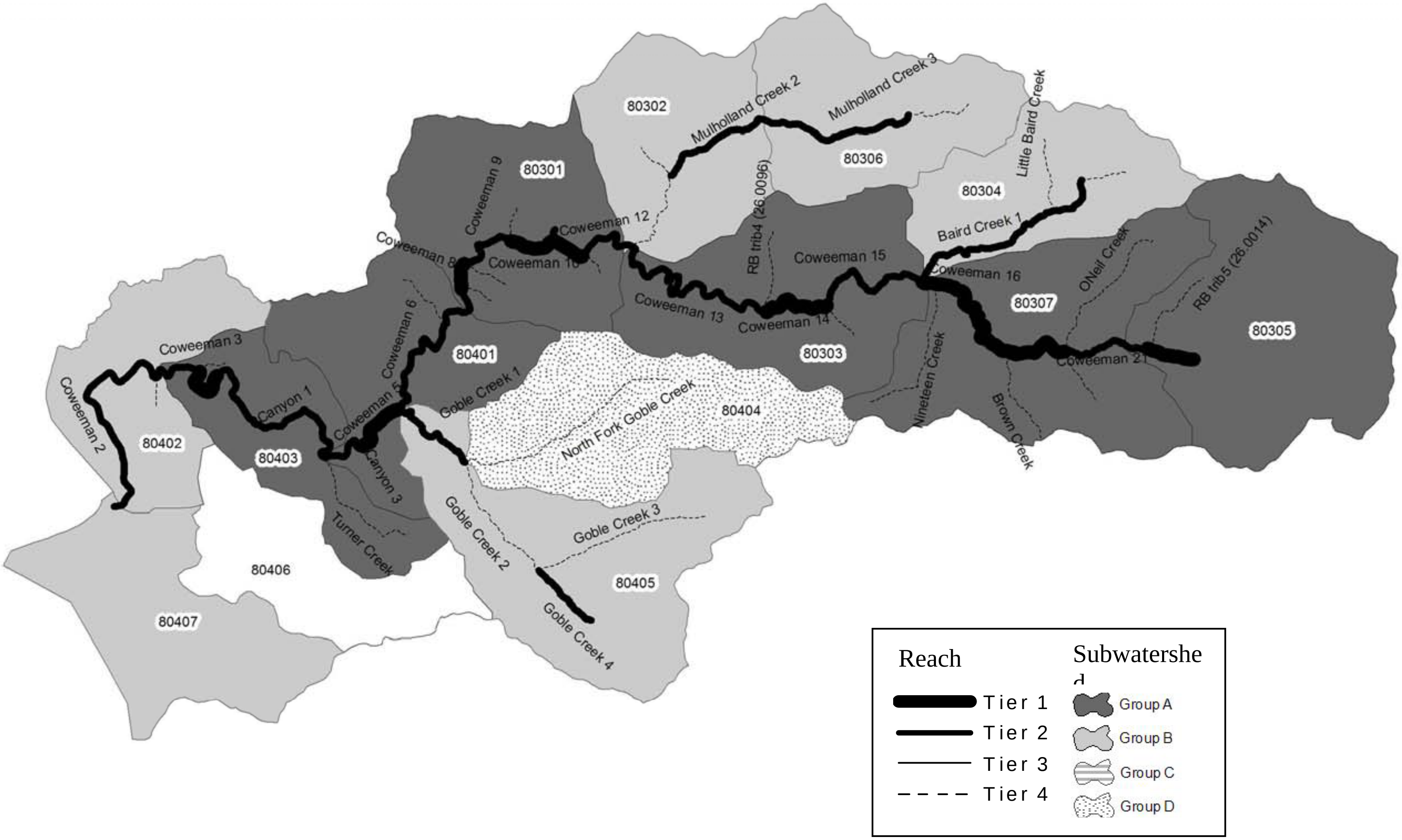


Figure 19. Reach tiers and subwatershed groups in the Coweeman Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach scale are useful for identifying stream corridor recovery measures. Priorities at the subwatershed scale are useful for identifying watershed process recovery measures. Watershed process recovery measures for stream reaches will need to occur within the surrounding (local) subwatershed as well as in upstream contributing subwatersheds.

Table 15. Summary Table of reach- and subwatershed-scale limiting factors in priority areas. The table is organized by subwatershed groups, beginning with the highest priority group. Species-specific reach priorities, critical life stages, high impact habitat factors, and recovery emphasis (P=preservation, R=restoration, PR=restoration and preservation) are included. Watershed process impairments: F=functional, M=moderately impaired, I=impaired. Species abbreviations: ChS=spring Chinook, ChF=fall Chinook, StS=summer steelhead, StW=winter steelhead.

Sub-watershed Group	Sub-watersheds	Reaches within subwatersheds	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors	Preservation or restoration emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
A	80403	Canyon 1 Coweeman 3 Coweeman 4 Turner Creek RB trib1 (26.0019)	ChF	Coweeman 4	spawning egg incubation early rearing adult holding	temperature sediment	PR	I	M	M	I	M
			Coho	Coweeman 4	egg incubation summer rearing winter rearing	channel stability habitat diversity temperature sediment	R					
			Chum	Coweeman 4	spawning egg incubation fry colonization adult holding	habitat diversity sediment key habitat quantity	P					
			StW	none								
	80401	Canyon 2 Canyon 3 Coweeman 5 Coweeman 6 Coweeman 7 RB trib2 (26.0068) Nye Creek	ChF	Canyon 3 Coweeman 5	spawning egg incubation fry colonization early rearing	temperature sediment	PR	I	M	M	I	M
			Coho	Canyon 3 Coweeman 5	egg incubation summer rearing winter rearing	channel stability habitat diversity sediment	R					
			StW	Coweeman 5	egg incubation summer rearing	habitat diversity	R					
	80303	Coweeman 13 Coweeman 14 Coweeman 15 Coweeman 16 LB trib4 (26.0097) RB trib4 (26.0096)	ChF	Coweeman 16	egg incubation fry colonization adult holding	habitat diversity sediment	P	I	M	M	I	M
			Coho	Coweeman 16	egg incubation summer rearing winter rearing	habitat diversity flow sediment	PR					
			StW	Coweeman 14 Coweeman 16	egg incubation fry colonization summer rearing winter rearing	habitat diversity flow sediment	PR					
	80301	Coweeman 10 Coweeman 11 Coweeman 12 Coweeman 8 Coweeman 9 Sam Smith Creek LB trib2 (26.0071) LB trib3 (26.0072) RB trib3 (26.0079) Jim Watson Creek	ChF	Coweeman 8 Coweeman 10	spawning egg incubation fry colonization early rearing	temperature sediment	PR	I	M	M	I	M
			Coho	Coweeman 8 Coweeman 10 Coweeman 11	egg incubation summer rearing winter rearing	habitat diversity sediment	R					
			StW	Coweeman 8 Coweeman 11	egg incubation summer rearing winter rearing	habitat diversity sediment	PR					
	80307	Brown Creek Coweeman 17 Coweeman 18 Coweeman 19 Coweeman 20 Coweeman 21 Nineteen Creek ONeil Creek Martin Creek	ChF	none				M	M	M	M	M
			Coho	none								
			StW	Coweeman 17 Coweeman 18 Coweeman 19 Coweeman 20	egg incubation fry colonization summer rearing winter rearing	habitat diversity flow sediment	PR					
	80305	Coweeman 22 RB trib5 (26.0014)	Coho	none				M	M	M	M	M
			StW	Coweeman 22	egg incubation fry colonization summer rearing winter rearing	habitat diversity sediment	R					
B	80407	Coweeman 1 tidal Lower Cowlitz-1	All	none				I	M	I	I	M
	80402	Coweeman 2	All	none				I	I	I	I	M
	80405	Goble Creek 1 Goble Creek 2 Goble Creek 3 Goble Creek 4	Coho	none				I	M	M	I	M
			StW	none								
	80306	Mulholland Creek 3 Mulholland Creek 4	Coho	none				M	F	M	M	F
			StW	none								
	80304	Baird Creek 1 Baird Creek 2 Baird Creek 3 Little Baird Creek	Coho	none				M	F	M	M	F
			StW	none								
	80302	Mulholland Creek 1 Mulholland Creek 2	ChF	none				I	M	M	I	M
			Coho	none								
			StW	none								
D	80404	North Fork Goble Creek	Coho	none				I	M	M	I	M
			StW	none								

5.4.2 *Habitat Measures*

Measures are means to achieve the regional strategies that are applicable to the Coweeman Basin and necessary to accomplish the biological objectives for focal fish species. Measures are based on the technical assessments for this subbasin (Section 3.0) as well as on the synthesis of priority areas, limiting factors, and threats presented earlier in this section. The measures applicable to the Coweeman Subbasin are presented in priority order in Table 16. Each measure has a set of submeasures that define the measure in greater detail and add specificity to the particular circumstances occurring within the subbasin. The table for each measure and associated submeasures indicates the limiting factors that are addressed, the contributing threats that are addressed, the species that would be most affected, and a short discussion. Priority locations are given for some measures. Priority locations typically refer to either stream reaches or subwatersheds, depending on the measure. Addressing measures in the highest priority areas first will provide the greatest opportunity for effectively accomplishing the biological objectives.

Following the list of priority locations is a list of the programs that are the most relevant to the measure. Each program is qualitatively evaluated as to whether it is sufficient or needs expansion with respect to the measure. This exercise provides an indication of how effectively the measure is already covered by existing programs, policy, or projects; and therefore indicates where there is a gap in measure implementation. This information is summarized in a discussion of Program Sufficiency and Gaps.

The measures themselves are prioritized based on the results of the technical assessment and in consideration of principles of ecosystem restoration (e.g. NRC 1992, Roni et al. 2002). These principles include the hypothesis that the most efficient way to achieve ecosystem recovery in the face of uncertainty is to focus on the following prioritized approaches: 1) protect existing functional habitats and the processes that sustain them, 2) allow no further degradation of habitat or supporting processes, 3) re-connect isolated habitat, 4) restore watershed processes (ecosystem function), 5) restore habitat structure, and 6) create new habitat where it is not recoverable. These priorities have been adjusted for the specific circumstances occurring in the Coweeman Basin. These priorities are adjusted depending on the results of the technical assessment and on the specific circumstances occurring in the basin. For example, re-connecting isolated habitat could be adjusted to a lower priority if there is little impact to the population created from passage barriers.

5.4.3 *Habitat Actions*

The prioritized measures and associated gaps are used to develop specific Actions for the subbasin. These are presented in Table 17. Actions are different than the measures in a number of ways: 1) actions have a greater degree of specificity than measures, 2) actions consider existing programs and are therefore not based strictly on biophysical conditions, 3) actions refer to the agency or entity that would be responsible for carrying out the action, and 4) actions are related to an expected outcome with respect to the biological objectives. Actions are not presented in priority order but instead represent the suite of activities that are all necessary for recovery of listed species. The priority for implementation of these actions must consider the priority of the measures they relate to, the “size” of the gap they are intended to fill, and feasibility considerations.

Table 16. Prioritized measures for the Coweeman Basin.

#1 – Protect stream corridor structure and function

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect floodplain function and channel migration processes B. Protect riparian function C. Protect access to habitats D. Protect instream flows through management of water withdrawals E. Protect channel structure and stability F. Protect water quality G. Protect the natural stream flow regime	Potentially addresses many limiting factors	Potentially addresses many threats related to limiting factors	All Species	Reach Coweeman 3 and 4 are low gradient, alluvial reaches that contain important potential chum and fall Chinook habitat. Providing adequate protections to these reaches is important given the proximity to the expanding Longview/Kelso urban area. Other Tier 1 and Tier 2 reaches in mixed-use areas are also at risk of continuing development pressure. Preventing further degradation of stream channel structure, riparian function, and floodplain function will be an important component of recovery.

Priority Locations

1st- Tier 1 and 2 reaches with functional riparian conditions according to the IWA assessment
Reaches: Coweeman 21-22
2nd- Tier 1 or 2 reaches in mixed-use lands at risk of further degradation
Reaches: Coweeman 1-tidal; Coweeman 2-12; Goble Creek 1
3rd- Remaining Tier 1 and 2 reaches
4th- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NOAA Fisheries	ESA Section 7 and Section 10	✓	
US Army Corps of Engineers (USACE)	Dredge & fill permitting (Clean Water Act sect. 404); Navigable waterways protection (Rivers & Harbors Act Sect, 10)	✓	
WA Department of Natural Resources (WDNR)	Forest Practices Rules, Riparian Easement Program	✓	
WA Department of Fish and Wildlife (WDFW)	Hydraulics Projects Approval	✓	
Cowlitz County	Comprehensive Planning		✓
City of Kelso	Comprehensive Planning		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Agricultural Land Habitat Protection Programs		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Education, Enforcement, Control		✓
Non-Governmental Organizations (NGOs) (e.g. Columbia Land Trust) and public agencies	Land acquisition and easements		✓

Program Sufficiency and Gaps

Alterations to stream corridor structure that may impact aquatic habitats are regulated through the WDFW Hydraulics Project Approval (HPA) permitting program. Other regulatory protections are provided through USACE permitting, ESA consultations, HCPs, and local government regulations. Riparian areas within private timberlands are protected through the Forest Practices Rules (FPR) administered by WDNR. The FPRs came out of an extensive review process and are believed to adequately protect riparian areas with respect to stream shading, bank stability, and LWD recruitment. The program is new, however, and careful monitoring of the effect of the regulations is necessary. Land-use conversion and development are increasing throughout the basin and local government ordinances must ensure that new development occurs in a manner that protects key habitats. Conversion of land-use from forest or agriculture to residential use has the potential to increase impairment of aquatic habitat, particularly when residential development is paired with flood control measures. Local government ordinances can limit potentially harmful land-use conversions by thoughtfully direction growth through comprehensive planning and tax incentives, by providing consistent protection of critical areas across jurisdictions, and by preventing development in floodplains. In cases where existing programs are unable to protect critical habitats due to inherent limitations of regulatory mechanisms, conservation easements and land acquisition may be necessary. The City of Kelso has purchased valley bottom property along the lower mainstem below the canyon, presenting a great opportunity to protect floodplain processes from further degradation. Cowlitz County is attempting to acquire additional lands in the lower reaches of the Coweeman basin.

#2 – Protect hillslope processes

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Manage forest practices to minimize impacts to sediment supply processes, runoff regime, and water quality B. Manage agricultural practices to minimize impacts to sediment supply processes, runoff regime, and water quality C. Manage growth and development to minimize impacts to sediment supply processes, runoff regime, and water quality	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Agricultural practices – impacts to sediment supply, water quality, and runoff processes • Development – impacts to sediment supply, water quality, and runoff processes	All species	There currently are functional hillslope sediment processes in the Upper Baird and Upper Mulholland Creek basins. In other areas, hillslope runoff and sediment delivery processes have been degraded due to past intensive timber harvest and road building. Agriculture and development have impacted sediment and flow processes in portions of the lower basin. Urban development impacts the lower mainstem subwatershed (80402). Limiting additional degradation will be necessary to prevent further habitat impairment.

Priority Locations

1st- Functional subwatersheds contributing to Tier 1 or 2 reaches (functional for sediment *or* flow according to the IWA – local rating)
Subwatersheds: upper Baird (80304) & upper Mulholland (80306)
2nd- All other functional subwatersheds plus Moderately Impaired subwatersheds contributing to Tier 1 or 2 reaches
Subwatersheds: 80403, 80401, 80405, 80404, 80301, 80302, 80303, 80307, 80305
3rd- All other Moderately Impaired subwatersheds plus Impaired subwatersheds contributing to Tier 1 or 2 reaches
Subwatersheds: 80402, 80407, 80406

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules	✓	
Cowlitz County	Comprehensive Planning		✓
City of Kelso	Comprehensive Planning		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Agricultural Land Habitat Protection Programs		✓

Program Sufficiency and Gaps

Hillslope processes on private forest lands are protected through Forest Practices Rules administered by the WDNR. These rules, developed as part of the Forests & Fish Agreement, are believed to be adequate for protecting watershed sediment supply, runoff processes, and water quality on private forest lands. The program is new, however, and careful monitoring of the effect of the regulations is necessary; particularly with respect to effects on watershed hydrology and sediment delivery. Small private landowners may be unable to meet some of the requirements on a timeline commensurate with large industrial landowners. Financial assistance to small owners would enable greater and quicker compliance. On non-forest lands (agriculture and developed), local government comprehensive planning is the primary nexus for protection of hillslope processes. Local governments can control impacts through zoning that protects open-space, through stormwater management ordinances, and through tax incentives to keep agricultural and forest lands from becoming developed. These protections are especially important in the lower basin due to expanding growth around Kelso. There are few to no regulatory protections of hillslope processes that relate to agricultural practices; such deficiencies could be addressed through local or state authorities. Protecting hillslope processes on agricultural lands would also benefit from the expansion of technical assistance and landowner incentive programs (NRCS, Conservation Districts). Protecting processes on agricultural lands is less of a priority than forest or rural residential lands due to the low amount of farmed land in the basin.

#3- Restore degraded hillslope processes on forest, agricultural, and developed lands

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Upgrade or remove problem forest roads B. Reforest heavily cut areas not recovering naturally C. Employ agricultural Best Management Practices with respect to contaminant use, erosion, and runoff D. Reduce watershed imperviousness E. Reduce effective stormwater runoff from developed areas	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Agricultural practices – impacts to sediment supply, water quality, and runoff processes • Development – impacts to water quality and runoff processes	All species	Hillslope runoff and sediment delivery processes have been degraded due to past intensive timber harvest, road building, agriculture, and development. These processes must be addressed for reach-level habitat recovery to be successful.

Priority Locations

1st- Moderately impaired or impaired subwatersheds contributing to Tier 1 reaches (mod. impaired or impaired for sediment *or* flow according to IWA – local rating)
 Subwatersheds: 80403, 80401, 80405, 80404, 80301, 80302, 80303, 80307, 80305, 80304, 80306
2nd- Moderately impaired or impaired subwatersheds contributing to Tier 2 reaches
 Subwatersheds: 80402
3rd- Moderately impaired or impaired subwatersheds contributing to other reaches
 Subwatersheds: 80406, 80407

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules	✓	
WDFW	Habitat Program		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Agricultural Land Habitat Restoration Programs		✓
Cowlitz County	Stormwater Management		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
City of Kelso	Stormwater Management		✓

Program Sufficiency and Gaps

Forest management programs including the new Forest Practices Rules (private timber lands) and the WDNR HCP (state timber lands) are expected to afford protections that will passively and actively restore degraded hillslope conditions. Timber harvest rules are expected to passively restore sediment and runoff processes. The road maintenance and abandonment requirements are expected to actively address road-related impairments within a 15 year time-frame. While these strategies are believed to be largely adequate to protect watershed processes, the degree of implementation and the effectiveness of the prescriptions will not be fully known for at least another 15 or 20 years. Of particular concern is the capacity of some forest land owners, especially small forest owners, to conduct the necessary road improvements (or removal) in the required timeframe. Additional financial and technical assistance would enable small forest landowners to conduct the necessary improvements in a timeline parallel to large industrial timber land owners. Ecological restoration of existing developed and agricultural lands occurs relatively infrequently and there are no programs that specifically require restoration in these areas. Restoring existing developed and farmed lands can involve retrofitting facilities with new materials, replacing existing systems, adopting new management practices, and creating or re-configuring landscaping. Means of increasing restoration activity include increasing landowner participation through education and incentive programs, building support for projects on public lands/facilities, requiring Best Management Practices through permitting and ordinances, and increasing available funding for entities to conduct projects.

#4 - Restore floodplain function and channel migration processes in the mainstem and major tributaries

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Set back, breach, or remove artificial confinement structures	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel incision • Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats	• Floodplain filling • Channel straightening • Artificial confinement	chum, fall Chinook, coho	Significant degradation of floodplain function and channel migration processes have occurred over the years in the lower mainstem (Coweeman 1 tidal – 4). This area has historically been utilized for agriculture and is experiencing increasing development pressure as nearby population centers expand. There are feasibility issues with implementation of floodplain restoration initiatives due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.

Priority Locations

1st- Tier 1 reaches with hydro-modifications (obtained from EDT ratings)
Reaches: Coweeman 4, 10, 11 & 14
2nd- Tier 2 reaches with hydro-modifications
Reaches: Coweeman 1-tidal; Coweeman 2, 9, 13, 15; Canyon 1; Goble Creek 1
3rd- Other reaches with hydro-modifications
Reaches: Goble Creek 3; North Fork Goble Cr; Turner Creek; LBtrib (26.0071)

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDFW	Habitat Program		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Cowlitz County	Land Acquisition		✓
City of Kelso	Habitat Projects; Parks and Recreation		✓

Program Sufficiency and Gaps

There currently are no programs or policy in place that set forth strategies for restoring floodplain function and channel migration processes in the Coweeman Basin. Without programmatic changes, projects are likely to occur only seldom as opportunities arise and only if financing is made available. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct projects. Floodplain restoration projects are often expensive, large-scale efforts that require partnerships among many agencies, NGOs, and landowners. Building partnerships is a necessary first step toward floodplain and CMZ restoration. The USACE is conducting a Lower Columbia River Ecosystem Restoration Study which may identify and assess potential floodplain restoration projects in the lower Coweeman Basin. The City of Kelso has purchased valley bottom property along the lower mainstem below the canyon, presenting a great opportunity to restore floodplain processes there. A potential acquisition by Cowlitz County in the same area represents additional opportunity.

#5 - Restore riparian conditions throughout the basin

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore the natural riparian plant community B. Exclude livestock from riparian areas C. Eradicate invasive plant species from riparian areas	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or invasive species • Bacteria	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to agriculture and residential development	All species	Recovery of riparian vegetation is necessary throughout the basin in both forest and mixed-use areas. Much of this recovery is expected to occur passively on forest lands due to protection requirements for riparian buffers. Active measures, such as hardwood-to-conifer conversion, may be necessary in some areas. The increasing abundance of exotic and invasive species is of particular concern. Riparian restoration projects are relatively inexpensive and are often supported by landowners.

Priority Locations

1st- Tier 1 reaches
2nd- Tier 2 reaches
3rd- Tier 3 reaches
4th- Tier 4 reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules	✓	
WDFW	Habitat Program		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Agricultural Land Habitat Restoration Programs		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Education, Enforcement, Control		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring riparian conditions; however, existing programs will afford protections that will allow for the *passive* restoration of riparian forests. These protections are believed to be adequate for riparian areas on forest lands that are subject to Forest Practices Rules. Other lands receive variable levels of protection through the Cowlitz County Comprehensive Plan. Many degraded riparian zones in urban, agricultural, rural residential, or transportation corridors will not passively restore with existing regulatory protections and will require active measures. Riparian restoration in these areas may entail livestock exclusion, tree planting, road relocation, invasive species eradication, and adjusting current land-use in the riparian zone. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

#6 – Restore access to habitat blocked by artificial barriers

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore access to isolated habitats blocked by culverts, dams, or other barriers	• Blockages to channel habitats • Blockages to off-channel habitats	• Dams, culverts, in-stream structures	All species	As many as 9 miles of potential anadromous habitat are blocked by artificial obstructions, mostly on small tributary streams. No individual barriers account for a large share of the blocked habitat. The extent of potential habitat above these barriers is not well known but is expected to be minimal. Passage restoration projects should focus only on cases where it can be demonstrated that there is good potential benefit and reasonable project costs.

Priority Locations

Several blocking culverts on small tributary streams

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, Family Forest Fish Passage		✓
WDFW	Habitat Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Washington Department of Transportation / WDFW	Fish Passage Program		✓
Cowlitz County	Roads		✓

Program Sufficiency and Gaps

The Forest Practices Rules require forest landowners to restore fish passage at artificial barriers by 2016. Small forest landowners are given the option to enroll in the Family Forest Fish Program in order to receive financial assistance to fix blockages. The Washington State Department of Transportation, in a cooperative program with WDFW, manages a program to inventory and correct blockages associated with state highways. The Salmon Recovery Funding Board, through the Lower Columbia Fish Recovery Board, funds barrier removal projects. Past efforts have corrected major blockages and have identified others in need of repair. Additional funding is needed to correct remaining blockages. Further monitoring and assessment is needed to ensure that all potential blockages have been identified and prioritized.

#7 - Restore channel structure and stability

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting B. Structurally modify channel morphology to create suitable habitat C. Restore natural rates of erosion and mass wasting within river corridors	• Lack of stable instream woody debris • Altered habitat unit composition • Reduced bank/soil stability • Excessive fine sediment • Excessive turbidity • Embedded substrates	• None (symptom-focused restoration strategy)	All species	Large wood installation projects could benefit habitat conditions in many areas although watershed processes contributing to wood deficiencies should be considered and addressed prior to placing wood in streams. Other structural enhancements to stream channels may be warranted in some places, especially in lowland alluvial reaches that have been simplified through channel straightening and confinement.

Priority Locations

1st- Tier 1 reaches
2nd- Tier 2 reaches
3rd- Tier 3 reaches
4th- Tier 4 reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NGOs, tribes, agencies, landowners	Habitat Projects		✓
WDFW	Habitat Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Agricultural Land Habitat Restoration Programs		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring channel stability and structure. Passive restoration is expected to slowly occur as a result of protections afforded to riparian areas and hillslope processes. Past projects have largely been opportunistic and have been completed due to the efforts of local NGOs and government agencies; such projects are likely to continue in a piecemeal fashion as opportunities arise and if financing is made available. The lack of LWD in stream channels, and the importance of wood for habitat of listed species, places an emphasis on LWD supplementation projects. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

#8 – Restore degraded water quality with emphasis on temperature impairments

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Exclude livestock from riparian areas B. Increase riparian shading C. Decrease channel width-to-depth ratios D. Reduce delivery of chemical contaminants to streams E. Address leaking septic systems	• Bacteria • Altered stream temperature regime • Chemical contaminants	• Timber harvest – riparian harvests • Riparian grazing • Leaking septic systems • Clearing of vegetation due to rural development and agriculture • Chemical contaminants from agricultural and developed lands	• All species	Several stream segments are listed on the draft 2002-2004 303(d) list (WDOE 2004) for stream temperature impairment. A few other segments are included as a concern for temperature impairment. Temperature impairment is believed to be related primarily to degraded riparian conditions.

Priority Locations

1st- Tier 1 or 2 reaches with 303(d) listings (2002-2004 draft list)
Reaches: Coweeman 5, 6, 10-12 (temperature); Canyon 1-2 (temperature); Baird Creek 1 (temperature); Goble Creek1 (temperature)
2nd- Other reaches with 303(d) listings
Reaches: Mulholland Creek 1 (temperature); Turner Creek (temperature); RB trib3 (temperature)
3rd- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Washington Department of Ecology	Water Quality Program		✓
WDNR	Forest Practices Rules	✓	
WDFW	Habitat Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Agriculture Land Habitat Restoration Programs, Centennial Clean Water Program		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Cowlitz County Health Department	Septic System Program		✓

Program Sufficiency and Gaps

The WDOE Water Quality Program manages the State 303(d) list of impaired water bodies. There are several listings in the Coweeman basin and several areas of concern (WDOE 2004). A Water Quality Clean-up Plan (TMDL) is required by the WDOE and it is anticipated that the TMDL will adequately set forth strategies to address the temperature impairment. It will be important that the strategies specified in the TMDLs are implementable and adequately funded. The 303(d) listings are believed to address the primary water quality concerns; however, other impairments may exist that the current monitoring effort is unable to detect. Additional monitoring is needed to fully understand the degree of water quality impairment in the basin.

#9 – Provide for adequate instream flows during critical periods

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect instream flows through water rights closures and enforcement B. Restore instream flows through acquisition of existing water rights C. Restore instream flows through implementation of water conservation measures	• Stream flow – maintain or improve flows during low-flow Summer months	• Water withdrawals	All species	Instream flow management strategies for the Coweeman Basin have been identified as part of Watershed Planning for WRIA 26 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies. This measure applies to instream flows associated with water withdrawals and diversions, generally a concern only during low flow periods. Hillslope processes also affect low flows but these issues are addressed in separate measures.

Priority Locations

Entire Basin

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WRIA 25/26 Watershed Planning Unit	Watershed Planning	✓	
City of Kelso	Water Supply	✓	
Washington Department of Ecology	Water Resources Program		✓

Program Sufficiency and Gaps

The Water Resources Program of the WDOE, in cooperation with the WDFW and other entities, manages water rights and instream flow protections. A collaborative process for setting and managing instream flows was launched in 1998 with the Watershed Planning Act (HB 2514), which called for the establishment of local watershed planning groups who's objective was to recommend instream flow guidelines to WDOE through a collaborative process. The current status of the planning effort is to adopt a watershed plan by December 2004. Instream flow management in the Coweeman Basin will be conducted using the recommendations of the WRIA 25/26 Planning Unit, which is coordinated by the LCFRB. Products of the WRIA 25/26 watershed planning effort can be found on the LCFRB website: www.lcfrb.gen.wa.us. The recommendations of the planning unit have been developed in close coordination with recovery planning and the instream flow prescriptions developed by this group are anticipated to adequately protect instream flows necessary to support healthy fish populations. The measures specified above are consistent with the planning group's recommended strategies.

#10 – Create/restore off-channel and side-channel habitat

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore historical off-channel and side-channel habitats where they have been eliminated B. Create new channel or off-channel habitats (i.e. spawning channels)	• Loss of off-channel and/or side-channel habitat	• Floodplain filling • Channel straightening • Artificial confinement	chum coho	There has been some loss of off-channel and side-channel habitats, especially along the lower mainstem below the canyon. This has limited chum spawning habitat and coho overwintering habitat. Targeted restoration or creation of habitats would increase available habitat where full floodplain and CMZ restoration is not possible.

Priority Locations

1st- Lower mainstem downstream of the canyon
Reaches: Coweeman 1-tidal; Coweeman 2-4
2nd- Other reaches that may have potential for off-channel and side-channel habitat restoration or creation

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDFW	Habitat Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for creating or restoring off-channel and side-channel habitat. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

Table 17. Habitat actions for the Coweeman Basin.

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
Cowee 1. Expand standards in local government comprehensive plans to afford adequate protections of ecologically important areas (i.e. stream channels, riparian zones, floodplains, CMZs, wetlands, unstable geology)	Expansion of existing program or activity	Cowlitz County, City of Kelso	1 & 2	Medium: Private lands. Applies primarily to residential, agricultural, and forest lands at risk of development	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
Cowee 2. Manage future growth and development patterns to ensure the protection of watershed processes. This includes limiting the conversion of agriculture and timber lands to developed uses through zoning regulations and tax incentives	Expansion of existing program or activity	Cowlitz County, City of Kelso	1 & 2	Medium: Private lands. Applies primarily to residential, agricultural, and forest lands at risk of development	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
Cowee 3. Increase funding available to purchase easements or property in sensitive areas in order to protect watershed function where existing programs are inadequate	Expansion of existing program or activity	LCFRB, NGOs, WDFW, USFWS, BPA (NPCC)	1 & 2	Medium: Residential, agricultural, or forest lands at risk of further degradation	High: Protection of riparian function, floodplain function, water quality, wetland function, and runoff and sediment supply processes	High
Cowee 4. Increase technical assistance to landowners and increase landowner participation in conservation programs that protect and restore habitat and habitat-forming processes. Includes increasing the incentives (financial or otherwise) and increasing program marketing and outreach	Expansion of existing program or activity	NRCS, W/CCD, WDNR, WDFW, LCFEG, Cowlitz County, Kelso	All measures	High: Private lands. Applies to lands in agriculture, rural residential, and forestland uses throughout the basin	High: Increased landowner stewardship of habitat. Potential improvement in all factors	Medium
Cowee 5. Fully implement and enforce the Forest Practices Rules (FPRs) on private timber lands in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 3, 5, 6 & 8	High: Private commercial timber lands	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
Cowee 6. Conduct floodplain restoration where feasible along the lower mainstem that has experienced channel confinement. Build partnerships with the City of Kelso and other landowners and provide financial incentives	New program or activity	NRCS, W/CCD, NGOs, WDFW, LCFRB, City of Kelso, USACE, Cowlitz County	4, 5, 6, 7 & 8	Low: Lower mainstem Coweeman	High: Restoration of floodplain function, habitat diversity, and habitat availability.	Medium
Cowee 7. Prevent floodplain impacts from new development through land use controls and Best Management Practices	New program or activity	Cowlitz County, WDOE, Kelso	1	Low: Private lands currently in agriculture or timber production in lowland areas.	Medium: Protection of floodplain function, CMZ processes, and off-channel/side-channel habitat. Prevention of reduced habitat diversity and key habitat availability	High

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[1] Relative amount of basin affected by action

[2] Expected response of action implementation

[3] Relative certainty that expected results will occur as a result of full implementation of action

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
Cowee 8. Review and adjust operations to ensure compliance with the Endangered Species Act; examples include roads, parks, and weed management	**Expansion of existing program or activity**	**Cowlitz County, Kelso**	**1, 3, 5, & 8**	**Low: Applies to lands under public jurisdiction**	**Medium: Protection of water quality, greater streambank stability, reduction in road-related fine sediment delivery, restoration and preservation of fish access to habitats**	**High**
Cowee 9. Implement the prescriptions of the WRIA 25/26 Watershed Planning Unit regarding instream flows	**Activity is currently in place**	**WDOE, WDFW, WRIA 25/26 Planning Unit, Kelso**	**9**	**High: Entire basin**	**Medium: Adequate instream flows to support life stages of salmonids and other aquatic biota.**	**Medium**
Cowee 10. Increase the level of implementation of voluntary habitat enhancement projects in high priority reaches and subwatersheds. This includes building partnerships, providing incentives to landowners, and increasing funding	**Expansion of existing program or activity**	**LCFRB, BPA (NPCC), NGOs, WDFW, NRCS, W/CCD, LCFEG**	**3, 4, 5, 6, 7, 8 & 10**	**High: Priority stream reaches and subwatersheds throughout the basin**	**Medium: Improved conditions related to water quality (temperature and bacteria), LWD quantities, bank stability, key habitat availability, habitat diversity, riparian function, floodplain function, sediment availability, & channel migration processes**	**Medium**
Cowee 11. Increase technical support and funding to small forest landowners faced with implementation of Forest and Fish requirements for fixing roads and barriers to ensure full and timely compliance with regulations	**Expansion of existing program or activity**	**WDNR**	**1, 2, 3, 5, 6, & 8**	**Medium: Small private timberland owners**	**High: Reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats**	**Medium**
Cowee 12. Assess the impact of fish passage barriers (especially culverts) throughout the basin and restore access to potentially productive habitats	**Expansion of existing program or activity**	**WDFW, WDNR, Cowlitz County WSDOT, City of Kelso, LCFEG**	**6**	**Medium: As many as 9 miles of stream are potentially blocked by artificial barriers**	**Medium: Increased spawning and rearing capacity due to access to blocked habitat. Habitat is marginal in most cases**	**Medium**
Cowee 13. Create and/or restore lost side-channel/off-channel habitat for chum spawning and coho overwintering	**New program or activity**	**LCFRB, BPA (NPCC), NGOs, WDFW, NRCS, W/CCD, LCFEG**	**10**	**Low: Lower mainstem Coweeman**	**Medium: Increased habitat availability for spawning and rearing**	**Medium**
Cowee 14. Protect and restore native plant communities from the effects of invasive species	**Expansion of existing program or activity**	**Weed Control Boards (local and state); NRCS, W/CCD, LCFEG**	**1 & 5**	**Medium: Greatest risk is in agriculture and residential use areas**	**Medium: restoration and protection of native plant communities necessary to support watershed and riparian function**	**Low**
Cowee 15. Address temperature impairments through development of water quality clean up plans (TMDLs)	**Expansion of existing program or activity**	**WDOE**	**8**	**High: There are several reaches with temperature impairement**	**Medium: More suitable temperatures to support fish rearing**	**Medium**

5.5 Hatcheries

5.5.1 *Subbasin Hatchery Strategy*

The desired future state of fish production within the Coweeman River Basin includes natural salmon and steelhead populations that are improving on a trajectory to recovery and hatchery programs that either enhance the natural fish recovery trajectory or are operated to not impede progress towards recovery. Hatchery recovery measures in each subbasin are tailored to the specific ecological and biological circumstances for each species in the subbasin. The recovery strategy includes a mixture of conservation programs and mitigation programs for lost fishing benefits. Mitigation programs involve areas or practices selected for consistency with natural population conservation and recovery objectives. A summary of the types of natural production enhancement strategies and fishery enhancement strategies to be implemented in the Coweeman River Basin are displayed by species in Table 7. More detailed descriptions and discussion of the regional hatchery strategy can be found in the Regional Recovery and Subbasin Plan Volume I.

Table 18. Summary of natural production and fishery enhancement strategies to be implemented in the Coweeman River Basin.

		Species					
		Fall Chinook	**Spring Chinook**	**Coho**	**Chum**	**Winter Steelhead**	**Steelhead**
Natural Production Enhancement	**Supplementation**			✓			
	Hatch/Nat Conservation [1/]						
	Isolation						
	Refuge	✓					
Fishery Enhancement	**Hatchery Production**					✓	

[1/] Hatchery and natural population management strategy coordinated meet biological recovery objectives. Strategy may include integration and/or isolation over time. Strategy will be unique to biological and ecological circumstances in each watershed

Conservation-based hatchery programs include strategies and measures which are specifically intended to enhance or protect production of a particular wild fish population within the basin. A unique conservation strategy is developed for each species and watershed depending on the status of the natural population, the biological relationship between the hatchery and natural populations, ecological attributes of the watershed, and logistical opportunities to jointly manage the populations. Four types of hatchery conservation strategies may be employed:

Natural Refuge Watersheds: In this strategy, certain sub-basins are designated as wild-fish-only areas for a particular species. The refuge areas include watersheds where populations have persisted with minimum hatchery influence and areas that may have a history of hatchery production but would not be subjected to future hatchery influence as part of the recovery strategy. More refuge areas may be added over time as wild populations recover. These refugia provide an opportunity to monitor population trends independent of the confounding influence of hatchery fish and will be key indicators of natural population status within the ESU. The Coweeman River Basin would be a refuge area for natural fall Chinook

Hatchery Supplementation: This strategy utilizes hatchery production as a tool to assist in rebuilding depressed natural populations. Supplementation would occur in selected areas that are producing natural fish at levels significantly below current capacity or capacity is expected to increase as a result of immediate benefits of habitat or passage improvements. This is intended to be a temporary measure to jump start critically low populations and to bolster natural fish numbers above critical levels in selected areas until habitat is restored to levels where a population can be self sustaining. This strategy would include coho in the Coweeman Basin.

Hatchery/Natural Isolation: This strategy is focused on physically separating hatchery adult fish from naturally-produced adult fish to avoid or minimize spawning interactions to allow natural adaptive processes to restore native population diversity and productivity. The strategy may be implemented in the entire watershed or more often in a section of the watershed upstream of a barrier or trap where the hatchery fish can be removed. This strategy is currently aimed at hatchery steelhead in watersheds with trapping capabilities. The strategy may also become part of spring and fall Chinook as well as coho strategy in certain watersheds in the future as unique wild runs develop. This definition refers only to programs where fish are physically sorted using a barrier or trap. Some mitigation programs for fishery benefits, particularly for steelhead, are managed to isolate hatchery and wild stocks based on run timing and release locations.

Hatchery/Natural Merged Conservation Strategy: This strategy addresses the case where natural and hatchery fish have been homogenized over time such that they are principally all one stock that includes the native genetic material for the basin. Many spring Chinook, fall Chinook, and coho populations in the lower Columbia currently fall into this category. In many cases, the composite stock productivity is no longer sufficient to support a self-sustaining natural population especially in the face of habitat degradation. The hatchery program will be critical to maintaining any population until habitat can be improved and a strictly natural population can be re-established. This merged strategy is intended to transition these mixed populations to a self-supporting natural population that is not subsidized by hatchery production or subject to deleterious hatchery impacts. Elements include separate management of hatchery and natural subpopulations, regulation of hatchery fish in natural areas, incorporation of natural fish into hatchery broodstock, and annual abundance-driven distribution. Corresponding programs are expected to evolve over time dependent on changes in the populations and in the habitat productivity. This strategy is primarily aimed at Chinook salmon in areas where harvest production occurs. There is not a Chinook harvest program in the Coweeman Basin.

Not every lower Columbia River hatchery program will be turned into a conservation program. The majority of funding for lower Columbia basin hatchery operations is for producing salmon and steelhead for harvest to mitigate for lost harvest of natural production due to hydro development and habitat degradation. Programs for fishery enhancement will continue during the recovery period, but will be managed to minimize risks and ensure they do not compromise recovery objectives for natural populations. It is expected that the need to produce compensatory fish for harvest through artificial production will reduce in the future as natural populations recover and become harvestable. There is a small fishery enhancement program for winter steelhead in the Coweeman Basin.

5.5.2 *Hatchery Measures and Actions*

Hatchery strategies and measures are focused on evaluating and reducing biological risks consistent with the recovery strategies identified for each natural population. Artificial production programs within Coweeman River facilities have been evaluated in detail through the WDFW Benefit-Risk Assessment Procedure (BRAP) relative to risks to natural populations. The BRAP results were utilized to inform the development of these program actions specific to the Coweeman River Basin (Table 19). These hatchery recovery actions were developed in coordination with WDFW and at the same time as the Hatchery and Genetic Management Plans (HGMP) were developed by WDFW for each hatchery program. As a result, the hatchery actions represented in this document will provide direction for specific actions which will be detailed in the HGMPs submitted by WDFW for public review and for NOAA fisheries approval. It is expected that the HGMPs and these recovery actions will be complementary and provide a coordinated strategy for the Coweeman River Basin hatchery programs. Further explanation of specific strategies and actions for hatcheries can be found in the Regional Recovery and Subbasin Plan Volume I.

Table 19. A summary of conservation and harvest strategies to be implemented through Coweeman River Hatchery programs.

Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Activity	Expected Outcome
*Adipose fin-clip mark hatchery released steelhead.	Elochoman Hatchery winter steelhead released into the Coweeman River	Coweeman winter steelhead.	Domestication, Diversity, Abundance	• In-breeding • Harvest	• Continue to mass mark Elochoman Hatchery steelhead releases to provide the means to identify hatchery fish for selective fisheries and to distinguish between hatchery and wild fish returning to the Coweeman River.	• Continue selective fishery opportunity for hatchery produced summer steelhead in the Coweeman River. Harvest impacts to wild Coweeman winter steelhead are minimal and indirect • Enable visual identification of hatchery and wild returns to provide the means to account for and manage the natural and wild escapement consistent with biological objectives
*Preclude release of hatchery produced chinook into the Coweeman River.	All fall chinook programs	Coweeman fall chinook	Domestication, Diversity	• In-breeding	• Maintain Coweeman as a refugia for natural fall chinook without genetic influence from hatchery produced fall chinook.	• Coweeman fall chinook population rebuilds while maintaining genetic legacy attributes. • Coweeman fall chinook possesses genetic attributes which enable the population to reach productivity potential.
*Juvenile release strategies to minimize impacts to natural populations	Elochoman Hatchery winter steelhead released into the Coweeman.	Coweeman steelhead, coho, fall chinook, and chum	Predation, Competition	• Hatchery smolt residence time in the Coweeman.	• Hatchery produced steelhead will be scheduled for release during the time when the maximum numbers of fish are smolted and prepared to emigrate rapidly. • Juvenile rearing strategies will be implemented to provide a fish growth schedule which coincides with an optimum release time for hatchery production survival and to minimize time spent in the Coweeman Basin.	• Minimal residence time of hatchery released juvenile resulting in reduced ecological interactions between hatchery and wild juveniles. • Minimized predation by summer steelhead smolts upon natural produced winter and summer steelhead, coho, fall chinook, and chum. • Improved survival of wild juveniles, resulting in increased productivity and abundance of winter and summer steelhead, coho, fall chinook, and chum
** Hatchery programs utilized for coho supplementation	Cowlitz and/or Kalama Hatchery coho.	Coweeman coho.	Abundance, spatial distribution	• Risk of low number of natural spawners • Ecologically	• Utilize coho production from Cowlitz and/or Kalama hatcheries to supplement coho production in the Coweeman. Cowlitz Hatchery coho could be used for late stock supplementation and Kalama Hatchery coho for early stock supplementation.	• a. Supplementation, strategies in key Coweeman tributaries will assist in “kick-starting” natural coho recovery, coinciding with habitat improvements and harvest management actions.

Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Activity	Expected Outcome
				appropriate brood stock.		
** Monitoring and evaluation, adaptive management	All species	All species	Hatchery production performance, Natural production performance	• All of above	• Research, monitoring , and evaluation of performance of the above actions in relation to expected outcomes • Performance standards developed for each actions with measurable criteria to determine success or failure • Adaptive Management applied to adjust or change actions as necessary	• Clear standards for performance and adequate monitoring programs to evaluate actions. • Adaptive management strategy reacts to information and provides clear path for adjustment or change to meet performance standard

1/ May include integrated and/or segregated strategy over time.
√ Denotes new program

5.6 Harvest

Fisheries are both an impact that reduces fish numbers and an objective of recovery. The long-term vision is to restore healthy, harvestable natural salmonid populations in many areas of the lower Columbia basin. The near-term strategy involves reducing fishery impacts on natural populations to ameliorate extinction risks until a combination of actions can restore natural population productivity to levels where increased fishing may resume. The regional strategy for interim reductions in fishery impacts involves: 1) elimination of directed fisheries on weak natural populations, 2) regulation of mixed stock fisheries for healthy hatchery and natural populations to limit and minimize indirect impacts on natural populations, 3) scaling of allowable indirect impacts for consistency with recovery, 4) annual abundance-based management to provide added protection in years of low abundance while allowing greater fishing opportunity consistent with recovery in years with much higher abundance, and 5) mass marking of hatchery fish for identification and selective fisheries.

Actions to address harvest impacts are generally focused at a regional level to cover fishery impacts accrued to lower Columbia salmon as they migrate along the Pacific Coast and through the mainstem Columbia River. Fisheries are no longer directed at weak natural populations but incidentally catch these fish while targeting healthy wild and hatchery stocks. Subbasin fisheries affecting natural populations have been largely eliminated. Fishery management has shifted from a focus on maximum sustainable harvest of the strong stocks to ensuring protection of the weak stocks. Weak stock protections often preclude access to large numbers of otherwise harvestable fish in strong stocks.

Fishery impact limits to protect ESA-listed weak populations are generally based on risk assessments that identify points where fisheries do not pose jeopardy to the continued persistence of a listed group of fish. In many cases, these assessments identify the point where additional fishery reductions provide little reduction in extinction risks. A population may continue to be at significant risk of extinction but those risks are no longer substantially affected by the specified fishing levels. Often, no level of fishery reduction will be adequate to meet naturally-spawning population escapement goals related to population viability. The elimination of harvest will not in itself lead to the recovery of a population. However, prudent and careful management of harvest can help close the gap in a coordinated effort to achieve recovery.

Fishery actions specific to the subbasins are addressed through the Washington State Fish and Wildlife sport fishing regulatory process. This public process includes an annual review focused on emergency type regulatory changes and a comprehensive review of sport fishing regulations which occurs every two years. This regulatory process includes development of fishing rules through the Washington Administrative Code (WAC) which are focused on protecting weak stock populations while providing appropriate access to harvestable populations. The actions consider the specific circumstances in each area of each subbasin and respond with rules that fit the relative risk to the weak populations in a given time and area of the subbasin. A summary of regulatory and protective fishery actions pertaining to the Coweeman River Basin are presented in Table 18. Additional tributary fishing rules detail can be found in the WDFW sport fishing regulation pamphlet.

Regional actions cover species from multiple watersheds which share the same migration routes and timing, resulting in similar fishery exposure. Regional strategies and actions for harvest are detailed in the Regional Recovery and Subbasin Plan Volume I. A number of regional strategies for harvest involve implementation of actions within specific subbasins. In-basin fishery management is generally applicable to steelhead and salmon while regional management is more applicable to salmon. Regional harvest actions with significant application to the Coweeman Subbasin populations are summarized in Table 19.

Table 20. Summary of regulatory and protective fishery actions in the Coweeman basin

Species	General Fishing Actions	Explanation	Other Protective Fishery Actions	Explanation
Fall chinook	Closed to retention	Protects wild fall chinook. No hatchery produced fall chinook in the Coweeman	No fisheries for other salmon	Further protection of wild fall chinook spawners
Chum	Closed to retention	Protects wild chum. Hatchery chum are not released in the Coweeman	No fisheries for other salmon	Further protection of wild chum spawners
Coho	Closed to retention	Protects wild coho. Hatchery coho are not released in the Coweeman for harvest.	No fisheries for other salmon	Further protection of wild coho spawners
Winter steelhead	Retain only adipose fin-clip marked steelhead	Selective fishery for hatchery steelhead, unmarked wild steelhead must be released	Steelhead and trout fishing closed in the spring and minimum size restrictions in affect	Spring closure Protects adult wild steelhead during spawning and minimum size protects juvenile steelhead

Table 21. Regional harvest actions from Volume I, Chapter 7 with significant application to the Coweeman River populations.

Action	Description	Responsible Parties	Programs	Comments
**F.A.8	Develop a regional mass marking program for tule fall Chinook	WDFW, NOAA, USFWS, Col. Tribes	U.S. Congress, Washington Fish and Wildlife Commission	Retention of fall Chinook is prohibited in the Coweeman sport fishery, however marking of other hatchery tule fall Chinook may provide regional selective fishery options
*F.A13	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Includes monitoring of naturally-spawning steelhead encounter rates in fisheries and refinement of long-term catch and release handling mortality estimates. Would include assessment of the current monitoring programs and determine their adequacy in formulating naturally-spawning steelhead incidental mortality estimates.
*F.A14	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Regulatory agencies should continue to refine gear, handle and release methods, and seasonal options to minimize mortality of naturally-spawning steelhead in commercial and sport fisheries.
*F.A20	Maintain selective sport fisheries in Ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	WDFW, NOAA, ODFW, USFWS	PFMC, Columbia Compact, BPA Fish and Wildlife Program, WDFW Creel	Mass marking of lower Columbia River coho and steelhead has enabled successful ocean and freshwater selective fisheries to be implemented since 1998. Marking programs should be continued and fisheries monitored to provide improved estimates of naturally-spawning salmon and steelhead release mortality.

* Extension or improvement of existing action
** New action

5.7 Hydropower

No hydropower facilities exist in the Coweeman Basin, hence, no in-basin hydropower actions are identified. Coweeman River anadromous fish populations will benefit from regional hydropower recovery measures and actions identified in regional plans to address habitat effects in the mainstem and estuary.

5.8 Mainstem and Estuary Habitat

Coweeman River anadromous fish populations will also benefit from regional recovery strategies and measures identified to address habitat conditions and threats in the Columbia River mainstem and estuary. Regional recovery plan strategies involve: 1) avoiding large scale habitat changes where risks are known or uncertain, 2) mitigating small-scale local habitat impacts to ensure no net loss, 3) protecting functioning habitats while restoring impaired habitats to functional conditions, 4) striving to understand, protect, and restore habitat-forming processes, 5) moving habitat conditions in the direction of the historical template which is presumed to be more consistent with restoring viable populations, and 6) improving understanding of salmonid habitat use in the Columbia River mainstem and estuary and their response to habitat changes. A series of specific measures are detailed in the regional plan for each of these strategies.

5.9 Ecological Interactions

For the purposes of this plan, ecological interactions refer to the relationships of salmon and steelhead with other elements of the ecosystem. Regional strategies and measures pertaining to exotic or non-native species, effects of salmon on system productivity, and native predators of salmon are detailed and discussed at length in the Regional Recovery and Subbasin Plan Volume I and are not reprised at length in each subbasin plan. Strategies include 1) avoiding, eliminating introductions of new exotic species and managing effects of existing exotic species, 2) recognizing the significance of salmon to the productivity of other species and the salmon themselves, and 3) managing predation by selected species while also maintaining a viable balance of predator populations. A series of specific measures are detailed in the regional plan for each of these strategies. Implementation will occur at the regional and subbasin scale.

5.10 Monitoring, Research, & Evaluation

Biological status monitoring quantifies progress toward ESU recovery objectives and also establishes a baseline for evaluating causal relationships between limiting factors and a population response. Status monitoring involves routine and intensive efforts. Routine monitoring of biological data consists of adult spawning escapement estimates, whereas routine monitoring for habitat data consists of a suite of water quality and quantity measurements.

Intensive monitoring supplements routine monitoring for populations and basins requiring additional information. Intensive monitoring for biological data consists of life-cycle population assessments, juvenile and adult abundance estimates and adult run-reconstruction. Intensive monitoring for habitat data includes stream/riparian surveys, and continuous stream flow assessment. The need for additional water quality sampling may be identified. Rather than prescribing one monitoring strategy, three scenarios are proposed ranging in level of effort and cost from high to low (Level 1-3 respectively). Given the fact that routine monitoring is ongoing, only intensive monitoring varies between each level.

An in-depth discussion of the monitoring, research and evaluation (M, R & E) approach for the Lower Columbia Region is presented in the Regional Recovery and Management Plan. It includes site selection rationale, cost considerations and potential funding sources. The following tables summarize the biological and habitat monitoring efforts specific to the Coweeman Basin.

Table 22. Summary of the biological monitoring plan for Coweeman River populations.

Coweeman: Lower Columbia Biolopgical Monitoring Plan				
Monitoring Type	**Fall Chinook**	**Chum**	**Coho**	**Winter Steelhead**
Routine	AA	AA	AA	AA
Intensive				
Level 1	✓		✓	✓
Level 2	✓			
Level 3	✓			

AA Annual adult abundance estimates
✓ Adult and juvenile intensive biological monitoring occurs periodically on a rotation schedule (every 9 years for 3-year duration)
× Adult and juvenile intensive biological monitoring occurs annually

Table 23. Summary of the habitat monitoring plan for Coweeman River populations.

Coweeman: Lower Columbia Habitat Monitoring Plan				
Monitoring Type	**Watershed**	**Existing stream / riparian habitat**	**Water quantity[3] (level of coverage)**	**Water quality [2] (level of coverage)**
Routine [1] (level of coverage)	Baseline complete	Poor	Stream Gage-Moderate IFA-Moderate	WDOE-Poor USGS-Moderate Temperature-Poor
Intensive				
Level 1			✓	
Level 2			✓	
Level 3				

IFAComprehensive Instream Flow Assessment (i.e. Instream Flow Incremental Methodology)
[1] Routine surveys for habitat data do not imply ongoing monitoring
[2] Intensive monitoring for water quality to be determined
[3] Water quantity monitoring may include stream gauge installation, IFA or low flow surveys

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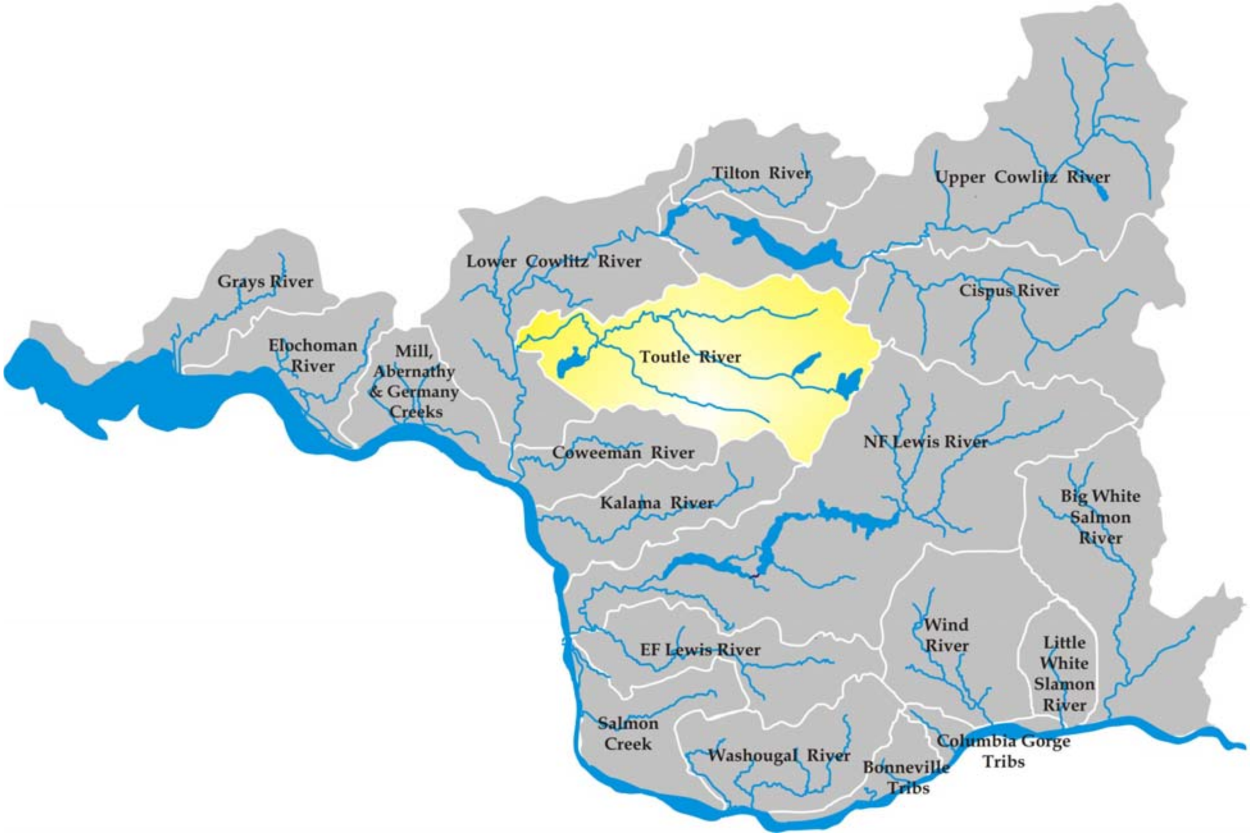
Cowlitz Subbasin - Toutle River



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1.0 Toutle River – Executive Summary

This plan describes a vision, strategy, and actions for recovery of listed salmon, steelhead, and trout species to healthy and harvestable levels, and mitigation of the effects of the Columbia River Hydro system in Washington lower Columbia River subbasins. Recovery of listed species and hydropower mitigation is accomplished at a regional scale. This plan for the Toutle River Subbasin describes implementation of the regional approach within this subbasin, as well as assessments of local fish populations, limiting factors, and ongoing activities that underlie local recovery or mitigation actions. The plan was developed in a partnership between the Lower Columbia Fish Recovery Board (Board), Northwest Power and Conservation Council, federal agencies, state agencies, tribal nations, local governments, and others.

The Toutle River is part of the Cowlitz Subbasin, one of eleven major subbasins in the Washington portion of the Lower Columbia Region. The North Fork Toutle Basin has historically supported populations of fall Chinook, winter steelhead, and coho. The South Fork Toutle Basin has historically supported large populations of spring Chinook, coho, and winter steelhead. Today, numbers of naturally spawning salmon and steelhead have plummeted to levels far below historical numbers. Chinook, chum, and steelhead have been listed as Threatened under the Endangered Species Act and coho is proposed for listing. The decline has occurred over decades and the reasons are many. Freshwater and estuary habitat quality has been reduced by agricultural and forestry practices. Key habitats have been isolated or eliminated by channel modifications including channel dredging, construction of levees, filling of floodplains, and wetland draining and filling. Altered habitat conditions have increased predation. Competition and interbreeding with domesticated or nonlocal hatchery fish has reduced productivity. The mainstem Columbia hydropower system has altered flows, habitat, and migration conditions. Fish are harvested in fresh and saltwater fisheries. In addition to these human caused factors, the eruption of Mt. St. Helens in 1980 has substantially altered the habitat conditions in the Toutle basin.

Toutle River salmon and steelhead will need to be restored to a high level of viability to meet regional recovery objectives. This means that the populations are productive, abundant, exhibit multiple life history strategies, and utilize significant portions of the subbasin. In recent years, agencies, local governments, and other entities have actively addressed the various threats to salmon and steelhead, but much remains to be done. One thing is clear: no single threat is responsible for the decline in these populations. All threats and limiting factors must be reduced if recovery is to be achieved. An effective recovery plan must also reflect a realistic balance within physical, technical, social, cultural and economic constraints. The decisions that govern how this balance is attained will shape the region’s future in terms of watershed health, economic vitality, and quality of life.

This plan represents the current best estimation of necessary actions for recovery and mitigation based on thorough research and analysis of the various threats and limiting factors that impact Toutle River fish populations. Specific strategies, measures, actions and priorities have been developed to address these threats and limiting factors. The specified strategies identify the best long term and short term avenues for achieving fish restoration and mitigation goals. While it is understood that data, models, and theories have their limitations and growing knowledge will certainly spawn new strategies, the Board is confident that by implementation of the recommended actions in this plan, the population goals in the Toutle River Basin can be achieved. Success will depend on implementation of these strategies at the program and project level. It remains uncertain what level of effort will need to be invested in each area of impact to ensure the desired result. The answer to the question of precisely how much is enough is currently beyond our understanding of the species and ecosystems and can only be answered through ongoing monitoring and adaptive management against the backdrop of what is socially possible.

1.1 Key Priorities

Many actions, programs, and projects will make necessary contributions to recovery and mitigation in the Toutle Basin. The following list identifies the most immediate priorities.

1. Address Passage and Sedimentation Issues Associated with the Sediment Retention Structure on the North Fork Toutle

The Sediment Retention Structure (SRS) on the North Fork Toutle was constructed following the 1980 Mount St. Helens eruption in an attempt to prevent the continuation of severe downstream sedimentation of stream channels, which created flood conveyance, transportation, and habitat degradation concerns. The SRS currently blocks volitional access to as many as 50 miles of habitat for anadromous fish, although fish are transported around the structure via a trap and haul system. The structure is also a source of chronic fine sediment to the lower river. In addition, sediment over the structure has interfered with the fish collection facility at the base of the structure. Addressing passage and sedimentation issues at the SRS will be a key component of salmon and steelhead recovery in the basin.

2. Manage Forest Lands to Protect and Restore Watershed Processes

Most of the Toutle Basin is managed for commercial timber production and has experienced intensive past forest practices activities, especially in the 1980s following the 1980 Mount St. Helens eruption. The landscape is still recovering from the eruption and subsequent intensive road building and forest harvest. Proper forest management will be critical to fish recovery. The eruption and forest practices activities have reduced fish habitat quantity and quality by altering stream flow, increasing sediment, and reducing riparian zones. In addition, forest road culverts have blocked fish passage in small tributary streams. Effective implementation of new forest practices through the Department of Natural Resources’ Habitat Conservation Plan (State-owned lands), Forest Practices Rules (private lands), and the Northwest Forest Plan (federal lands) are expected to substantially improve conditions by restoring passage, protecting riparian conditions, reducing sediment inputs, lowering water temperatures, improving flows, and restoring habitat diversity. Improvements will benefit all species, particularly winter steelhead and coho.

3. Restore Valley Floodplain Function, Riparian Function and Stream Habitat Diversity

Much of the lower mainstem Toutle was dredged and diked following the 1980 Mount St. Helens eruption. Stream channels, floodplains, and channel migration zones are constrained and riparian areas are degraded. Land-uses along these reaches currently include timber harvest, rural residential development, and small-scale agriculture. Removing or modifying channel control and containment structures to reconnect the stream and its floodplain, where this is feasible and can be done without increasing risks of substantial flood damage,will restore normal habitat-forming processes to reestablish habitat complexity, off-channel habitats, and conditions favorable to fish spawning and rearing. These improvements will be particularly beneficial to chum, fall Chinook, and coho. Partially restoring normal floodplain functions will also help control catastrophic flooding and provide wetland and riparian habitats critical to other fish, wildlife, and plant species. Existing floodplain function and riparian habitats will be protected through local land use ordinances, partnerships with landowners, and the acquisition of land, where appropriate. Restoration will be achieved by working with willing landowners, non-governmental organizations, conservation districts, and state and federal agencies.

4. Help Address Immediate Risks with Short-term Habitat Fixes

Restoration of normal watershed processes that allow a basin to restore itself over time has proven to be the most effective strategy for long term habitat improvements. However, restoration of some critical habitats may take decades to occur. In the near term, it is important to initiate short-term fixes to address current critical low numbers of some species. Examples in the Toutle subbasin include building of chum salmon spawning channel and construction of coho overwinter habitat with alcoves, side channels, or engineered log jams. Benefits will be temporary but will help bridge the period until normal habitat-forming processes are reestablished.

5. Manage Growth and Development to Protect Watershed Processes and Habitat Conditions

The human population in the basin is relatively low, but it is projected to grow by at least twenty percent in the next twenty years. This growth is likely to result in the conversion of forest and agricultural land to residential uses, with potential impacts to habitat conditions. Land-use changes will provide a variety of risks to terrestrial and aquatic habitats. Careful land-use planning will be necessary to protect and restore natural fish populations and habitats and will also present opportunities to preserve the rural character and local economic base of the basin.

6. Align Hatchery Priorities Consistent with Conservation Objectives

Hatcheries throughout the Columbia basin historically focused on producing fish for fisheries as mitigation for hydropower development and widespread habitat degradation. Emphasis of hatchery production without regard for natural populations can pose risks to natural population viability. Hatchery priorities must be aligned to conserve natural populations, enhance natural fish recovery, and avoid impeding progress toward recovery while continuing to provide fishery mitigation benefits. The Toutle River hatchery program will produce and/or acclimate fall Chinook, coho and summer steelhead for use in the Toutle Basin. Hatchery production will be used to supplement natural production in appropriate areas of the basin and adjacent tributary streams, develop a local broodstock to reestablish historical diversity and life history characteristics, and also to provide fishery mitigation in a manner that does not pose significant risk to natural population rebuilding efforts.

7. Manage Fishery Impacts so they do not Impede Progress Toward Recovery

This near-term strategy involves limiting fishery impacts on natural populations to ameliorate extinction risks until a combination of measures can restore fishable natural populations. There is no directed Columbia River or tributary harvest of ESA-listed Toutle River salmon and steelhead. This practice will continue until the populations are sufficiently recovered to withstand such pressure and remain self-sustaining. Some Toutle River salmon and steelhead are incidentally taken in mainstem Columbia River and ocean mixed stock fisheries for strong wild and hatchery runs of fall chinook and coho. These fisheries will be managed with strict limits to ensure this incidental take does not threaten the recovery of wild populations including those from the Toutle. Steelhead and chum will continue to be protected from significant fishery impacts in the Columbia River and are not subject to ocean fisheries. Selective fisheries for marked hatchery steelhead and coho (and fall chinook after mass marking occurs) will be a critical tool for limiting wild fish impacts. State and federal legislative bodies will be encouraged to develop funding necessary to implement mass-marking of fall Chinook, thus enabling a selective fishery with lower impacts on wild fish. State and federal fisheries managers will better incorporate Lower Columbia indicator populations into fisheries impact models.

8. Reduce Out-of-Subbasin Impacts so that the Benefits of In-Basin Actions can be Realized

Toutle River salmon and steelhead are exposed to a variety of human and natural threats in migrations outside of the subbasin. Human impacts include drastic habitat changes in the Columbia River estuary, effects of Columbia Basin hydropower operation on mainstem, estuary, and nearshore ocean conditions, interactions with introduced animal and plant species, and altered natural predation patterns by northern pikeminnow, birds, seals, and sea lions. A variety of restoration and management actions are needed to reduce these out-of-basin effects so that the benefits in-subbasin actions can be realized. To ensure equivalent sharing of the recovery and mitigation burden, impacts in each area of effect (habitat, hydropower, etc.) should be reduced in proportion to their significance to species of interest.

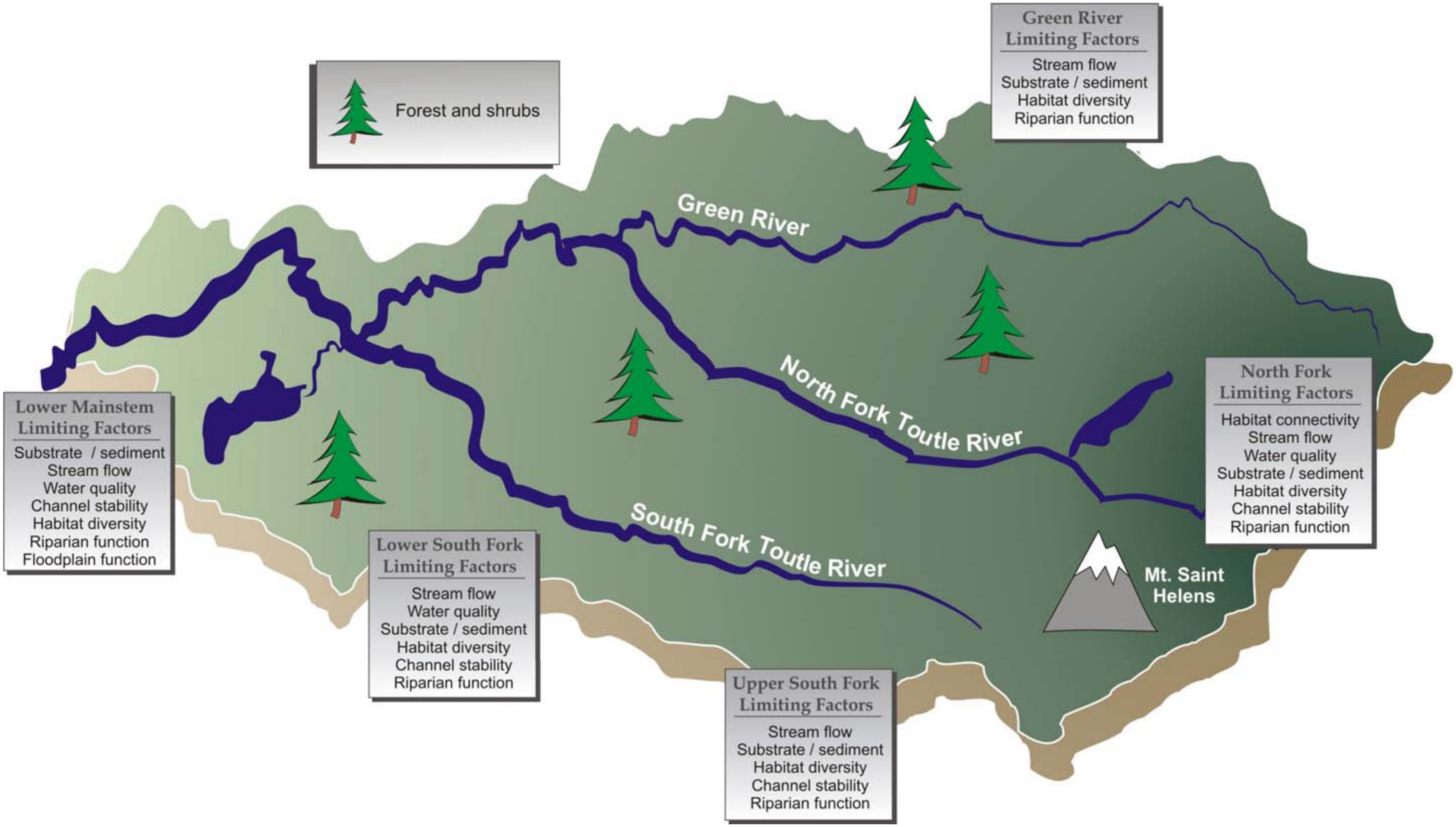


Figure 1. **Key features of the Toutle River Basin including a summary of limiting fish habitat factors in different areas and the status and relative distribution of focal salmonid species.**

2.0 Background

This plan describes a vision and framework for rebuilding salmon and steelhead populations in Washington's Toutle River Subbasin. The plan addresses subbasin elements of a regional recovery plan for Chinook salmon, chum salmon, coho salmon, steelhead, and bull trout listed or under consideration for listing as Threatened under the federal Endangered Species Act (ESA). The plan also serves as the subbasin plan for the Northwest Power and Conservation Council (NPCC) Fish and Wildlife Program to address effects of construction and operation of the Federal Columbia River Power System.

Development of this plan was led and coordinated by the Washington Lower Columbia River Fish Recovery Board (LCFRB). The Board was established by state statue (RCW 77.85.200) in 1998 to oversee and coordinate salmon and steelhead recovery efforts in the lower Columbia region of Washington. It is comprised of representatives from the state legislature, city and county governments, the Cowlitz Tribe, private property owners, hydro project operators, the environmental community, and concerned citizens. A variety of partners representing federal agencies, Tribal Governments, Washington state agencies, regional organizations, and local governments participated in the process through involvement on the LCFRB, a Recovery Planning Steering Committee, planning working groups, public outreach, and other coordinated efforts.

The planning process integrated four interrelated initiatives to produce a single Recovery/Subbasin Plan for Washington subbasins of the lower Columbia:

- Endangered Species Act recovery planning for listed salmon and trout.
- Northwest Power and Conservation Council (NPCC) fish and wildlife subbasin planning for eight full and three partial subbasins.
- Watershed planning pursuant to the Washington Watershed Management Act, RCW 90-82.
- Habitat protection and restoration pursuant to the Washington Salmon Recovery Act, RCW 77.85.

This integrated approach ensures consistency and compatibility of goals, objectives, strategies, priorities and actions; eliminates redundancy in the collection and analysis of data; and establishes the framework for a partnership of federal, state, tribal and local governments under which agencies can effectively and efficiently coordinate planning and implement efforts.

The plan includes an assessment of limiting factors and threats to key fish species, an inventory of related projects and programs, and a management plan to guide actions to address specific factors and threats. The assessment includes a description of the subbasin, focal fish species, current conditions, and evaluations of factors affecting focal fish species inside and outside the subbasin. This assessment forms the scientific and technical foundation for developing a subbasin vision, objectives, strategies, and measures. The inventory summarizes current and planned fish and habitat protection, restoration, and artificial production activities and programs. This inventory illustrates current management direction and existing tools for plan implementation. The management plan details biological objectives, strategies, measures, actions, and expected effects consistent with the planning process goals and the corresponding subbasin vision.

3.0 Assessment

3.1 Subbasin Description

3.1.1 *Topography & Geology*

The Toutle basin encompasses approximately 513 mi^2 in portions of Lewis, Cowlitz, and Skamania Counties. The basin is within WRIA 26 of Washington State. The Toutle enters the Cowlitz at RM 20, just north of the town of Castle Rock. Elevations range from near sea level at the mouth to over 8,000 feet at the summit of Mount St. Helens. The Toutle drains the north and west sides of Mount St. Helens and flows generally westward towards the Cowlitz. The watershed contains three main drainages: the North Fork Toutle, the South Fork Toutle, and the Green River. Most of the North and South Fork were impacted severely by the 1980 eruption of Mount St. Helens and the resulting massive debris torrents and mudflows.

3.1.2 *Climate*

The basin has a typical northwest maritime climate. Summers are dry and warm and winters are cool, wet, and cloudy. Mean annual precipitation is 61 inches at Kid Valley (North Fork Toutle). Most precipitation occurs between October and March. Snowfall predominates in the higher elevations around Mount St. Helens and rainfall predominates in most of the remaining, lower elevation portion of the basin.

3.1.3 *Land Use, Ownership, and Cover*

Forestry is the dominant land use in the basin. Commercial forestland makes up over 90% of the Toutle basin. Much of the upper basin around Mount St. Helens is within the Mount St. Helens National Volcanic Monument and is managed by the US Forest Service. A significant proportion of the forests to the north and west of Mount St. Helens were decimated in the 1980 eruption and are now in early seral or ‘other forest’ (bare soil, shrubs) vegetation conditions. Population centers in the basin consist primarily of small rural towns. Projected population change from 2000-2020 for unincorporated areas in WRIA 26 is 22% (LCFRB 2001). The State of Washington owns, and the Washington State Department of Natural Resources (DNR) manages the beds of all navigable waters within the subbasin. Any proposed use of those lands must be approved in advance by the DNR. A breakdown of land ownership and land cover is presented in Figure 1 and Figure 2.

3.1.4 *Development Trends*

Population centers in the basin consist primarily of small rural towns. Projected population change from 2000 to 2020 for unincorporated areas in WRIA 26 is 22%. Continued population growth will increase pressures for conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions.

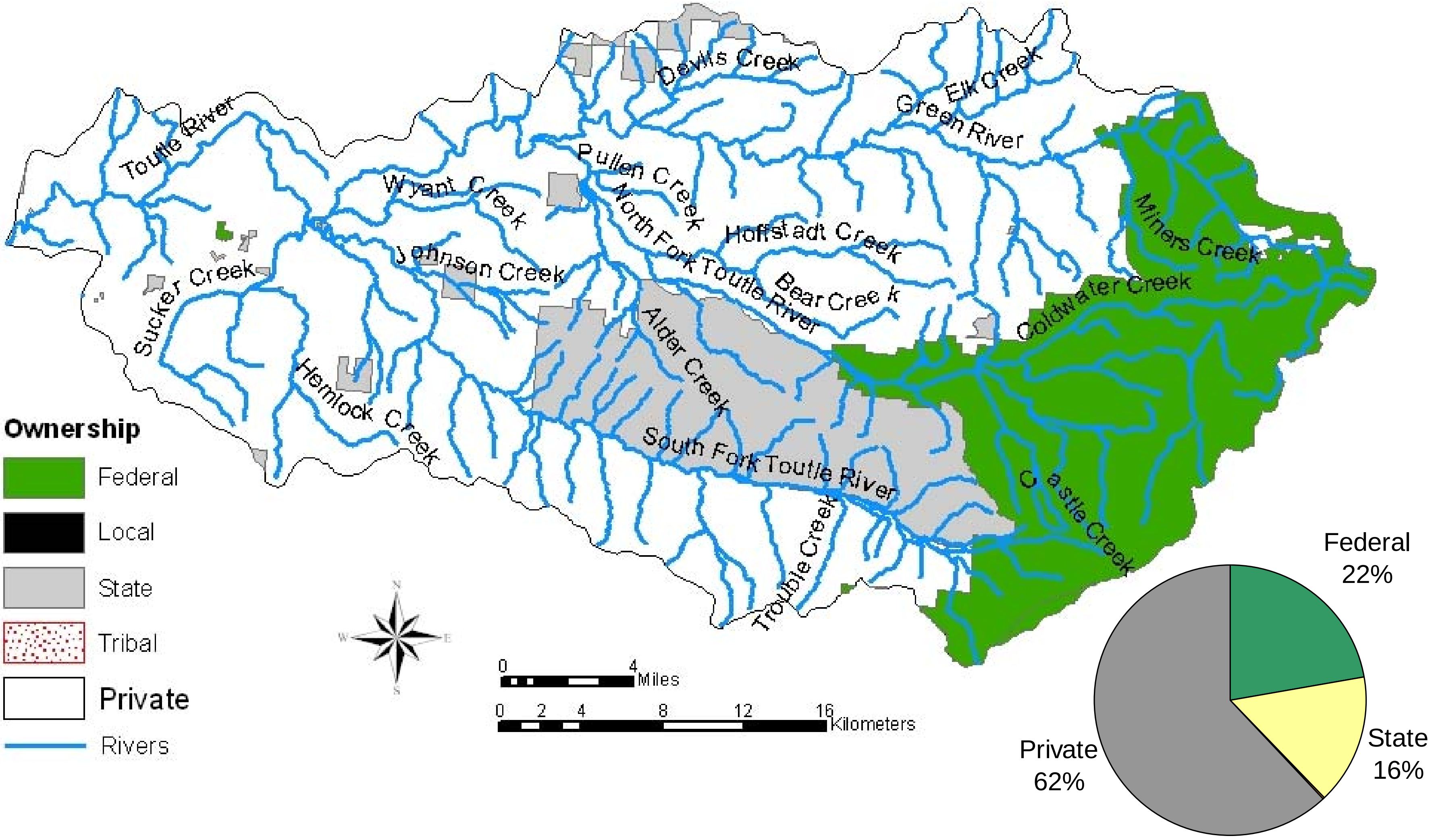


Figure 2. Landownership within the Toutle subbasin. Data is WDNR data that was obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

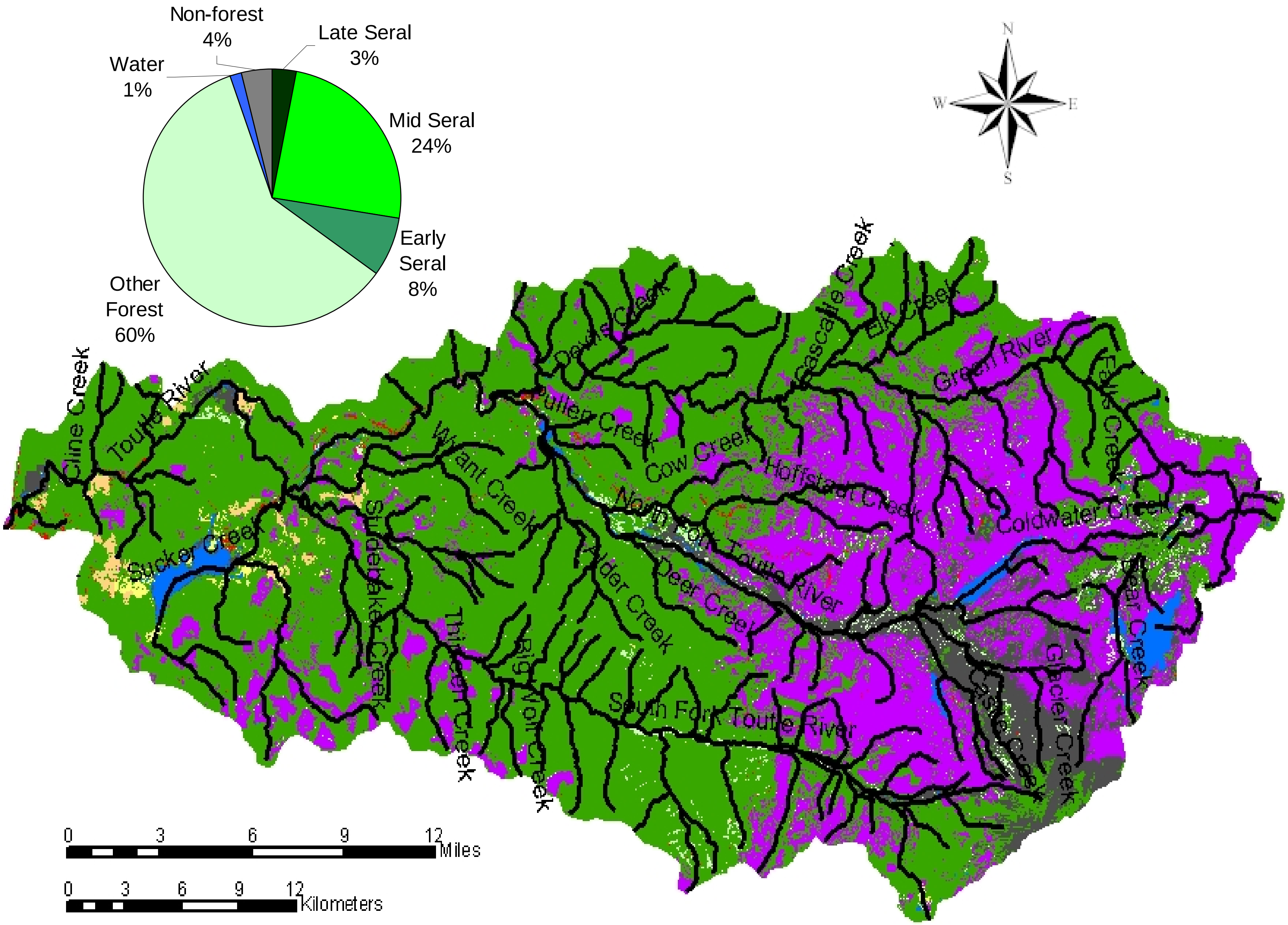


Figure 3. Land cover within the Toutle basin. Vegetation cover (pie chart) derived from Landsat data based on methods in Lunetta et al. (1997). Mapped data was obtained from the USGS National Land Cover Dataset (NLCD).

3.2 Focal and Other Species of Interest

Listed salmon, steelhead, and trout species are focal species of this planning effort for the Toutle Subbasin. Other species of interest were also identified as appropriate. Species were selected because they are listed or under consideration for listing under the U.S. Endangered Species Act or because viability or use is significantly affected by the Federal Columbia Hydropower system. Federal hydropower system effects are not significant within the Toutle River basin although anadromous species are subject to effects in the Columbia River, estuary, and near shore ocean. The Toutle ecosystem supports and depends on a wide variety of fish and wildlife in addition to designated focal species. A comprehensive ecosystem-based approach to salmon and steelhead recovery will provide significant benefits to other native species through restoration of landscape-level processes and habitat conditions. Other fish and wildlife species not directly addressed by this plan are subject to a variety of other Federal, State, and local planning or management activities.

Focal salmonid species in Toutle River watersheds include fall and spring Chinook, coho, chum, and winter steelhead. Toutle River Chum are a subset of a larger population which includes the lower Cowlitz, Coweeman, and Toutle rivers. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 1). Extinction risks are significant for all focal species – the current health or viability ranges from very low for spring Chinook to low for fall Chinook, coho and winter steelhead. Returns of fall Chinook, coho, and winter steelhead, include both natural and hatchery produced fish.

Table 1. Status of focal salmond and steelhead populations in the Toutle River subbasin.

Focal Species	ESA Status	Hatchery Component[1]	Historical numbers[2]	Recent numbers[3]	Current viability[4]	Extinction risk[5]
Fall Chinook	Threatened	Yes	15,000-20,000	300-5,000	Low	70%
Spring Chinook	Threatened	No	4,000-40,000	<200	Very Low	80%
Coho	Proposed	Yes	60,000	Unknown	Low	70%
Winter Steelhead	Threatened	No	7,000-15,000	100-300	NF - Low SF – Med	20-30%[6]
Chum (a)	Threatened	No	300,000-500,000[7]	<150	Very Low	70%

(a) Includes combined lower Cowlitz, Coweeman, and Toutle populations

[1] *Significant numbers of hatchery fish are released in the subbasin.*

[2] *Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NOAA rough calculations..*

[3] *Approximate current annual range in number of naturally-produced fish returning to the subbasin.*

[4] *Propsects for long term persistence based on criteria developed by the NOAA Technical Recovery Team.*

[5] *Probability of extinction within 100 years corresponding to estimated viability.*

[6] *20% in the South Fork, and 30% in the North Fork*

[7] *Includes entire lower Cowlitz subbasin*

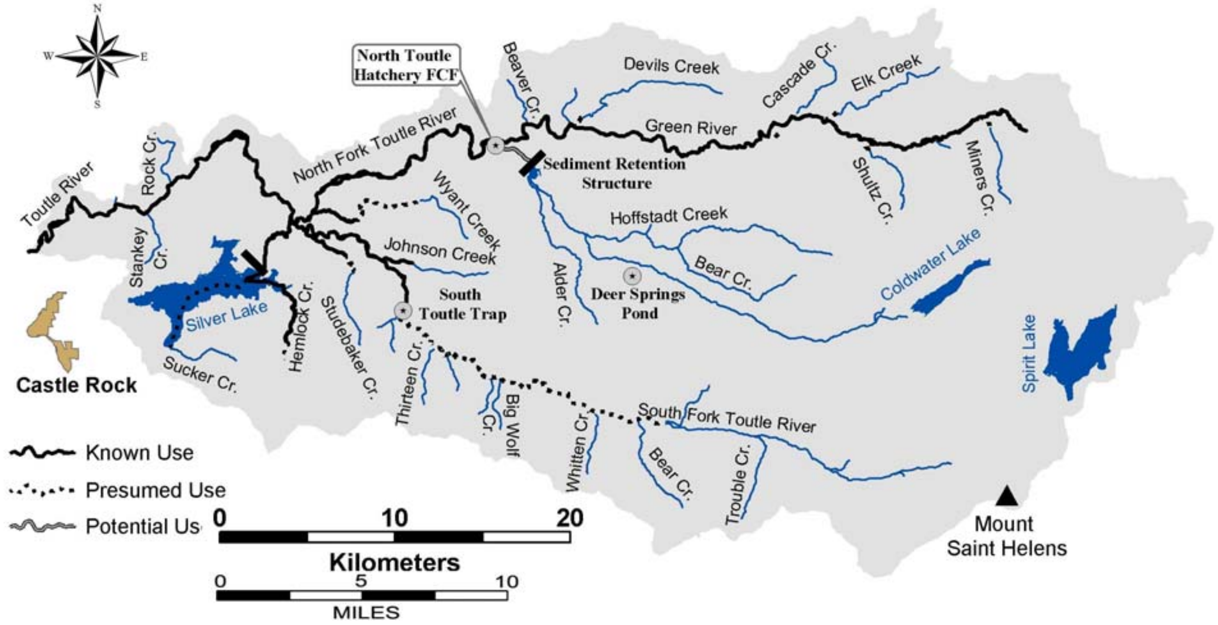
Other species of interest in the Toutle Subbasin include coastal cutthroat trout and Pacific lamprey. These species have been affected by many of the same habitat factors that have reduced numbers of anadromous salmonids.

Brief summaries of the population characteristics and status follow. Additional information on life history, population characteristics, and status assessments may be found in Appendix A (focal species) and B (other species).

3.2.1 *Fall Chinook—Cowlitz Subbasin (Toutle/Green River)*

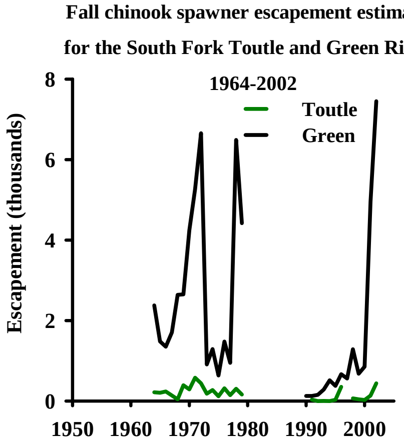
ESA: Threatened 1999	**SASSI: South Fork—Depressed 2002, Green—Healthy 2002**

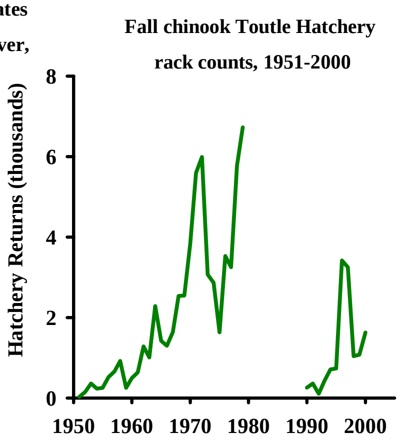
The historical Toutle adult population is estimated from 15,000-20,000 fish. Current natural spawning returns range from 300-5,000 with the majority of hatchery origin fish spawning in the Lower 0.5 mile of the Green River. Prior to the eruption of Mt. St. Helens in 1980, Significant fall Chinook natural spawning occurred in the lower 5 miles of the mainstem Toutle and in the lower NF Toutle. The eruption devastated much of the spawning area in the mainstem and NF Toutle. Current spawning primarily occurs in the lower Green below the North Toutle Hathery and in the lower SF Toutle. Juvenile rearing occurs near and downstream of the spawning area. Juveniles emerge in early spring and migrate to the Columbia in spring and summer of their first year.

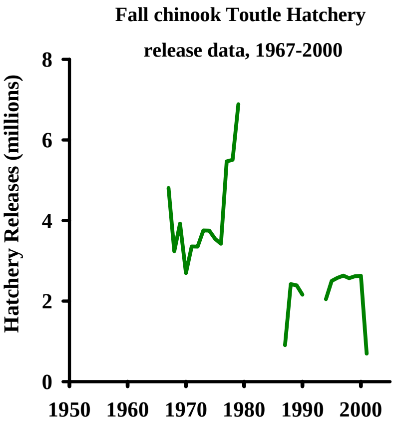


Distribution

- Toutle River fall chinook spawning distribution from 1964 to 1979 was estimated as 4.8% mainstem Toutle, 3.8% SF Toutle, 49.4% NF Toutle, and 42% Green River
- Historical spawning areas in the mainstem Toutle, NF Toutle, and lower Green River were devastated by the 1980 eruption of Mt. St. Helens
- Records indicate most historical fall chinook spawning occurred in the lower 5 miles of the mainstem Toutle River, but spawning spread as far upstream as Coldwater Creek on the NF Toutle River (46 mi from the river mouth)
- In the SF Toutle River, spawning primarily occurs from the 4700 Bridge to the confluence with the mainstem Toutle River (~2.6 mi)
- In the Green River, spawning primarily occurs from the North Toutle Hatchery to the river mouth (~0.6 mi)


Fall chinook spawner escapement estimates for the South Fork Toutle and Green River, 1964-2002


Fall chinook Toutle Hatchery rack counts, 1951-2000


Fall chinook Toutle Hatchery release data, 1967-2000

Life History

- Columbia River fall chinook migration occurs from mid August to early September, depending partly on early fall rain
- Natural spawning occurs between late September and early-November, usually peaking in mid-October
- Age ranges from 2-year-old jacks to 6-year-old adults, with dominant adult ages of 3 and 4
- Fry emerge around early May, depending on time of egg deposition and water temperature; fall chinook fry spend the summer in fresh water, and emigrate in the late summer/fall as sub-yearlings

Diversity

- Considered a tule population within the lower Columbia River Evolutionary Significant Unit (ESU)
- NF and SF Toutle River stocks designated based on distinct spawning distribution

Abundance

- In 1951, WDF estimated fall chinook escapement to the Toutle River was 6,500 fish
- SF Toutle River spawning escapements from 1964-2001 ranged from 0-578 (average 177)
- Green River spawning escapements from 1964-2001 ranged from 10-6,654 (average 1,900)
- Hatchery production accounts for most fall chinook returning to the Toutle River Basin; chinook are re-establishing a population in the basin after the 1980 Mt. St. Helens eruption
- Hatchery produced adults comprise the majority of natural spawners in the Green and NF Toutle Rivers

Productivity & Persistence

- Smolt density model predicted natural production potential for the Toutle River of 2,799,000 smolts
- Juvenile production from natural spawning is presumed to be low

Hatchery

- The North Toutle Hatchery (formerly called the Green River Hatchery) is located on the lower Green River near the confluence with the NF Toutle River; operations began in 1956, but the hatchery was destroyed in the 1980 eruption of Mt. St. Helens
- The North Toutle Hatchery was renovated and began collecting brood stock again in 1990

- Rearing ponds near the original hatchery site were developed after the eruption and began operation in 1985
- Releases of fall chinook in the Toutle River basin has occurred since 1951; current program releases 2.5 million sub-yearling fall chinook annually; release data are displayed from 1967-2002

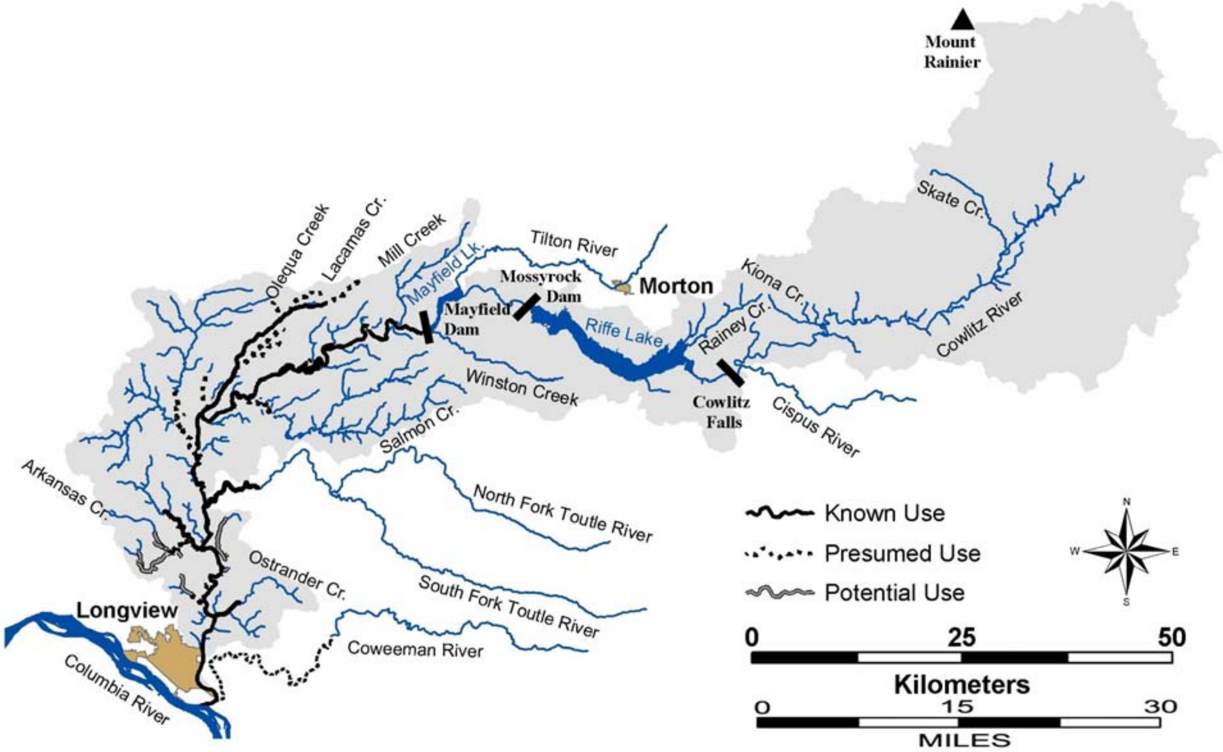
Harvest

- Fall chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, in addition to Columbia River commercial gill net and freshwater sport fisheries
- Lower Columbia tule fall chinook are an important contributor to Washington ocean troll and sport fisheries and to the Columbia River estuary sport fishery
- Columbia River commercial harvest occurs primarily in September, but tule chinook flesh quality is low once the fish move from salt water; the price is low compared to higher quality bright stock chinook
- Annual harvest is dependent on management response to annual abundance in Pacific Salmon Commission (PSC)(US/Canada), Pacific Fisheries Management Council (PFMC) (US ocean), and Columbia River Compact forums
- outle River and Green River chinook harvest in ocean and mainstem Columbia River limited by an ESA constraint of 49% or less on Coweeman River fall chinook
- Coded-wire tag (CWT) data analysis of the 1989-94 brood North Toutle Hatchery fall chinook indicates a total Toutle River fall chinook harvest rate of 41%
- The majority of the North Toutle Hatchery fall chinook stock harvest occurred in Toutle tributary sport (31%), British Columbia (30%), Columbia River (13%), Alaska (14%), and Washington ocean (10%) fisheries
- Sport fishing for salmon in the SF Toutle River has been closed since the 1980 eruption of Mt. St. Helens

3.2.2 *Chum—Cowlitz Subbasin*

ESA: Threatened 1999	**SASSI: NA**

The chum population is considered part of the lower Cowlitz population.



Distribution

- Chum were reported to historically utilize the lower Cowlitz River and tributaries downstream of the Mayfield Dam site

Life History

- Lower Columbia River chum salmon run from mid-October through November; peak spawner abundance occurs in late November
- Dominant age classes of adults are 3 and 4
- Fry emerge in early spring; chum emigrate as age-0 smolts generally from March to May

Diversity

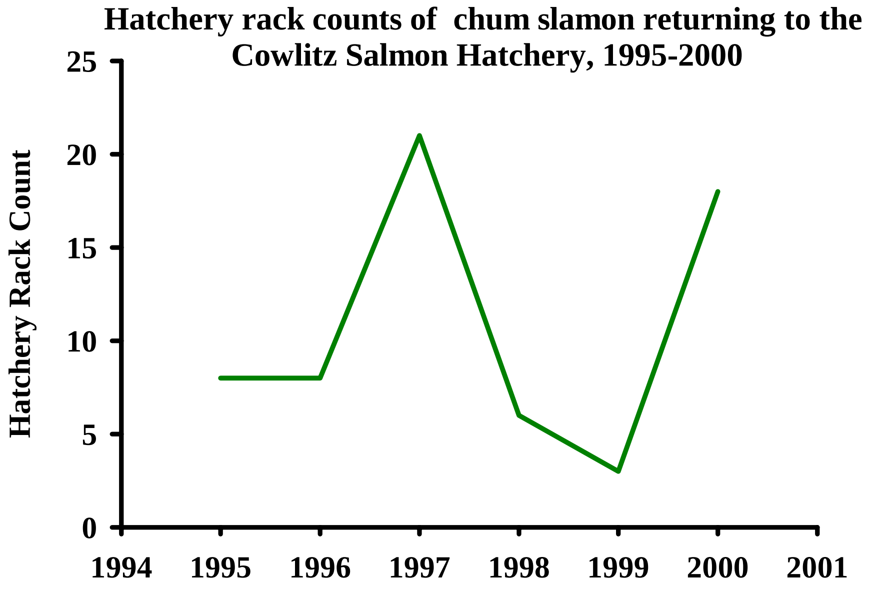
- No hatchery releases of chum have occurred in the Cowlitz basin

Abundance

- Estimated escapement of approximately 1,000 chum in early 1950's
- Between 1961 and 1966, the Mayfield Dam fish passage facility counted 58 chum
- Typically less than 20 adults are collected annually at the Cowlitz Salmon Hatchery

Productivity & Persistence

- Anadromous chum production primarily in lower watershed
- Harvest, habitat degradation, and to some degree construction of Mayfield and Mossyrock Dams contributed to decreased productivity



Hatchery

- Cowlitz or NF Toutle Salmon hatcheries do not produce/release chum salmon
- Chum salmon are captured annually in the Cowlitz hatchery rack

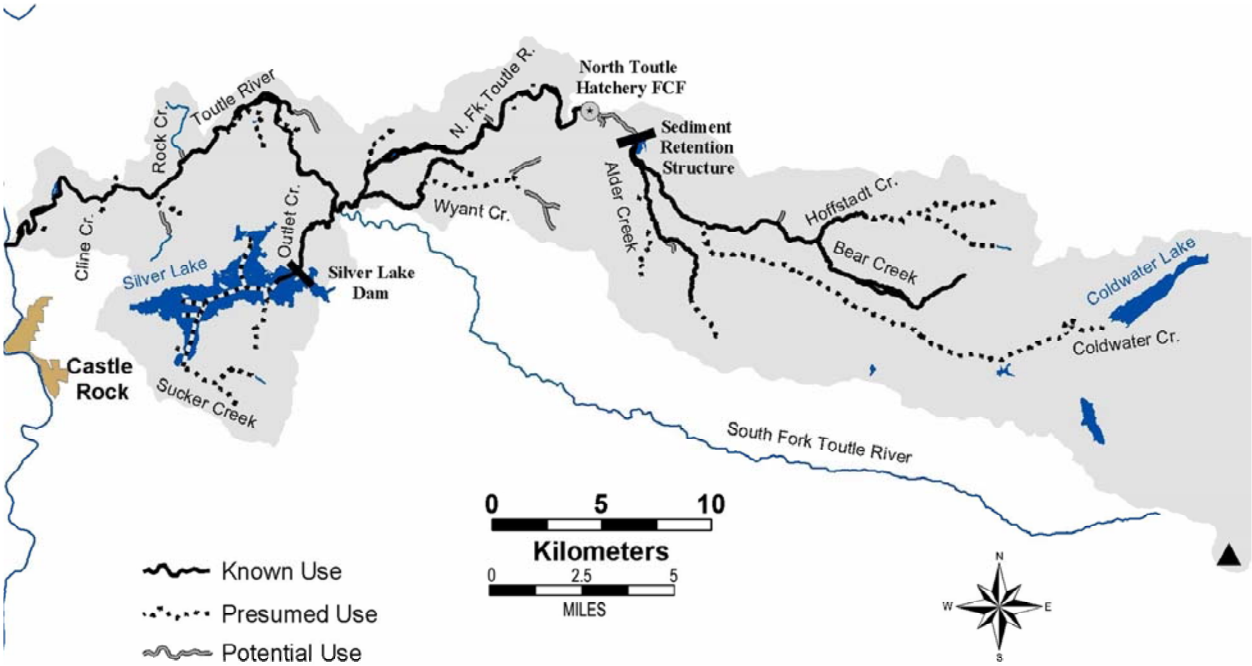
Harvest

- Currently very limited chum harvest occurs in the ocean and Columbia River and is incidental to fisheries directed at other species
- Columbia River commercial fishery historically harvested chum salmon in large numbers (80,000 to 650,000 in years prior to 1943); from 1965-1992 landings averaged less than 2,000 chum, and since 1993 less then 100 chum
- In the 1990s November commercial fisheries were curtailed and retention of chum was prohibited in Columbia River sport fisheries
- The ESA limits incidental harvest of Columbia River chum to less then 5% of the annual return

3.2.3 *Winter Steelhead—Cowlitz Subbasin (Mainstem & NF Toutle/Green)*

ESA: Threatened 1998	**SASSI: Depressed 2002**

The historical NF Toutle adult population is estimated from 7,000-15,000 fish. Current natural spawning returns are 100-300. In the Green River, spawning occurs in the mainstem, Devils, Elk, and Shultz creeks. In the NF Toutle River spawning occurs primarily in the mainstem, Alder, and Deer creeks. Spawning time is March to early June. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Toutle basin.

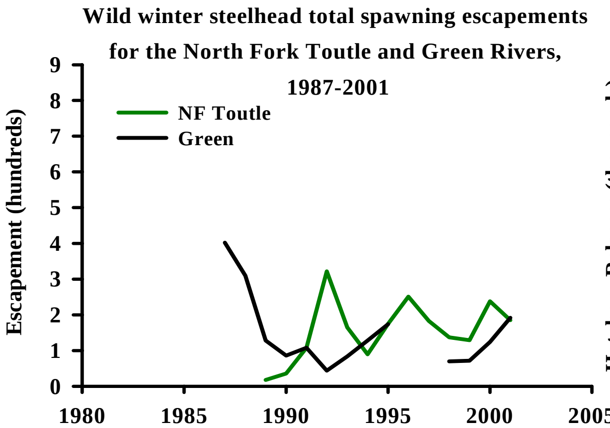


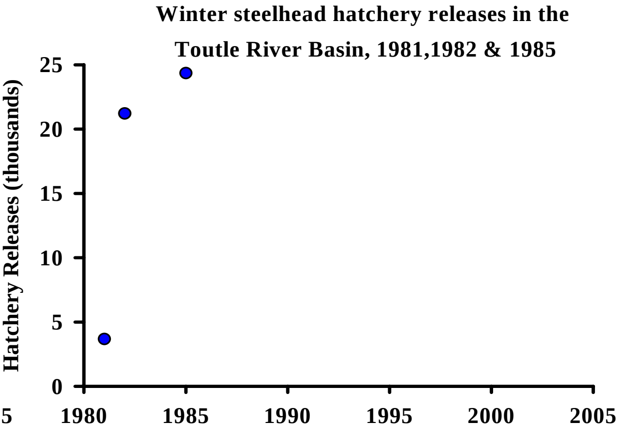
Distribution

- Historically, steelhead were distributed throughout the mainstem Toutle, NF Toutle and Green Rivers
- In the mainstem/NF Toutle, spawning occurs in the mainstem and Alder and Deer Creeks
- In the Green River, spawning occurs in the mainstem and Devil, Elk, and Shultz Creeks
- The 1980 eruption of Mt. St. Helens greatly altered the habitat within the Toutle River Basin; the NF Toutle sustained the most significant habitat degradation

Life History

- Adult migration timing for mainstem/NF Toutle and Green River winter steelhead is from December through April
- Spawning timing on the mainstem/NF Toutle and Green River is generally from March to early June
- Limited age composition data for Toutle River winter steelhead indicate that the dominant age class is 2.2 (58.6%)
- Wild steelhead fry emerge from March through May; juveniles generally rear in fresh water for two years; juvenile emigration occurs from April to May, with peak migration in early May


Wild winter steelhead total spawning escapements for the North Fork Toutle and Green Rivers, 1987-2001


Winter steelhead hatchery releases in the Toutle River Basin, 1981,1982 & 1985

Diversity

- Mainstem/NF Toutle and Green River winter steelhead stocks designated based on distinct spawning distribution
- Wild stock interbreeding with hatchery brood stock from the Elochoman River, Chambers Creek, and the Cowlitz River is a concern
- Allele frequency analysis of Green River winter steelhead in 1995 was unable to determine the distinctiveness of the stock compared to other lower Columbia steelhead stocks

Abundance

- In 1936, steelhead were observed in the Toutle River during escapement surveys
- Between 1985-1989, an average of 2,743 winter steelhead escaped to the Toutle River annually to spawn
- North Fork Toutle total escapement counts from 1989-2001 ranged from 18-322 (average 157)
- Green River total escapement counts from 1985-2001 ranged from 44-775 (average 193)
- From 1991-1996, the winter steelhead run was believed to be completely from naturally produced fish

Productivity & Persistence

- Live-spawning of Toutle River winter steelhead in 1982 and 1988 resulted in mean fecundity estimates of 2,251 and 3,900 eggs per female, respectively
- Estimated potential winter steelhead smolt production for the Toutle River is 135,573
- The NMFS Status Assessment estimated that the risk of 90% decline in 25 years was 0.71, the risk of 90% decline in 50 years was 0.93, and the risk of extinction in 50 years was 0.73 for the Green River winter steelhead

Hatchery

- The Cowlitz Trout Hatchery, located on the mainstem Cowlitz at RM 42, is the only hatchery in the basin producing winter steelhead
- Hatchery winter steelhead have been planted in the NF Toutle River basin from since 1953; broodstock from the Elochoman and Cowlitz Rivers and Chambers Creek have been used
- Aside from small releases of winter steelhead fry after the 1980 Mt. St. Helens eruption, no hatchery winter steelhead have been released in the Green River
- Hatchery fish contribute little to natural production of winter steelhead

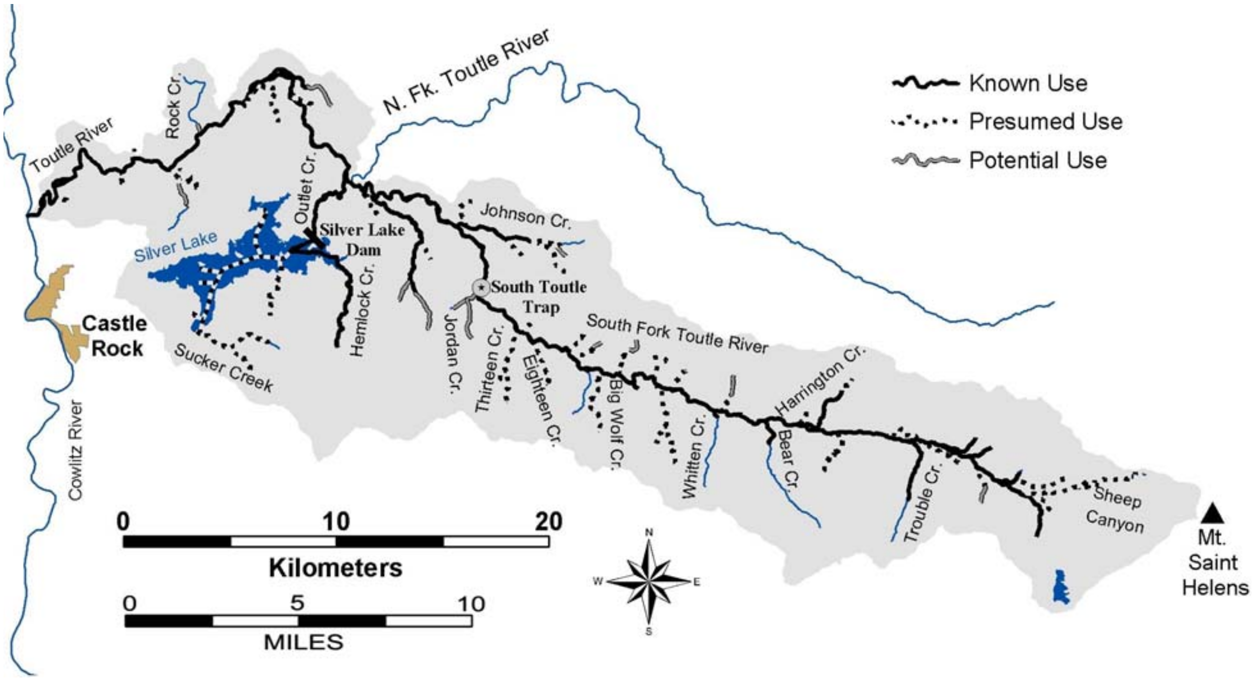
Harvest

- No directed commercial or tribal fisheries target NF Toutle winter steelhead; incidental mortality currently occurs during the lower Columbia River spring chinook tangle net fisheries
- Approximately 6.2% of returning Cowlitz River hatchery steelhead are harvested in the Columbia River sport fishery
- Winter steelhead sport harvest (hatchery and wild) in the mainstem Toutle River from 1987-1990 averaged 223; the NF Toutle River has been closed to sport fishery harvest of winter steelhead since 1980; the Green River has been closed since 1981
- Incidental harvest of Toutle basin winter steelhead is limited to ESA impact rates as described in the Fishery and Management Evaluation Plan submitted to NOAA Fisheries by WDFW in 2003.

3.2.4 *Winter Steelhead—Cowlitz Subbasin (SF Toutle)*

ESA: Threatened 1998 **SASSI: Depressed 2002**

The historical NF Toutle adult population is estimated from 7,000-15,000 fish. Current natural spawning returns are 100-300. In the Green River, spawning occurs in the mainstem, Devils, Elk, and Shultz creeks. In the NF Toutle River spawning occurs primarily in the mainstem, Alder, and Deer creeks. Spawning time is March to early June. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Toutle basin.



Distribution

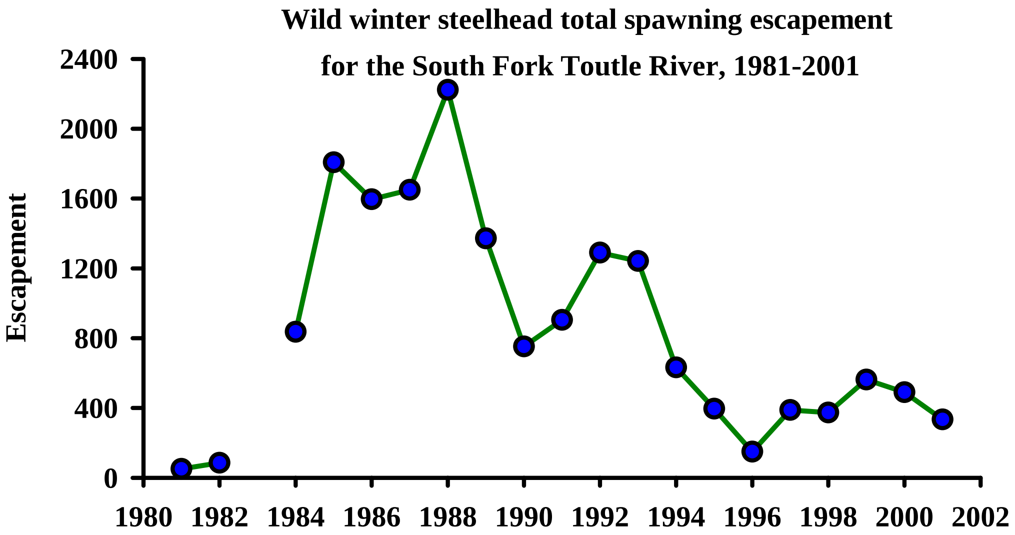
- Spawning occurs in the mainstem SF Toutle and Studebaker, Johnson, and Bear Creeks
- The 1980 eruption of Mt. St. Helens greatly altered the habitat within the Toutle River

Life History

- Adult migration timing for SF Toutle winter steelhead is from December through April
- Spawning timing on the SF Toutle is generally from early March to early June
- Limited age composition data for Toutle River winter steelhead indicate that the dominant age class is 2.2 (58.6%)
- Wild steelhead fry emerge from March through May; juveniles generally rear in fresh water for two years; juvenile emigration occurs from April to May, with peak migration in early May

Diversity

- SF Toutle winter steelhead stock designated based on distinct spawning distribution
- Allele frequency analysis of SF Toutle winter steelhead in 1996 was unable to determine the distinctiveness of this stock compared to other lower Columbia steelhead stock



Wild winter steelhead total spawning escapement for the South Fork Toutle River, 1981-2001

Abundance

- In 1936, steelhead were observed in the Toutle River during escapement surveys
- Between 1985-1989, an average of 2,743 winter steelhead escaped to the Toutle River annually to spawn
- SF Toutle total escapement counts from 1981-2001 ranged from 51-2,222 (average 857); escapements have been low since 1994
- Escapement goal for the SF Toutle River is 1,058 wild adult steelhead

Productivity & Persistence

- The NMFS Status Assessment estimated that the risk of 90% decline in both 25 years and 50 years was 1.0 for the SF Toutle River winter steelhead
- Estimated potential winter steelhead smolt production for the Toutle River is 135,573

Hatchery

- The Cowlitz Trout Hatchery, located on the mainstem Cowlitz at RM 42, is the only hatchery in the basin producing winter steelhead
- Aside from small releases of winter steelhead fry after the 1980 Mt. St. Helens eruption, no hatchery winter steelhead have been released in the SF Toutle River; total winter steelhead hatchery releases are estimated as 58,079 from 1968-1985

Harvest

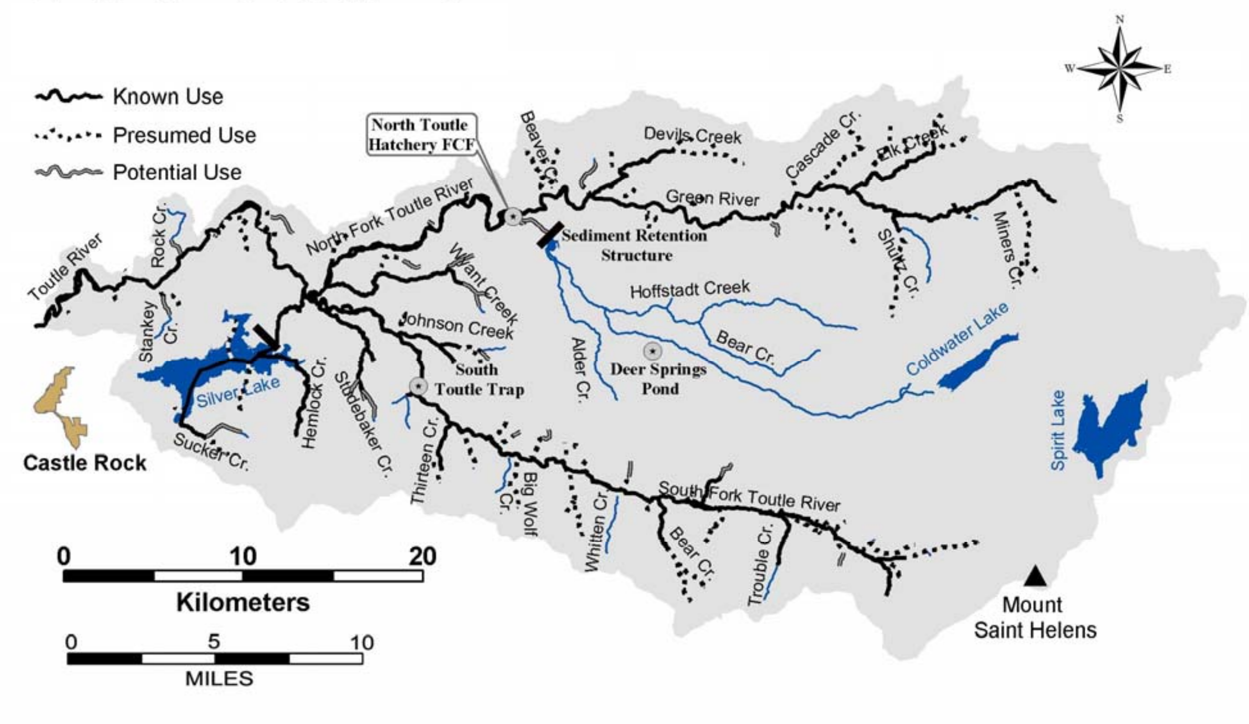
- No directed commercial or tribal fisheries target South Fork Toutle winter steelhead; incidental mortality currently occurs during the lower Columbia River spring chinook tangle net fisheries
- Treaty Indian harvest does not occur on the South Fork Toutle River
- Approximately 6.2% of returning Cowlitz River steelhead are harvested in the Columbia River sport fishery
- Winter steelhead sport harvest (hatchery and wild) in the Toutle River from 1987-1990 averaged 223; the SF Toutle River was closed to sport fish harvest in 1981 and reopened to limited harvest in 1987.
- The SF Toutlle sport fishery became selective for retention of marked hatchery steelhead only in 1994. The SF Toutle sport fishery is now closed during winter steelhead return time.

- Incidental harvest of Toutle basin winter steelhead is limited to ESA impact rates as described in the Fishery and Management Evaluation Plan submitted to NOAA Fisheries by WDFW in 2003.

3.2.5 *Cutthroat Trout—Cowlitz River Subbasin (Toutle)*

ESA: Not Listed **SASSI: Depressed 2000**

Coastal cutthroat abundance in the NF Toutle and Green rivers has not been quantified but the population is considered depressed. Cutthroat trout are present throughout the basin. Anadromous, fluvial, and resident forms of cutthroat trout are found in the basin. Anadromous cutthroat enter the Toutle from September-December and spawn from January through June. Most juveniles rear 2-4 years before migrating from their natal stream.



Distribution

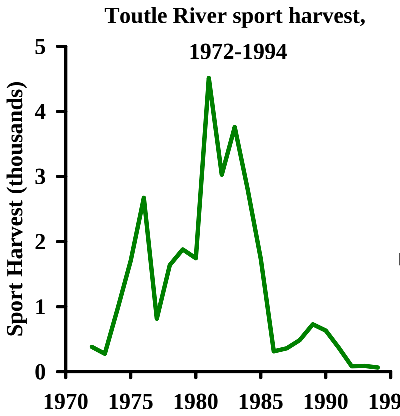
- Anadromous forms have access to most of the watershed except upper tributary, high gradient reaches
- Adfluvial forms are documented in Silver Lake
- Resident and fluvial forms are observed throughout the subbasin

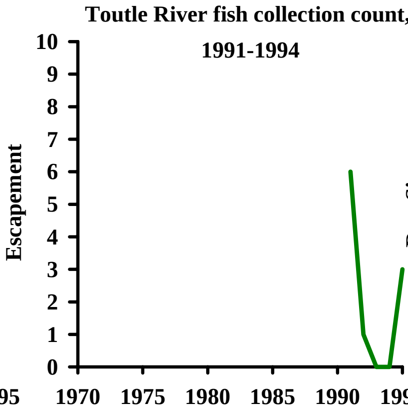
Life History

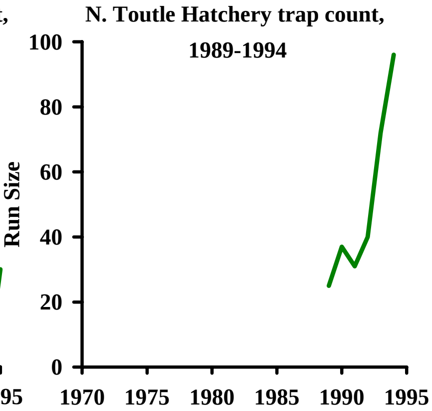
- Anadromous, adfluvial, fluvial and resident forms are present
- Anadromous river entry peaks from September through November
- Anadromous spawning occurs from January through June
- Fluvial and resident spawn timing is not documented but is believed to be similar to anadromous timing

Diversity

- Distinct stock based on geographic distribution of spawning areas
- No genetic sampling has been conducted


Toutle River sport harvest, 1972-1994


Toutle River fish collection count, 1991-1994


N. Toutle Hatchery trap count, 1989-1994

Abundance

- No abundance information exists for resident and fluvial forms
- Long term negative decline in the lower Columbia River cutthroat catch
- North Toutle Hatchery counts have shown a steady increase since the eruption of Mt. St. Helens in 1980, but escapement remains low
- Chronically low escapement at Toutle River Fish Collection Facility (0 to 6 fish annually since 1991)

Hatchery

- North Toutle Hatchery raises chinook and coho
- Summer steelhead smolts from Elochoman or Kalama Hatchery are released into the SF and NF Toutle and Green Rivers annually
- Silver Lake was stocked with rainbow trout prior to 1980

Harvest

- Not harvested in ocean commercial or recreational fisheries
- Angler harvest for adipose fin clipped hatchery fish occurs in mainstem Columbia River summer fisheries downstream of the Cowlitz River
- Toutle River wild cutthroat (unmarked fish) must be released in mainstem Columbia River and Toutle basin sport fisheries

3.2.6 *Other Species*

Pacific lamprey – Information on lamprey abundance is limited and does not exist for the Toutle Basin population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have also declined in the Toutle. The adult lamprey return from the ocean to spawn in the spring and summer. Spawning likely occurs in the small to mid-size streams of the Toutle. Juveniles rear in freshwater up to seven years before migrating to the ocean.

3.3 Subbasin Habitat Conditions

This section describes the current condition of aquatic and terrestrial habitats within the subbasin. Descriptions are included for habitat features of particular significance to focal salmonid species including watershed hydrology, passage obstructions, water quality, key habitat availability, substrate and sediment, woody debris, channel stability, riparian function, and floodplain function. These descriptions will form the basis for subsequent assessments of the effects of habitat conditions on focal salmonids and opportunities for improvement.

3.3.1 *Watershed Hydrology*

Runoff is predominantly generated by fall, winter, and spring rainfall, with a portion of spring flows coming from snowmelt in the upper elevations and occasional winter peaks related to rain-on-snow events. Combined surface water and groundwater demand in the Toutle basin, which totaled 389 acre-feet per year in 2000, is expected to increase 21.9% by 2020

The Integrated Watershed Assessment (IWA), which is presented in greater detail later in this chapter, indicates that the majority of the basin suffers from'impaired' runoff conditions as a result of immature forest stands and high road densities. Several headwater subwatersheds around Mount St. Helens were modeled to only have 'moderately impaired' conditions. Only 1 subwatershed, located in the upper Green River basin, was identified as hydrologically 'functional'.

The Upper Toutle Watershed Analysis found that 55% of the upper basins have the potential for an increase in peak flow volumes of over 10% due to a lack of mature coniferous stand structures. The USFS also noted that stream lengths have been increased by as much as 63% due to roads, with an addition of approximately 370 miles to the stream network as a result of roads and road ditches (USFS 1997). Increasing the stream network can accelerate the delivery of streamflow to downstream channels, thereby increasing stormflow peaks.

Low summer flows in Outlet Creek were identified in the Silver Creek Watershed Analysis as a problem for juvenile rearing (Weyerhaeuser 1994).

3.3.2 *Passage Obstructions*

The two major passage barriers in the Toutle basin are the Sediment Retention Structure (SRS) on the North Fork Toutle and the Silver Lake Dam on Outlet Creek. Problems at Silver Lake Dam are associated with lack of sufficient flows in the fishway and low flows and high temperatures in Outlet Creek. These problems may limit fish access into the Silver Lake basin. Other passage problems in the Toutle basin are associated with culverts, road crossings, trash racks, beaver dams, and fish weirs. A thorough description is provided in the WRIA 26 Limiting Factors Analysis (Wade 2000).

3.3.3 *Water Quality*

Water temperatures in the upper Toutle basin are thought to be high due to channel widening and loss of riparian cover associated with mud and debris flows. Temperatures near the mouth of the Green River at the Toutle River Hatchery often exceed state standards. The Green River and Harrington Creek (South Fork Toutle tributary) were listed on the State's 1998 303(d) list for elevated water temperatures (WDOE 1998). High suspended sediment and turbidity are considered major limiting factors in the North Fork and mainstem Toutle, restricting suitable fish habitat to tributary streams. Nutrient problems may exist in the Toutle basin as a result of low steelhead, chinook, and coho escapement (Wade 2000).

Silver Lake was identified as being in an advanced state of eutrophication in the 1994 watershed analysis. This is likely due to natural rates of phosphorous delivery as well as anthropogenic nutrient sources including forest fertilizers and residential septic systems (Weyerhaeuser 1994). Water temperatures are also a concern in the Silver Lake basin.

3.3.4 *Key Habitat Availability*

Following the eruption of Mount St. Helens, some channels in the NF and SF Toutle basins re-developed pool habitats to near pre-eruption levels, however, pool quality was generally low (Jones and Salo 1986). Large sediment loads will likely continue to reduce the quality of pools throughout the Toutle system. Side channel habitat may be created in the upper Toutle channels that experienced debris flows, though adequate LWD and riparian cover necessary for good side channel habitat will take a long time to develop (Wade 2000). Side channel habitat in the Silver Lake basin is lacking (Weyerhaeuser 1994).

3.3.5 *Substrate & Sediment*

Massive debris torrents and mud flows in the NF and SF Toutle buried, scoured, or filled spawning gravels with sediment. Conditions have improved quicker in the South Fork and Green River than in the North Fork (USFWS 1984). Annual sediment yields in the North Fork had not changed appreciably 5 years following the eruption (Lucas 1986) and sediment delivery is still considered a major liming factor in the system. The SRS is considered a major source of sediment in the mainstem North Fork and its existence is believed to be preventing the recovery of the system (Wade 2000).

Sediment supply conditions were evaluated as part of the IWA watershed process modeling, which is presented in greater detail later in this chapter. The results indicate that sediment supply conditions are ‘moderately impaired’ throughout the basin, with a few ‘impaired’ subwatersheds scattered throughout and a few ‘functional’ subwatersheds in headwater areas around Mount St. Helens. Risk of increased sediment supply is related to the 1980 eruption as well as intensive road building in the 1980s and 1990s. There is an average road density of 4.63 mi/mi^2. Furthermore, the eruption prevented access to many private roads that may now have elevated erosion potential due to lack of maintenance. The Silver Lake Watershed Analysis concluded that road erosion contributed to fine sediment production in the Silver Lake basin. A lack of spawning gravels was attributed to a lack of coarse material delivery and low LWD levels (Weyerhaeuser 1996).

Sediment production from private forest roads is expected to decline over the next 15 years as roads are updated to meet the new forest practices standards, which include ditchline disconnect from streams and culvert upgrades. The frequency of mass wasting events should also decline due to the new regulations, which require geotechnical review and mitigation measures to minimize the impact of forest practices activities on unstable slopes.

3.3.6 *Woody Debris*

Low levels of LWD likely existed prior to 1980 due to extensive logging. Mud and debris flows associated with the eruption of Mount St. Helens further reduced LWD through channel scouring, destruction of riparian forests, and burying of in-stream wood (Jones and Salo 1986). Salvage operations removed much of the remaining LWD in areas outside the National Monument (USFS 1997). LWD concentrations are considered poor in nearly all of the tributary basins. Wood accumulations have formed pools in the upper Green River, but they are of low quality (Wade 2000). Recruitment potential is also regarded as poor. 80-100% of riparian areas in the upper basin (National Forest portion) contain grass/forb vegetation structures (USFS 1997).

3.3.7 *Channel Stability*

The eruption of Mount St. Helens, combined with years of logging impacts, has increased the potential for elevated peak flows, exacerbating channel erosion and channel shifting. Eruption-related mud and debris flows in the North Fork, South Fork, and many tributaries altered channel form and location. Channel adjustments frequently occur during high flow events (USFWS 1984). Dredging and the placement of dredge spoils along channel margins are believed to have increased bank instability on portions of the lower river. Channel stability is improving in some areas, as the systems are slowly recovering from the effects of the eruption.

3.3.8 *Riparian Function*

The eruption of Mount St. Helens, timber harvest, timber salvage, and fire have drastically altered the quality of riparian forests; most of the riparian areas in the basin are in early- to mid-successional stages (USFS 1997). Only 11.6% of the basin has >70% mature coniferous cover. Low canopy cover in the upper basin is believed to contribute to elevated stream temperatures. The Silver Lake and Outlet Creek basins have degraded riparian areas that are dominated by deciduous species (Wade 2000).

According to IWA watershed process modeling, which is presented in greater detail later in this chapter, nearly the entire watershed has ‘moderately impaired’ riparian function. This rating was based on the amount of mature forest stands along stream channels. Riparian function is expected to improve as forests continue to recover from the eruption and timber harvest impacts.

Riparian function is expected to improve over time on private forestlands. This is due to the requirements under the Washington State Forest Practices Rules (Washington Administrative Code Chapter 222). Riparian protection has increased dramatically today compared to past regulations and practices.

3.3.9 *Floodplain Function*

Following the eruption of Mount St. Helens, significant floodplain loss occurred due to the dredging and placement of sediment in the floodplain and near-stream wetlands, essentially creating levees along the channel. Floodplain disconnection has occurred on several Toutle River tributaries as well, also as a result of diking, channel incision, and dredging (Wade 2000).

3.4 Stream Habitat Limitations

A systematic link between habitat conditions and salmonid population performance is needed to identify the net effect of habitat changes, specific stream sections where problems occur, and specific habitat conditions that account for the problems in each stream reach. In order to help identify the links between fish and habitat conditions, the Ecosystem Diagnosis and Treatment (EDT) model was applied to Toutle River fall Chinook, chum, coho, and steelhead. A thorough description of the EDT model, and its application to lower Columbia salmonid populations, can be found in Appendix E.

Three general categories of EDT output are discussed in this section: population analysis, reach analysis, and habitat factor analysis. Population analysis has the broadest scope of all model outputs. It is useful for evaluating the reasonableness of results, assessing broad trends in population performance, comparing among populations, and for comparing past, present, and desired conditions against recovery planning objectives. Reach analysis provides a greater level of detail. Reach analysis rates specific reaches according to how degradation or restoration within the reach affects overall population performance. This level of output is useful for identifying general categories of management (i.e. preservation and/or restoration), and for focusing recovery strategies in appropriate portions of a subbasin. The habitat factor analysis section provides the greatest level of detail. Reach specific habitat attributes are rated according to their relative degree of impact on population performance. This level of output is most useful for practitioners who will be developing and implementing specific recovery actions.

3.4.1 *Population Analysis*

Population assessments under different habitat conditions are useful for comparing fish trends and establishing recovery goals. Fish population levels under current and potential habitat conditions were inferred using the EDT model based on habitat characteristics of each stream reach and a synthesis of habitat effects on fish life cycle processes. Habitat-based assessments were completed in the Toutle basin for winter steelhead, fall chinook, spring chinook and chum. It is important to note that spring chinook have become functionally extinct in the Toutle subbasin. As such, all current estimates for spring chinook in the population analysis are approximately zero (Table 2). Therefore, there will be no discussion of relative change among model variables for spring chinook.

Model results indicate a decline in adult productivity for all species in the Toutle basin (Table 2). Declines in adult productivity from historical levels range from 70% for fall chinook to greater than 90% for winter steelhead. Similarly, adult abundance levels have declined for all species (Table 2). Current estimates of abundance are 44% of historical levels for fall chinook, 13% of historical levels for winter steelhead, 11% of historical levels for coho and only 5% of historical levels for chum.

Estimated diversity has also decreased significantly for all species in the Toutle basin (Table 2). Declines in species diversity range from 34% for fall chinook, to greater than 70% for coho. This sharp decline in diversity may be due to a dramatic loss of available habitats compared to pre-Mount St. Helens eruption conditions. The 1980 eruption may also contribute to the observed trends in productivity and abundance. Timber harvest and road building in the post-eruption years has further depressed the stocks and has limited the rate of recovery.

As with adult productivity, model results indicate that current smolt productivity is sharply reduced compared to historical levels. Current smolt productivity estimates are between 17% and 52% of historical productivity, depending on species (Table 2). Smolt abundance numbers are similarly low, especially for chum and coho (Table 2). Current smolt abundance estimates for chum and coho are at 13% and 10% of historical levels, respectively.

Model results indicate that restoration of PFC conditions would have large benefits in all performance parameters for all species (Table 2). For adult abundance, restoration of PFC conditions would increase current returns by 107% for fall Chinook, by 255% for winter steelhead, by 496% for chum and by 600% for coho. Similarly, smolt abundance numbers would increase for all species (Table 2). Coho would see the greatest increase in smolt numbers with a modeled 709% increase.

Table 2. Population productivity, abundance, and diversity (of both smolts and adults) based on EDT analysis of current (P or patient), historical (T or template)[1], and properly functioning (PFC) habitat conditions.

	Adult Abundance			Adult Productivity			Diversity Index			Smolt Abundance			Smolt Productivity		
Species	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	T[1]
Fall Chinook	4,370	9,066	10,046	3.2	8.3	10.7	0.66	1.00	1.00	499,147	919,467	1,022,259	306	738	937
Spring Chinook	0	2,703	3,083	0.0	10.9	15.8	0.00	1.00	1.00	0	85,801	96,292	0	319	454
Chum	1,376	8,196	25,984	1.9	7.1	10.5	0.39	1.00	1.00	595,692	2,731,905	4,495,859	548	901	1,057
Winter Steelhead	1,343	4,766	10,330	3.1	13.0	36.1	0.45	0.94	0.99	29,188	86,779	100,718	64	233	345

[1] Estimate represents historical conditions in the subbasin and current conditions in the mainstem and estuary.

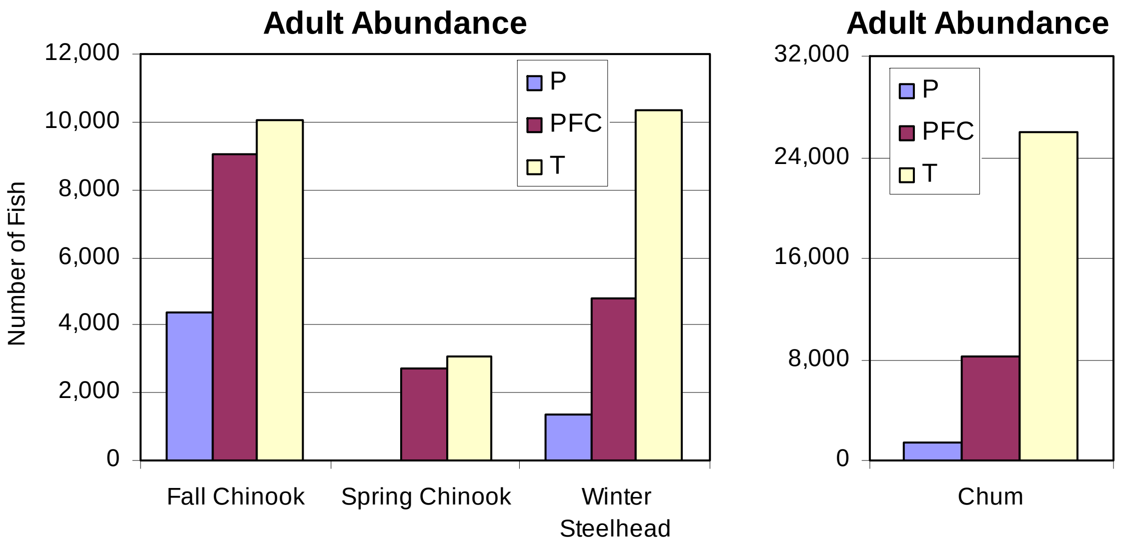


Figure 4. Adult abundance of Toutle River fall chinook, coho, winter steelhead and chum based on EDT analysis of current (P or patient), historical (T or template), and properly functioning (PFC) habitat conditions.

3.4.2 *Stream Reach Analysis*

Habitat conditions and suitability for fish are better in some portions of a subbasin than in others. The reach analysis of the EDT model uses estimates of the difference in projected population performance between current/patient and historical/template habitat conditions to identify core and degraded fish production areas. Core production areas, where habitat degradation would have a large negative impact on the population, are assigned a high value for preservation. Likewise, currently degraded areas that provide significant potential for restoration are assigned a high value for restoration. Collectively, these values are used to prioritize the reaches within a given subbasin.

The Toutle basin is one of the largest basins in the region analyzed with the EDT model. It consists of nearly 100 EDT reaches in the Toutle, South Fork, North Fork, and Green River basins. Spawning and rearing for winter steelhead occurs throughout the mainstems and tributaries of these basins. Fall Chinook use is constrained primarily to the mainstems, and chum use is limited to just the first several lower Toutle River reaches. Each major stream system within the Toutle basin is characterized by a variety of channel and valley types, from steep and confined sections—like Hollywood Gorge—to broad alluvial floodplain valleys—like those found in the lower South Fork and upper North Fork. See Figure 5 for a map of reaches in the Toutle River subbasin.

High priority reaches for fall Chinook include those in the lower Green River (Green River 3 and 4), the mainstem Toutle (Toutle 4 and 9), and the South Fork Toutle (SF Toutle 1-4, 7-9, 11-13 and 16) (Figure 6). The lower and middle South Fork reaches are widely used by chinook, especially since the North Fork and lower Toutle channels have been slower to recover from eruption impacts. Reach Green River 4 has the highest habitat preservation potential and highest habitat restoration potential of any fall chinook reach modeled in the Toutle basin

For spring chinook, the high priority reaches are located in the middle and upper NF Toutle (NF Toutle 10-12) (Figure 7). Due to the fact that spring-run chinook are functionally extinct from the basin, these reaches all show a huge habitat restoration potential, with reach NF Toutle 10 having the highest restorative potential of any spring chinook reach in the system.

High priority reaches for chum are located in the lower mainstem Toutle River (Toutle 1 and 3-6) (Figure 8). These reaches are important for chum spawning and rearing and have significantly degraded habitat. As such, all of the high priority reaches modeled for chum show a strong habitat restoration emphasis. Reach Toutle 4 has the highest restorative potential of any reach modeled for chum.

Reaches with a high priority ranking for winter steelhead are located in the South Fork Toutle (SF Toutle 12-20), the Green River (Green 6), and the North Fork Toutle (NF Toutle 7 and 12-13) (Figure 9). All high priority reaches in the NF Toutle show a strong habitat restoration emphasis, while reaches in the SF Toutle have either a restoration emphasis or a combined preservation and restoration emphasis. The one high priority reach in the Green River shows a combined habitat preservation and restoration emphasis (Figure 9). The Green River was spared the worst of the eruption impacts and therefore has some good preservation value.

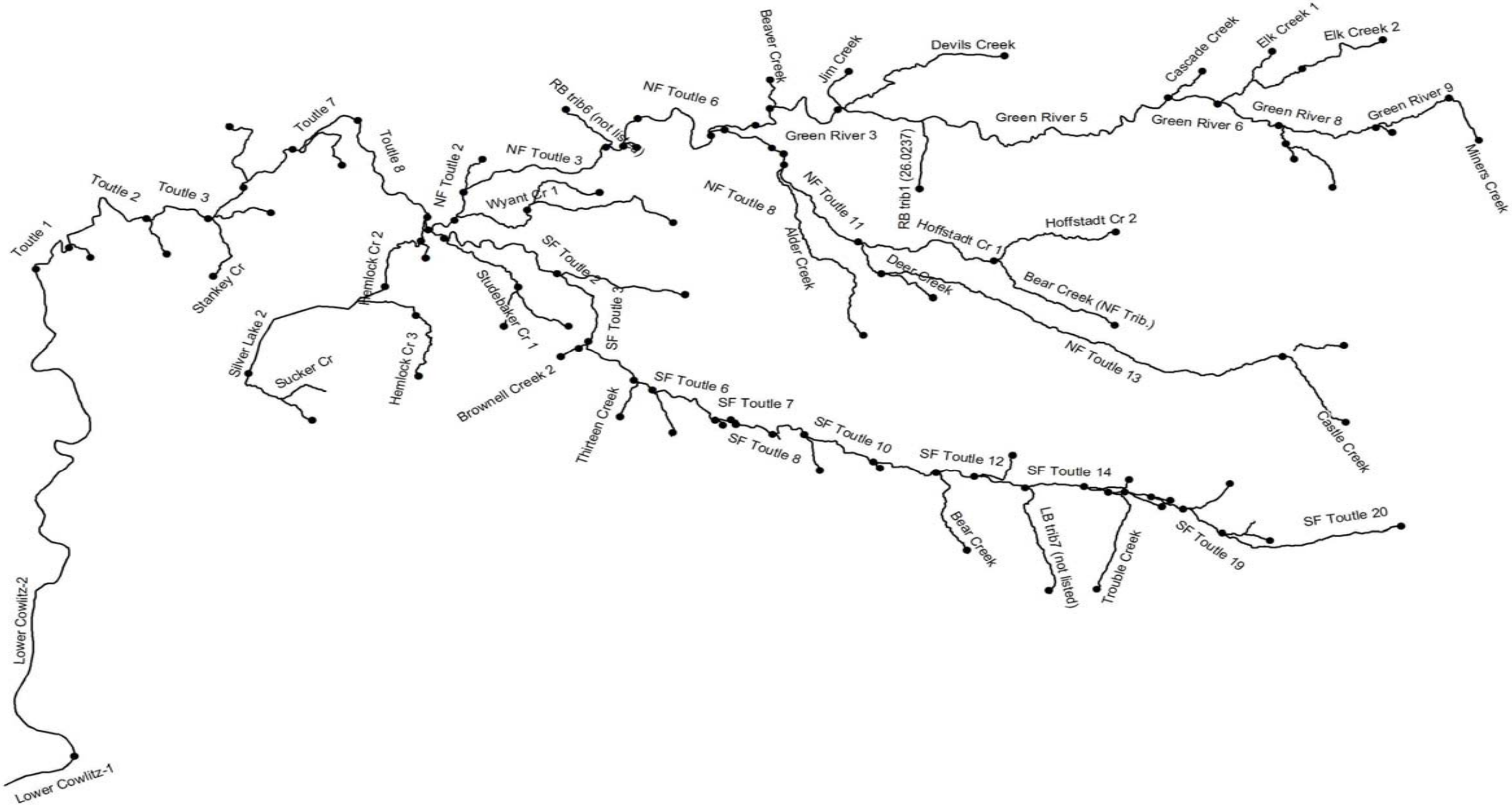
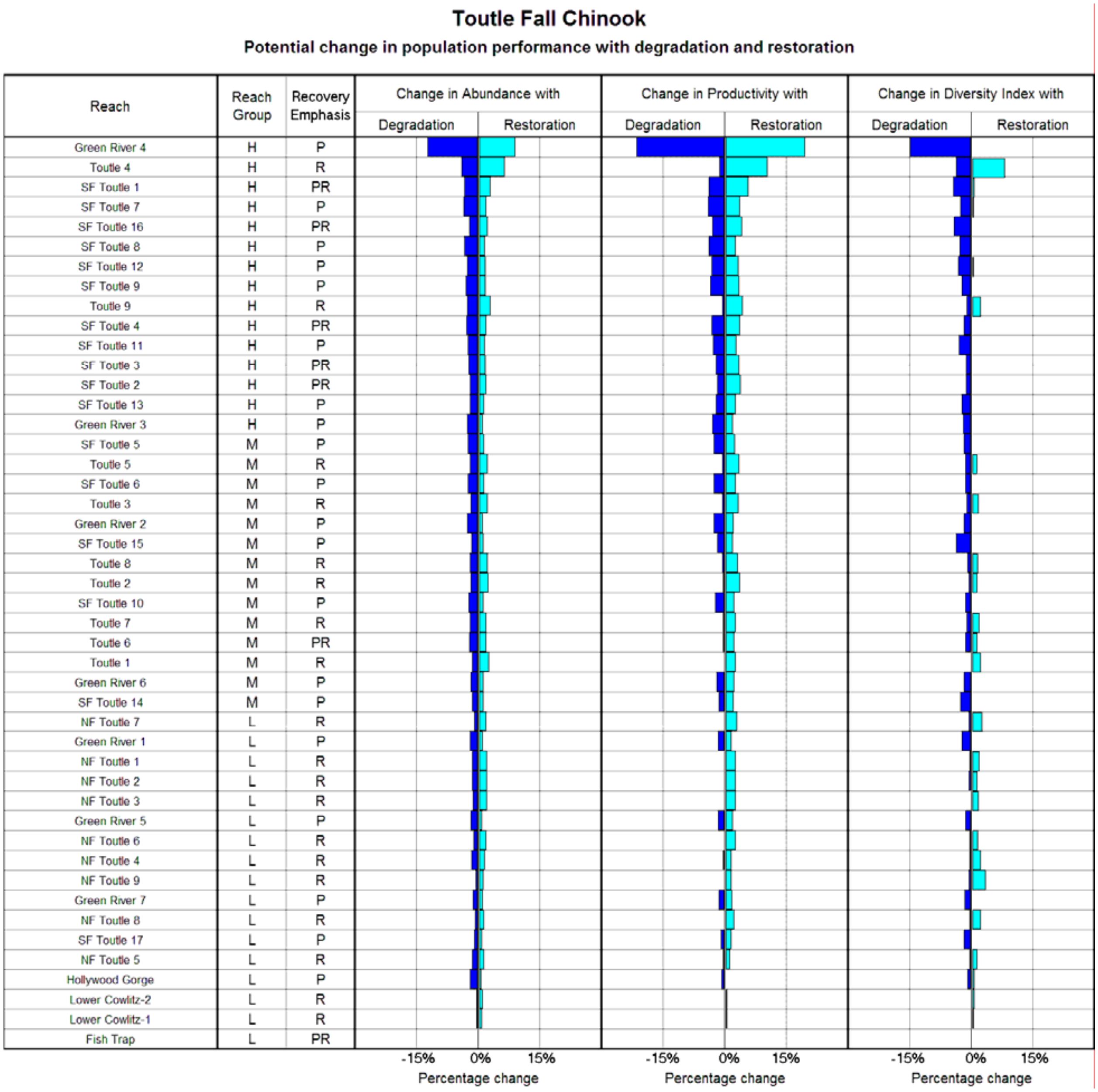
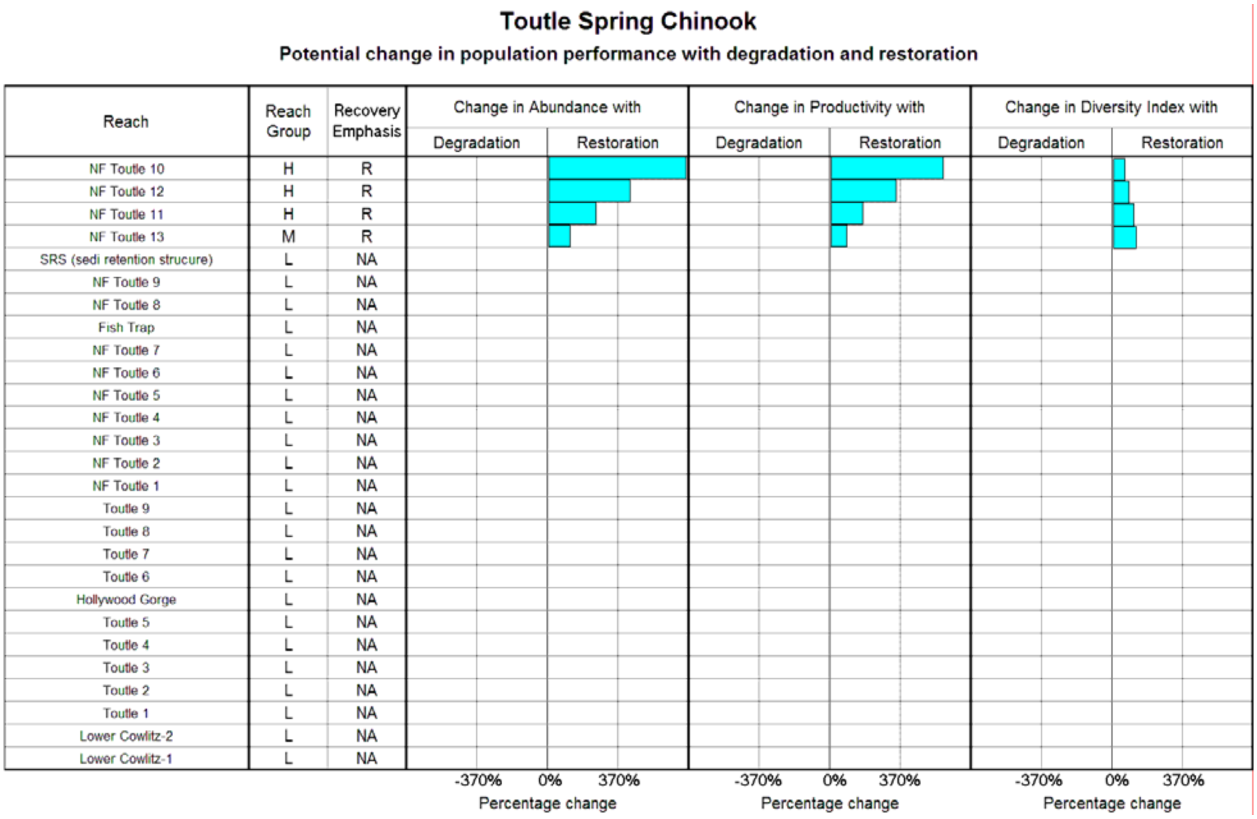


Figure 5. Toutle subbasin with EDT reaches identified. For readability, not all reaches are labeled.



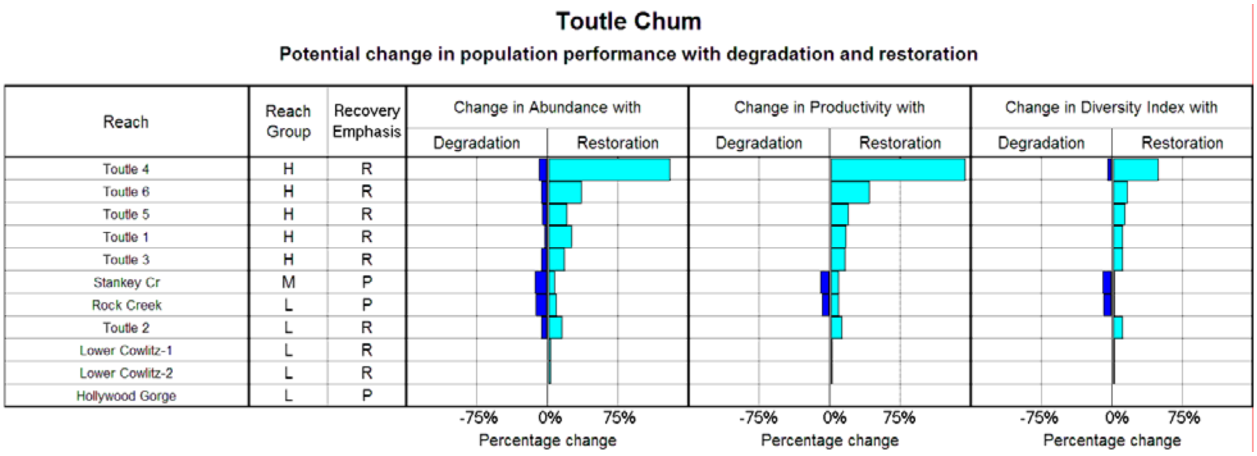
Reach	Reach Group	Recovery Emphasis
Green River 4	H	P
Toutle 4	H	R
SF Toutle 1	H	PR
SF Toutle 7	H	P
SF Toutle 16	H	PR
SF Toutle 8	H	P
SF Toutle 12	H	P
SF Toutle 9	H	P
Toutle 9	H	R
SF Toutle 4	H	PR
SF Toutle 11	H	P
SF Toutle 3	H	PR
SF Toutle 2	H	PR
SF Toutle 13	H	P
Green River 3	H	P
SF Toutle 5	M	P
Toutle 5	M	R
SF Toutle 6	M	P
Toutle 3	M	R
Green River 2	M	P
SF Toutle 15	M	P
Toutle 8	M	R
Toutle 2	M	R
SF Toutle 10	M	P
Toutle 7	M	R
Toutle 6	M	PR
Toutle 1	M	R
Green River 6	M	P
SF Toutle 14	M	P
NF Toutle 7	L	R
Green River 1	L	P
NF Toutle 1	L	R
NF Toutle 2	L	R
NF Toutle 3	L	R
Green River 5	L	P
NF Toutle 6	L	R
NF Toutle 4	L	R
NF Toutle 9	L	R
Green River 7	L	P
NF Toutle 8	L	R
SF Toutle 17	L	P
NF Toutle 5	L	R
Hollywood Gorge	L	P
Lower Cowlitz-2	L	R
Lower Cowlitz-1	L	R
Fish Trap	L	PR

Figure 6.Toutle River fall Chinook ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphasis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams. Some low priority reaches are not included for display purposes.



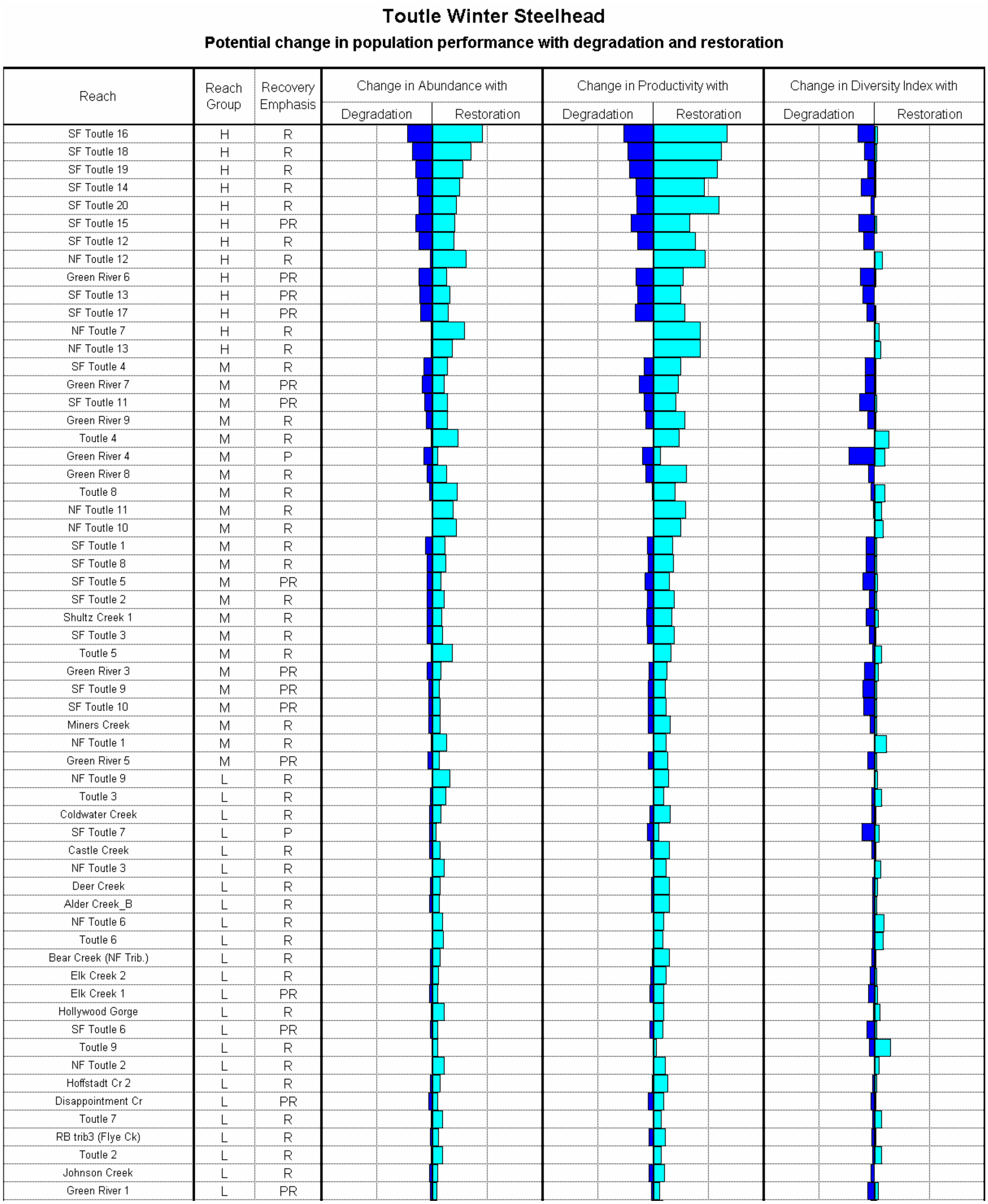
Reach	Reach Group	Recovery Emphasis
NF Toutle 10	H	R
NF Toutle 12	H	R
NF Toutle 11	H	R
NF Toutle 13	M	R
SRS (sedi retention strucure)	L	NA
NF Toutle 9	L	NA
NF Toutle 8	L	NA
Fish Trap	L	NA
NF Toutle 7	L	NA
NF Toutle 6	L	NA
NF Toutle 5	L	NA
NF Toutle 4	L	NA
NF Toutle 3	L	NA
NF Toutle 2	L	NA
NF Toutle 1	L	NA
Toutle 9	L	NA
Toutle 8	L	NA
Toutle 7	L	NA
Toutle 6	L	NA
Hollywood Gorge	L	NA
Toutle 5	L	NA
Toutle 4	L	NA
Toutle 3	L	NA
Toutle 2	L	NA
Toutle 1	L	NA
Lower Cowlitz-2	L	NA
Lower Cowlitz-1	L	NA

Figure 7. Toutle spring chinook ladder diagram.



Reach	Reach Group	Recovery Emphasis
Toutle 4	H	R
Toutle 6	H	R
Toutle 5	H	R
Toutle 1	H	R
Toutle 3	H	R
Stankey Cr	M	P
Rock Creek	L	P
Toutle 2	L	R
Lower Cowlitz-1	L	R
Lower Cowlitz-2	L	R
Hollywood Gorge	L	P

Figure 8. Toutle chum ladder diagram.



Reach	Reach Group	Recovery Emphasis
SF Toutle 16	H	R
SF Toutle 18	H	R
SF Toutle 19	H	R
SF Toutle 14	H	R
SF Toutle 20	H	R
SF Toutle 15	H	PR
SF Toutle 12	H	R
NF Toutle 12	H	R
Green River 6	H	PR
SF Toutle 13	H	PR
SF Toutle 17	H	PR
NF Toutle 7	H	R
NF Toutle 13	H	R
SF Toutle 4	M	R
Green River 7	M	PR
SF Toutle 11	M	PR
Green River 9	M	R
Toutle 4	M	R
Green River 4	M	P
Green River 8	M	R
Toutle 8	M	R
NF Toutle 11	M	R
NF Toutle 10	M	R
SF Toutle 1	M	R
SF Toutle 8	M	R
SF Toutle 5	M	PR
SF Toutle 2	M	R
Shultz Creek 1	M	R
SF Toutle 3	M	R
Toutle 5	M	R
Green River 3	M	PR
SF Toutle 9	M	PR
SF Toutle 10	M	PR
Miners Creek	M	R
NF Toutle 1	M	R
Green River 5	M	PR
NF Toutle 9	L	R
Toutle 3	L	R
Coldwater Creek	L	R
SF Toutle 7	L	P
Castle Creek	L	R
NF Toutle 3	L	R
Deer Creek	L	R
Alder Creek_B	L	R
NF Toutle 6	L	R
Toutle 6	L	R
Bear Creek (NF Trib.)	L	R
Elk Creek 2	L	R
Elk Creek 1	L	PR
Hollywood Gorge	L	R
SF Toutle 6	L	PR
Toutle 9	L	R
NF Toutle 2	L	R
Hoffstadt Cr 2	L	R
Disappointment Cr	L	PR
Toutle 7	L	R
RB trib3 (Flye Ck)	L	R
Toutle 2	L	R
Johnson Creek	L	R
Green River 1	L	PR

Figure 9. Toutle winter steelhead ladder diagram.

3.4.3 *Habitat Factor Analysis*

The Habitat Factor Analysis of EDT identifies the most important habitat factors affecting fish in each reach. Whereas the EDT reach analysis identifies reaches where changes are likely to significantly affect the fish, the Habitat Factor Analysis identifies specific stream reach conditions that may be modified to produce an effect. Like all EDT analyses, the habitat factor analysis compares current/patient and historical/template habitat conditions. For each reach, EDT generates what is refered to as a “consumer reports diagram”, which identifies the degree to which individual habitat factors are acting to suppress population performance. The effect of each habitat factor is identified for each life stage that occurs in the reach and the relative importance of each life stage is indicated. For additional information and examples of this analysis, see Appendix E. Inclusion of the consumer report diagram for each reach is beyond the scope of this document. A summary of the most critical life stages and the habitat factors affecting them are displayed for each species in Table 3.

Table 3. Summary of the primary limiting factors affecting life stages of focal salmonid species. Results are summarized from EDT Analysis.

Species and Lifestage		***Primary factors***	***Secondary factors***	***Tertiary factors***
Toutle Fall Chinook				
most critical	Egg incubation	channel stability, sediment		
second	Fry colonization	habitat diversity	flow, channel stability	food
third	Spawning	habitat diversity, temperature		
Toutle Spring Chinook				
most critical	Egg incubation	channel stability, sediment, temperature		
second	Spawning	temperature		
third	Fry colonization	sediment	habitat diversity, food	channel stability, flow
Toutle Chum				
most critical	Egg incubation	channel stability, sediment		
second	Prespawning holding	habitat diversity, sediment	flow, harassment, key habitat	
third	Spawning	habitat diversity, sediment	harassment	key habitat
Toutle Coho				
most critical	0-age summer rearing	habitat diversity, temperature	sediment	competition (hatchery), pathogens, predation
second	Egg incubation	channel stability, sediment		
third	0-age winter rearing	habitat diversity	channel stability, flow	sediment
Toutle Winter Steelhead				
most critical	Egg incubation	sediment, channel stability	temperature	
second	0,1-age winter	habitat diversity, flow, channel stability	food	
third	1-age summer	habitat diversity, flow	channel stability	competition (hatchery), food, temperature, key habitat

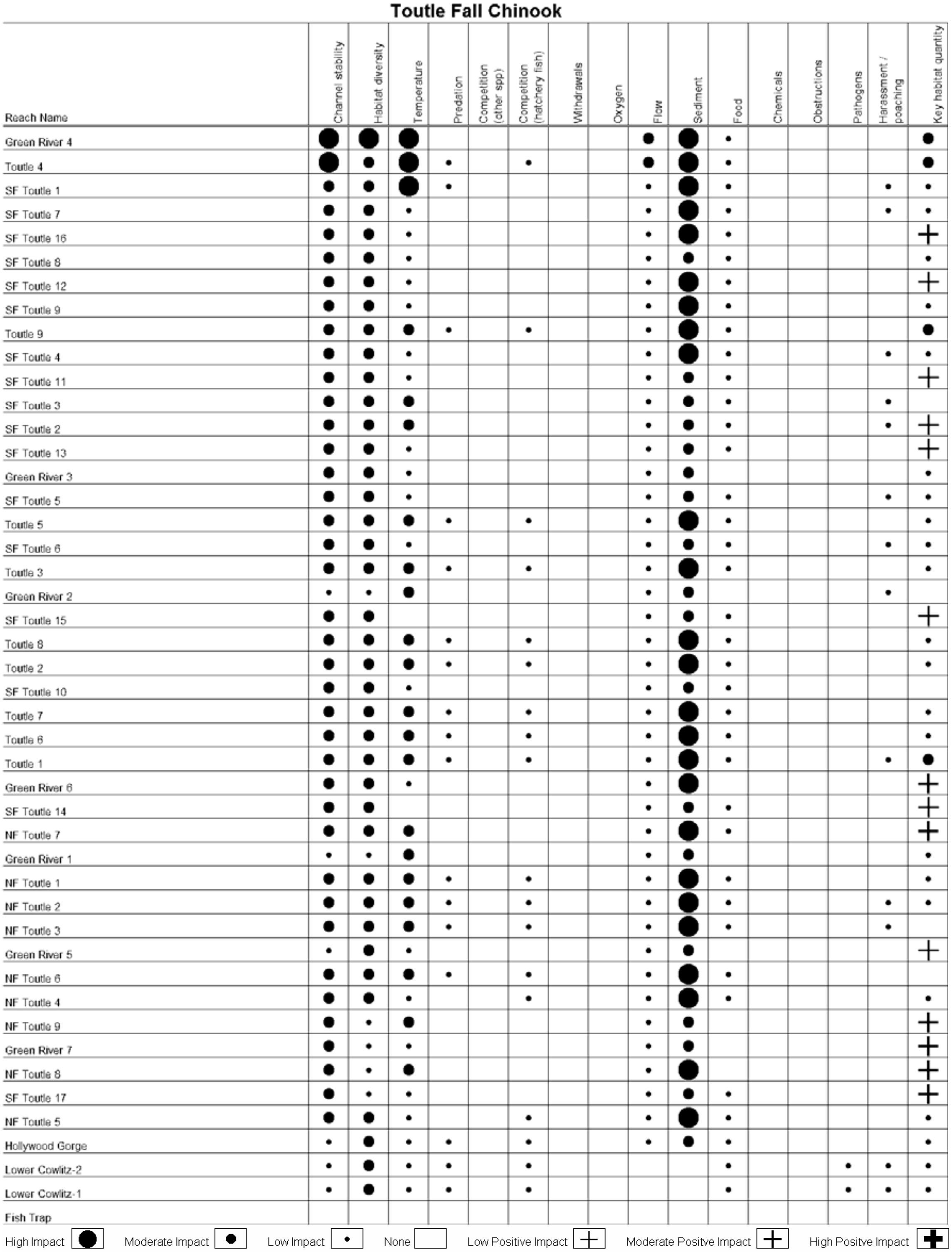
The consumer reports diagrams have also been summarized to show the relative importance of habitat factors by reach. The summary figures are referred to as habitat factor analysis diagrams and are displayed for each species below. The reaches are ordered according to their combined restoration and preservation rank. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to historical conditions.

Key reaches for fall Chinook in the Toutle Basin area located primarily in the South Fork and North Fork Toutle with an emphasis on reaches lower in the system (Figure 10). Sediment has had the greatest impact, followed by channel stability, habitat diversity and temperature. Sediment is a significant problem for Chinook as it impacts important spawning areas in the mainstem and SF Toutle. Sediment originates from channel as well as upslope sources. Severe sediment aggradation from upstream sources has initiated bank cutting that increases sedimentation from channel sources. Habitat diversity has been reduced by scour or burial of large wood pieces. Loss of channel stability and wood recruitment potential is related to the poor condition of riparian forests.

Important spring chinook reaches in the Toutle basin are located in the North Fork. Habitat factors affecting these reaches include sediment, temperature, channel stability and habitat diversity (Figure 11). The causes of these impacts are similar to those discussed above.

For winter steelhead in the Toutle basin many of the important reaches and the habitat factors affecting them are similar to those for fall Chinook but with less emphasis on reaches lower in the system. These reaches are negatively impacted by sediment, habitat diversity, flow, channel stability, and temperature (Figure 12). Sediment remains in the system from the eruption and continues to be delivered as a result of unstable upslope soils and high road densities. Much of the North Fork basin was heavily roaded and harvested following the 1980 eruption, further increasing sediment and flow problems and slowing recovery rates. Except for the subwatersheds on the flanks of Mount St. Helens, the entire North Fork basin has road densities of over 5 mi/mi^2. Habitat diversity is low due to a lack of LWD. Mudflows from the eruption either scoured wood from channels or buried it with sediment. Recruitment of LWD is very low due to a lack of mature riparian forest cover. Reduced riparian cover and increased channel widths due to sediment aggradation have increased summer stream temperatures. Peak flows are believed to have increased due to the low hydrologic maturity of basin forests. Many of the upper North Fork subwatersheds have over 90% ‘other forest’ conditions, indicating severely degraded vegetation conditions.

In the lower Toutle mainstem, where the majority of important reaches for chum are located, habitat has been negatively impacted by sediment, habitat diversity, and channel stability (Figure 13). Reaches 1-2 and 6-8 have nearly 80% of riparian forests in ‘other forest’ condition, which consists of brush, grass, or bare soil. Reach 3 up to Hollywood Gorge has over 60% of riparian forests in ‘other forest’ conditions. These poor riparian conditions contribute to impaired habitat diversity and channel stability.



Toutle Fall Chinook

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Green River 4	⬤	⬤	⬤						●	⬤	•					●
Toutle 4	⬤	●	⬤	•		•			●	⬤	•					●
SF Toutle 1	●	●	⬤	•					•	⬤	•				•	•
SF Toutle 7	●	●	•						•	⬤	•				•	•
SF Toutle 16	●	●	•						•	⬤	•					✚
SF Toutle 8	●	●	•						•	●	•					•
SF Toutle 12	●	●	•						•	⬤	•					+
SF Toutle 9	●	●	•						•	⬤	•					•
Toutle 9	●	●	●	•		•			•	⬤	•					●
SF Toutle 4	●	●	•						•	⬤	•				•	•
SF Toutle 11	●	●	•						•	●	•					+
SF Toutle 3	●	●	●						•	●	•				•	
SF Toutle 2	●	●	●						•	●	•				•	+
SF Toutle 13	●	●	•						•	●	•					✚
Green River 3	●	●	•						•	●						•
SF Toutle 5	●	●	•						•	●	•				•	•
Toutle 5	●	●	●	•		•			•	⬤	•					•
SF Toutle 6	●	●	•						•	●	•				•	•
Toutle 3	●	●	●	•		•			•	⬤	•					•
Green River 2	•	•	●						•	●					•	
SF Toutle 15	●	●							•	●	•					+
Toutle 8	●	●	●	•		•			•	⬤	•					•
Toutle 2	●	●	●	•		•			•	⬤	•					•
SF Toutle 10	●	●	•						•	●	•					
Toutle 7	●	●	●	•		•			•	⬤	•					•
Toutle 6	●	●	●	•		•			•	⬤	•					•
Toutle 1	●	●	●	•		•			•	⬤	•				•	●
Green River 6	●	●	•						•	⬤						✚
SF Toutle 14	●	●							•	●	•					+
NF Toutle 7	●	●	●						•	⬤	•					✚
Green River 1	•	•	●						•	●						•
NF Toutle 1	●	●	●	•		•			•	⬤	•					•
NF Toutle 2	●	●	●	•		•			•	⬤	•				•	•
NF Toutle 3	●	●	●	•		•			•	⬤	•				•	
Green River 5	•	●	•						•	●						+
NF Toutle 6	●	●	●	•		•			•	⬤	•					
NF Toutle 4	●	●	•			•			•	⬤	•					•
NF Toutle 9	●	•	●						•	●						✚
Green River 7	●	•	•						•	●						✚
NF Toutle 8	●	•	●						•	⬤						✚
SF Toutle 17	●	•	•						•	●	•					✚
NF Toutle 5	●	●	•			•			•	⬤	•					•
Hollywood Gorge	•	●	•	•		•			•	●	•					•
Lower Cowlitz-2	•	●	•	•		•					•			•	•	•
Lower Cowlitz-1	•	●	•	•		•					•			•	•	•
Fish Trap																

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✚ High Positve Impact ✚

Figure 10. Toutle fall Chinook habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to template conditions. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams. Some low priority reaches are not included for display purposes.

Toutle Spring Chinook

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
NF Toutle 10	⬤	⬤	⬤		•	•			●	⬤	●					●
NF Toutle 12	⬤	⬤	⬤			•			●	⬤	●					✚
NF Toutle 11	●	●	⬤		•	•			●	⬤	●					•
NF Toutle 13	●	●	⬤						•	⬤	•					✛
SRS (sedi retention strucure)																
NF Toutle 9																
NF Toutle 8																
Fish Trap																
NF Toutle 7																
NF Toutle 6																
NF Toutle 5																
NF Toutle 4																
NF Toutle 3																
NF Toutle 2																
NF Toutle 1																
Toutle 9																
Toutle 8																
Toutle 7																
Toutle 6																
Hollywood Gorge																
Toutle 5																
Toutle 4																
Toutle 3																
Toutle 2																
Toutle 1																
Lower Cowlitz-2																
Lower Cowlitz-1																

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

Figure 11. Toutle spring chinook habitat factor analysis diagram.

Toutle Chum

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Toutle 4	⬤	⬤		•					●	⬤	●				●	✛
Toutle 6	●	⬤		•					●	⬤	•					✛
Toutle 5	•	●		•					•	⬤	•				•	✛
Toutle 1	•	●							•	●	•				•	●
Toutle 3	•	●		•					•	⬤	•				•	✛
Stankey Cr	•	●							•	•	•				•	✛
Rock Creek	•	●							•	•	•				•	✛
Toutle 2	•	●		•					•	⬤	•				•	✛
Lower Cowlitz-1		•														•
Lower Cowlitz-2		•							•							•
Hollywood Gorge																

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ✛ High Positve Impact ✚

Figure 12. Toutle chum habitat factor analysis diagram.

Toutle Winter Steelhead

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
SF Toutle 16	⬤	⬤	●	•		•			⬤	⬤	●			•		+
SF Toutle 18	⬤	⬤	●	•		•			⬤	⬤	●			•		+
SF Toutle 19	●	⬤	●	•		•			⬤	⬤	●			•		╋
SF Toutle 14	●	⬤	●	•		•			⬤	●	●			•		+
SF Toutle 20	●	●	●	•		•			⬤	⬤	●			•		⬤
SF Toutle 15	●	⬤	●			•			●	●	•			•		+
SF Toutle 12	●	⬤	●	•					●	●	•			•		+
NF Toutle 12	●	●	⬤	•		•			⬤	⬤	●			•		+
Green River 6	●	●	●	•					●	●	•			•		+
SF Toutle 13	●	⬤	●			•			●	●	•					+
SF Toutle 17	●	●	•	•		•			●	●	●			•		+
NF Toutle 7	●	●	⬤	●		●			●	⬤	•			•		
NF Toutle 13	●	●	●	•		•			●	⬤	•			•		⬤
SF Toutle 4	●	●	●	•		•			●	●	•			•		+
Green River 7	●	●	•	•					●	●	•			•		+
SF Toutle 11	●	⬤	•						●	●	•					+
Green River 9	●	●	•	•					●	●						╋
Toutle 4	●	⬤	●	●		•			●	⬤	•			•		
Green River 4	•	●	●						•	●						
Green River 8	●	●	•	•					●	●	•					+
Toutle 8	●	⬤	●	●		●			●	⬤	•			•		+
NF Toutle 11	●	●	●	•	•	•			●	⬤	●			•		+
NF Toutle 10	●	●	⬤	•	•	•			●	⬤	●			•		+
SF Toutle 1	●	●	●	•		•			●	●	•			•		
SF Toutle 8	•	●	●						●	●	•			•		
SF Toutle 5	•	●	•						•	●	•					
SF Toutle 2	●	●	●	•		•			●	●	•			•		
Shultz Creek 1	•	•	●	•					•	●				•		+
SF Toutle 3	●	●	●	•		•			●	●	•			•		
Toutle 5	●	⬤	●	●		•			●	⬤	•			•		
Green River 3	•	●	●						●	•				•		
SF Toutle 9	•	●	•						•	•	•					
SF Toutle 10	•	●	•						•	●	•					
Miners Creek	•	•	●	•					•	●				•		•
NF Toutle 1	●	●	●	●		•			●	⬤	•			•		
Green River 5	•	●	•						•	●						●
NF Toutle 9	●	●	●	•		•			●	⬤	•			•		
Toutle 3	•	●	●	●		•			●	⬤	•			•		
Coldwater Creek	•	•	●	•					●	●	•			•		•
SF Toutle 7	•	●	•						•	•						
Castle Creek	•	•	●	•					●	●	•			•		●
NF Toutle 3	•	●	●	•		•			●	⬤	•			•		

High Impact ⬤ Moderate Impact ● Low Impact • None ☐ Low Positive Impact + Moderate Positve Impact ╋ High Positve Impact ✚

Figure 13. Toutle winter steelhead habitat factor analysis diagram.

3.5 Watershed Process Limitations

This section describes watershed process limitations that contribute to stream habitat conditions significant to focal fish species. Reach level stream habitat conditions are influenced by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input, and large woody debris recruitment are often affected by upstream conditions and by contributing landscape factors. Accordingly, restoration of degraded channel habitat may require action outside the targeted reach, often extending into riparian and hillslope (upland) areas that are believed to influence the condition of aquatic habitats.

Watershed process impairments that affect stream habitat conditions were evaluated using a watershed process screening tool termed the Integrated Watershed Assessment (IWA). The IWA is a GIS-based assessment that evaluates watershed impairments at the subwatershed scale (3,000 to 12,000 acres). The tool uses landscape conditions (i.e. road density, impervious surfaces, vegetation, soil erodability, and topography) to identify the level of impairment of 1) riparian function, 2) sediment supply conditions, and 3) hydrology (runoff) conditions. For sediment and hydrology, the level of impairment is determined for local conditions (i.e. within subwatersheds, not including upstream drainage area) and at the watershed level (i.e. integrating the entire drainage area upstream of each subwatershed). See Appendix E for additional information on the IWA.

The Toutle River watershed contains 46 planning subwatersheds, ranging from approximately 3,000 to 12,000 acres. IWA results for the Toutle River watershed are shown in Table 4. A reference map showing the location of each subwatershed in the basin is presented in Figure 14. Maps of the distribution of local and watershed level IWA results are displayed in Figure 15.

3.5.1 *Hydrology*

Current Conditions.— Local level hydrologic conditions across the Toutle River watershed range from moderately impaired to impaired. The only functional hydrologic rating is in the upper Green River-Falls Creek subwatershed (40101). Moderately impaired subwatersheds are located in headwater areas, along the lower Green River, and along the middle mainstem of the SF Toutle. Impaired conditions make up the remainder of the basin. Watershed level conditions have a slightly different pattern across the basin. Impaired subwatersheds are concentrated in the entire lower porton of the basin, along the mainstem SF Toutle, throughout the Green River basin, and in the Hoffstadt basin (tributary to the middle NF Toutle). Less impaired hydrologic conditions in headwater subwatersheds buffer downstream conditions in the upper NF, but this is not the case in the Green and SF basins, which contain impaired subwatersheds. Except for the moderately impaired subwatersheds in the upper NF basin (30306, 30202, 30201), all major anadromous fish bearing subwatersheds are impaired at the watershed level.

Subwatersheds in the NF drainage are susceptible to hydrologic impacts due to vegetation destruction caused by the 1980 eruption. This risk is mitigated by low road densities (0-2.7 mi/sq mi) and large amounts of wetland area (>10%). The exception is the South Coldwater Creek subwatershed (30103) and the NF Toutle below Maratta Creek (30306, 30302), which have high road and stream crossing densities.

Hydrologic impairments along the lower NF subwatersheds are caused by locally high road densities, young forest vegetation, and upstream inputs. The mainstem NF Toutle above the Green River confluence (30304) supports important winter steelhead habitat and suffers from high road densities (6.6 mi/sq mi) and low mature forest vegetation coverage (33%). It is also impacted by the Hoffstadt Creek drainage (30301, 30302, 30305), which is rated as impaired across all subwatersheds. The lower NF Toutle (70301) has even worse values for road density (7.1 mi/sq mi) and mature forest cover (23%). It also receives inputs from hydrologically impaired upstream subwatersheds (Green River and North Fork drainages).

IWA impairment ratings for the SF Toutle basin (50201-50302, 50402-50405) are strongly influenced by local hydrologic conditions, including high road densities (average 6.3 mi/sq mi) and moderate rain-on-snow zone coverage (avg. 37%). Similar conditions exist in subwatersheds drained by the Green River (40201-40402), with IWA results showing impaired local and watershed level conditions driven by high road densities (average 6.1 mi/sq mi) and moderate rain-on-snow area (average is 47% and maximum is 84%). Current land cover conditions in the Green River subwatersheds are poor, with only 27% of subwatershed area in hydrologically mature forest. Impaired hydrologic conditions in subwatersheds along the upper Green and the SF Toutle contribute to impaired ratings for downstream subwatersheds.

Subwatersheds along the mainstem Toutle River that encompass important anadromous fish habitat (70603, 70604, and 70607) are rated as hydrologically impaired at the local and watershed levels. The impairments are due to upstream inputs, high local road densities (5.3-6.1 mi/sq mi), and locally young forest vegetation (22-34% hydrologically mature).

Predicted Future Trends.— Hydrologic conditions in the Toutle River watershed are generally predicted to trend towards gradual improvement over the next 20 years as a result of improved forestry practices and vegetation recovery from the Mount St. Helens eruption.

Hydrologic conditions in the NF Toutle basin are predicted to trend stable or improve gradually over the next 20 years. Much of the land in the NF Toutle drainage is publicly owned, managed by either the USFS or WDNR. Forest cover within these subwatersheds is predicted to generally mature and improve. These improvements are expected to benefit downstream mainstem reaches..

Table 4. IWA results for the Toutle River Watershed

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
30101	M	M	M	M	M	none
30102	M	F	M	M	F	none
30103	I	M	M	I	M	none
30104	M	F	M	M	F	none
30201	I	F	M	M	F	30101, 30102, 30103, 30104, 30203, 30204, 30205, 30301, 30302
30202	I	M	M	M	F	30101, 30102, 30103, 30104, 30201, 30203, 30204, 30205, 30301, 30302
30203	M	M	M	M	F	30204
30204	M	F	M	M	F	none
30205	M	M	M	M	M	none
30301	I	M	M	I	M	30302, 30305
30302	I	M	M	I	M	none
30303	M	M	M	M	M	none
30304	I	M	M	I	M	30101, 30102, 30103, 30104, 30201, 30202, 30203, 30204, 30205, 30301, 30302, 30303, 30305, 30306
30305	I	M	M	I	M	30302
30306	I	M	M	M	M	30101, 30102, 30103, 30104, 30201, 30202, 30203, 30204, 30205
40101	F	M	F	M	M	40102
40102	M	M	M	M	M	none
40201	I	M	M	I	M	40101, 40102, 40202
40202	I	M	M	I	M	none
40203	I	I	M	I	I	none
40301	I	M	I	I	M	40101, 40102, 40201, 40202, 40203, 40302
40302	I	I	M	I	I	none
40401	M	M	M	I	M	40101, 40102, 40201, 40202, 40203, 40301, 40302
40402	I	M	M	I	M	40101, 40102, 40201, 40202, 40203, 40301, 40302, 40401, 40403, 40404
40403	M	M	M	M	M	none
40404						40101, 40102, 40201, 40202, 40203, 40301, 40302, 40401
50101	M	M	M	M	M	none
50102	M	M	M	M	M	none
50201	I	M	M	I	M	50101, 50102
50202	I	I	M	I	I	none
50301	M	M	M	I	M	50101, 50102, 50201, 50202, 50302
50302	I	M	M	I	M	50101, 50102, 50201, 50202

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	**Sediment**	**Riparian**	**Hydrology**	**Sediment**	
50401	I	M	M	I	M	50101, 50102, 50201, 50202, 50301, 50302, 50404, 50405
50402	I	M	M	I	M	none
50403	I	I	M	I	M	50101, 50102, 50201, 50202, 50301, 50302, 50401, 50404, 50405
50404	M	M	M	I	M	50101, 50102, 50201, 50202, 50301, 50302, 50405
50405	M	M	M	I	M	50101, 50102, 50201, 50202, 50301, 50302, 50401, 50402, 50403
70301	I	M	M	I	M	30101, 30102, 30103, 30104, 30201, 30202, 30203, 30204, 30205, 30301, 30302, 30303, 30304, 30305, 30306, 40101, 40102, 40201, 40202, 40203, 40301, 40302, 40401, 40402, 40403, 40404
70302	I	M	M	I	M	none
70401	I	M	M	I	M	70402, 70403
70402	I	M	M	I	M	none
70403	I	M	M	I	M	none
70602	M	M	M	M	M	none
70603	I	M	M	I	M	30101, 30102, 30103, 30104, 30201, 30202, 30203, 30204, 30205, 30301, 30302, 30303, 30304, 30305, 30306, 40101, 40102, 40201, 40202, 40203, 40301, 40302, 40401, 40402, 40403, 40404, 50101, 50102, 50201, 50202, 50301, 50302, 50401, 50402, 50403, 50404, 50405, 70301, 70302, 70401, 70402, 70403
70604	I	M	M	I	M	30101, 30102, 30103, 30104, 30201, 30202, 30203, 30204, 30205, 30301, 30302, 30303, 30304, 30305, 30306, 40101, 40102, 40201, 40202, 40203, 40301, 40302, 40401, 40402, 40403, 40404, 50101, 50102, 50201, 50202, 50301, 50302, 50401, 50402, 50403, 50404, 50405, 70301, 70302, 70401, 70402, 70403, 70602, 70603
70607	I	M	M	I	M	30101, 30102, 30103, 30104, 30201, 30202, 30203, 30204, 30205, 30301, 30302, 30303, 30304, 30305, 30306, 40101, 40102, 40201, 40202, 40203, 40301, 40302, 40401, 40402, 40403, 40404, 50101, 50102, 50201, 50202, 50301, 50302, 50401, 50402, 50403, 50404, 50405, 70301, 70302, 70401, 70402, 70403, 70602, 70603, 70604

Notes:

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170800050#####.

[b] IWA results for watershed processes at the subwatershed level (i.e., not considering upstream effects). This information is used to identify areas that are potential sources of degraded conditions for watershed processes, abbreviated as follows:

F: Functional
M: Moderately impaired
I: Impaired

[c] IWA results for watershed processes at the watershed level (i.e., considering upstream effects). These results integrate the contribution from all upstream subwatersheds to watershed processes and are used to identify the probable condition of these processes in subwatersheds where key reaches are present.

[d] Subwatersheds upstream from this subwatershed

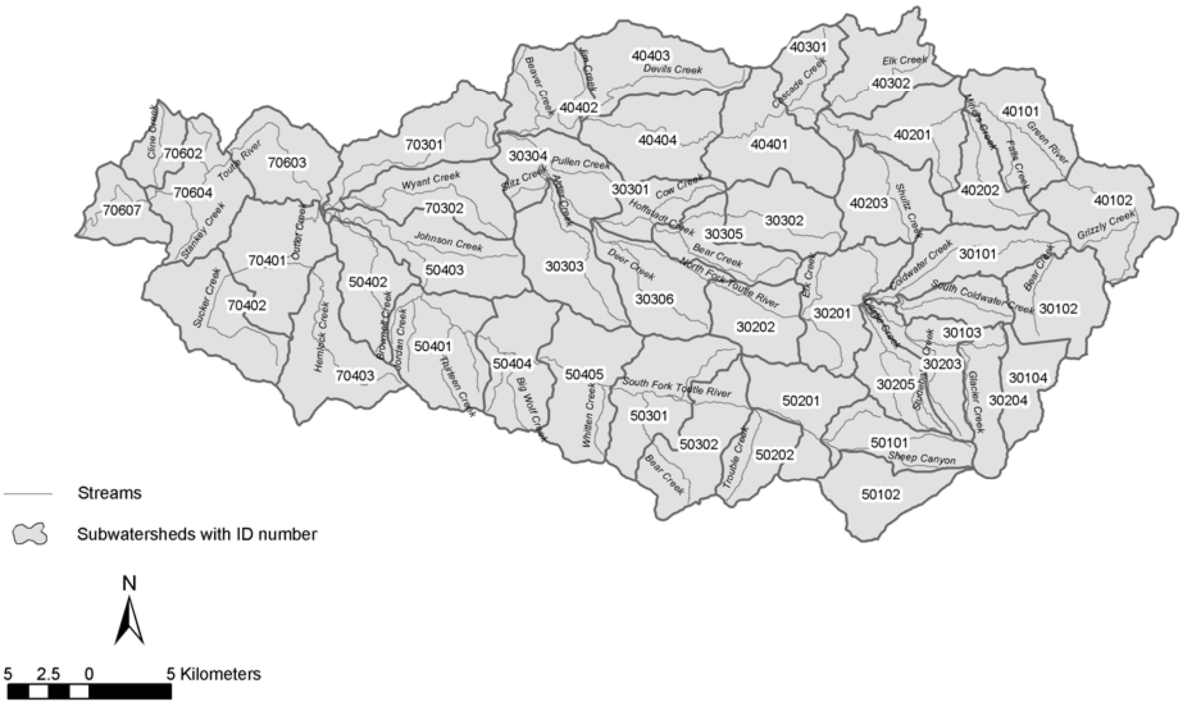
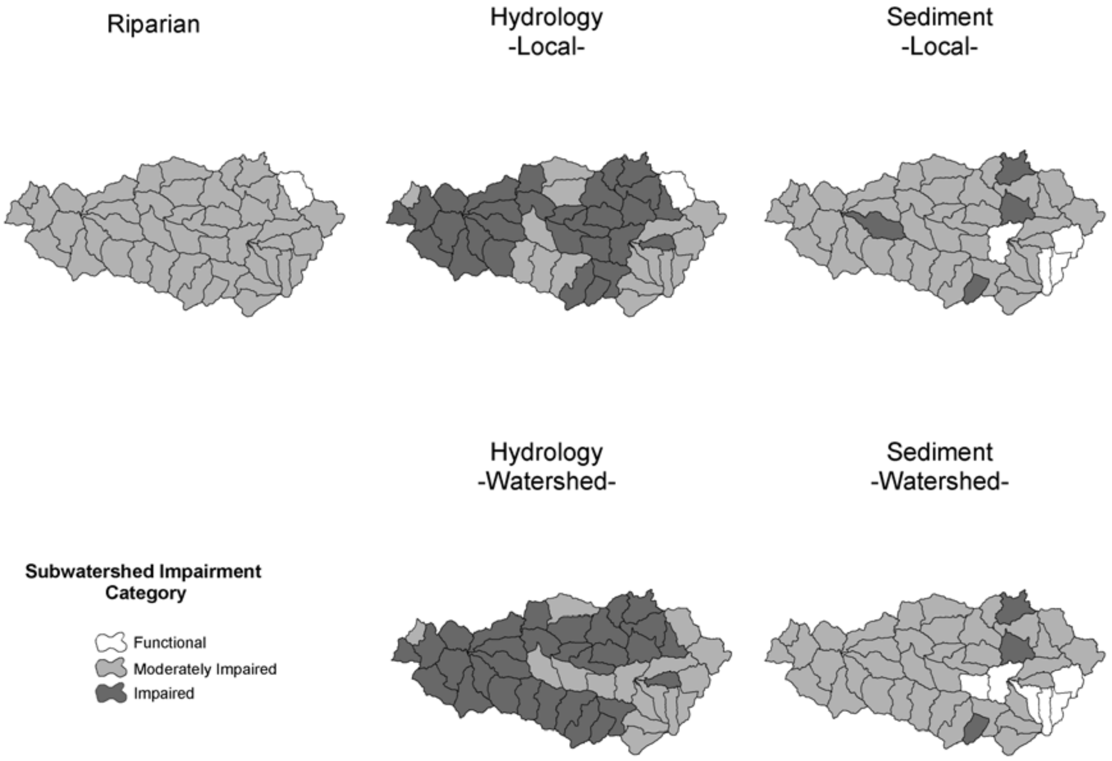


Figure 14. Map of the Toutle basin showing the location of the IWA subwatersheds.


Riparian

Hydrology -Local-

Sediment -Local-

Hydrology -Watershed-

Sediment -Watershed-

Figure 15. IWA subwatershed impairment ratings by category for the Toutle basin

3.5.2 *Sediment Supply*

Current Conditions.— Local and watershed level sediment supply ratings are nearly identical, with only a few exceptions. The majority of subwatersheds (80%) have moderately impaired sediment supply ratings. The few impaired subwatersheds are scattered throughout the basin. Functional conditions occur in the upper NF Toutle basin. These functional conditions improve the watershed level ratings of downstream subwatersheds. Impaired subwatersheds (40302, 40203, 50202, and 50403) suffer from young forests and high road densities on erodable geology types. Streamside road densites and stream crossing densities are also high in these areas.

Fish bearing subwatersheds along the mainstem NF Toutle are rated as moderately impaired for sediment. The impairments are due to young forests and high road densities. Inputs from upstream subwatersheds in the lower and middle part of the drainage, such as Hoffstadt Creek (30301, 30302, 30305) and the Green River, also affect sediment condition.

Most of the mainstem Toutle subwatersheds (70603, 70604, and 70607) are moderately impaired with respect to sediment supply conditions. Again, most of the problems arise from young forest vegetation, high road densities, and high stream crossing densities. Upstream sediment conditions play a major role in the watershed level sediment ratings for these lower basin subwatersheds.

Predicted Future Trends.— In general, Toutle River basin subwatersheds have low to moderate natural erodability ratings, based on geology type and slope class, averaging less than 20, with a maximum of 40, on a scale of 0-126. This suggests that these subwatersheds would not be major sources of sediment impacts under undisturbed conditions. However, road densities, streamside road densities, and stream crossings in these subwatersheds are relatively high, leading to a risk of elevated sediment supply. Given the large amount of private and public timber holdings, and the protected areas around Mount St. Helens, the overall sediment condition is expected to remain stable over the next 20 years.

The outlook is good for improving conditions in the NF Toutle above Hoffstadt Creek because of the high degree of public ownership. In the lower NF Toutle, the large percentage of industrial timber lands and high road densities suggests that trends are likely to remain stable. However, some gradual improvement may occur as improved forestry and road management practices are implemented. Sediment conditions in the SF Toutle and Green River basins are likely to follow a similar trend, as forestry and road management practices on private timberlands improve.

Trends in sediment conditions in mainstem subwatersheds are expected to remain relatively constant due to the likelihood of ongoing timber harvest, high road densities, moderately high streamside road densities (ranging from 0.4-0.6 miles/stream mile), and the potential for increased development.

3.5.3 *Riparian Condition*

Current Conditions.— Riparian conditions are rated moderately impaired throughout the Toutle River watershed, with the exception of one subwatershed in the Green River headwaters (40101). These conditions are due to historical logging practices and the impacts of the Mount St. Helens eruption. Riparian conditions in all important anadromous subwatersheds are uniformly rated as moderately impaired.

Predicted Future Trends.— In general, riparian conditions are likely to improve over time with improved forestry practices and recovery of vegetation destroyed by the Mount St. Helens eruption.

Mainstem subwatersheds on the upper NF Toutle (30201, 30202, 30306), which contain important anadromous fish habitat, have large areas of public and private lands managed for timber harvest and low to moderate streamside road densities (12 miles/stream mile). The predicted trend in these subwatersheds is for riparian conditions to remain the same or to slightly improve. Some riparian recovery is expected on timber lands where streamside roads are not present, however, these gains may be offset by streamside development in some areas.

Riparian conditions along the lower mainstem Toutle, the SF Toutle, and the Green River are expected to remain stable or trend towards further degradation over the next 20 years, as development pressure and timber production continue in the lower basin.

3.6 Other Factors and Limitations

3.6.1 *Hatcheries*

Hatcheries currently release over 50 million salmon and steelhead per year in Washington lower Columbia River subbasins. Many of these fish are released to mitigate for loss of habitat. Hatcheries can provide valuable mitigation and conservation benefits but may also cause significant adverse impacts if not prudently and properly employed. Risks to wild fish include genetic deterioration, reduced fitness and survival, ecological effects such as competition or predation, facility effects on passage and water quality, mixed stock fishery effects, and confounding the accuracy of wild population status estimates. This section describes hatchery programs in the Toutle subbasin and discusses their potential effects.

North Fork Toutle Hatchery

The North Toutle Hatchery (since 1952) produces fall Chinook and coho, and releases summer steelhead for harvest opportunity. The hatchery is located on the lower Green River near the confluence with the NF Toutle River. The hatchery was destroyed in the 1980 eruption of Mt. St. Helens, but was renovated in 1990. The steelhead are transferred in from Skamania Hatchery as pre-smolts. Skamania Hatchery steelhead are a composite stock and are genetically different from the naturally-produced winter steelhead in the Toutle Basin. The main threats from hatchery steelhead are potential domestication of the naturally-produced steelhead as a result of adult interactions or ecological interactions between natural juvenile salmon and hatchery released juvenile steelhead. The main hatchery threats from the North Toutle Hatchery salmon programs are domestication of natural fall Chinook and coho and potential ecological interactions between hatchery and natural juvenile salmon.

Table 5. Current Toutle subbasin hatchery production.

Hatchery	Release Location	Fall Chinook	Early Coho	Summer Steelhead
North Toutle	Green River	2,500,000[1]	800,000	25,000
Skamania	South Toutle			25,000

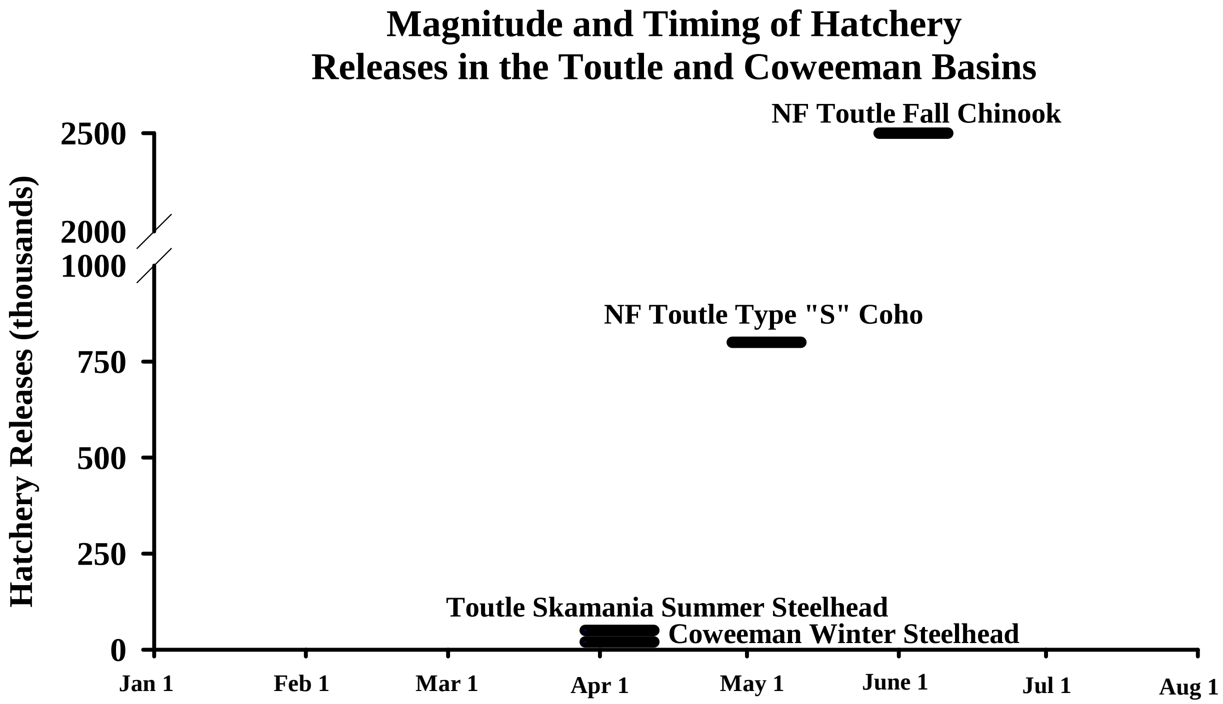


Figure 16. Magnitude and timing of hatchery releases in the Toutle and Coweeman River basins by species, based on 2003 brood production goals.

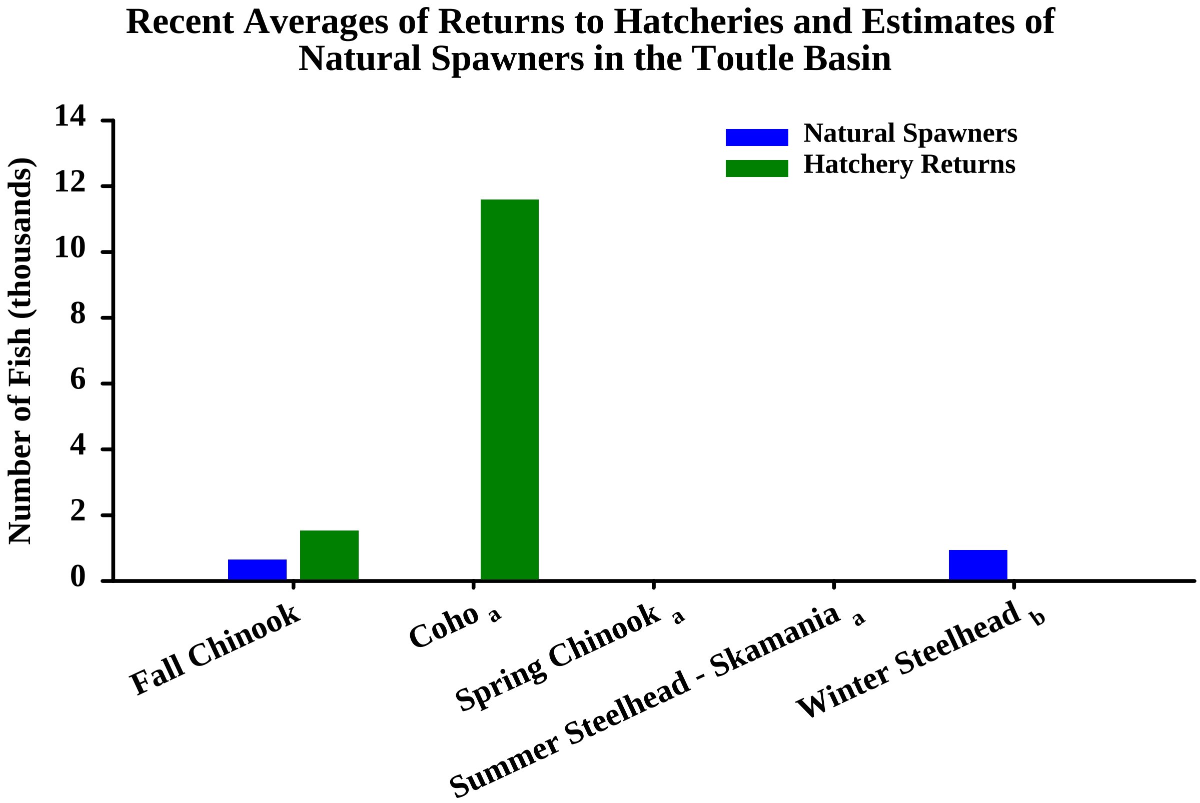


Figure 17. Recent average hatchery returns and estimates of natural spawning escapement in the Toutle River basins by species. The years used to calculate averages varied by species, based on available data. The data used to calculate average hatchery returns and natural escapement for a particular species and basin were derived from the same years in all cases. All data were from 1992 to the present. Calculation of each average utilized a minimum of 5 years of data.

Hatchery Effects

Genetics— Fall chinook broodstock at the North Toutle Hatchery have been primarily collected from the Toutle River although there have been been significant transfers made from lower Columbia ESU hatchery stocks, most significantly Spring Creek Hatchery and Kalama Hatchery fall chinook. Specific genetic data is not available for Toutle Fall chinook.

Broodstock for the coho salmon hatchery programs in the Cowlitz Basin has come from native Cowlitz River (Cowlitz Salmon Hatchery) and Toutle River (North Toutle Hatchery) stocks. These stocks also have been used as broodstock for other lower Columbia River coho hatchery programs. Late stock coho salmon (Type N) and early coho salmon (Type S) are informally considered synonymous with Cowlitz River and Toutle River coho stocks, respectively. Columbia River early and late stock coho salmon produced from Washington hatcheries have not been found to be genetically different.

Broodstock for the summer steelhead hatchery program at the North Toutle Hatchery and the Cowlitz Trout Hatchery originated from Skamania stock. The North Toutle Hatchery continues to receive broodstock from the Skamania Hatchery, while summer steelhead broodstock for the Cowlitz program is collected at the Cowlitz Trout and Salmon hatcheries.

Interactions— Hatchery fall Chinook account for most adults returning to the Cowlitz, Toutle, and Green rivers (Figure 17). Hatchery returns are approximately double the natural escapement in the Cowlitz basin. Many natural spawners are expected to be first generation hatchery fish; wild fish abundance is likely low. The Toutle and Green River fall Chinook populations are re-establishing after the 1980 Mt. St. Helens eruption. Depending on the rebuilding success of these populations, the potential for wild/hatchery fish interactions may increase.

Hatchery coho salmon, account for most adults returning to the Cowlitz and Toutle rivers. Significant coho production can occur in the upper Cowlitz basin from adults transplanted from the lower river; these fish are usually first generation hatchery fish (Figure 17). Natural coho production in the Toutle basin primarily occurs in tributaries of the South Fork Toutle and Green rivers, as well as tributaries of the North Fork Toutle River upstream of the Sediment Retention Dam. Hatchery smolts released in the lower Cowlitz River potentially compete with wild fall Chinook, steelhead, and chum salmon for food and space, but competition is limited to smolt migration time through the basin. Migration time is minimized by releasing smolts (in May) when they are prepared to move towards the Columbia estuary

In the Toutle River system, the winter steelhead annual return is thought to be primarily comprised of naturally produced fish (Figure 17). Potential for interaction between wild and hatchery adults is expected to be low because of relative numbers of natural and hatchery fish and temporal and spatial segregation.

Water Quality/Disease— Water for the North Toutle Hatchery comes from the Green River; the hatchery has a water right totaling 26,031 gpm. A rearing site associated on the South Fork Toutle River utilizes 3-4 cfs directly from the river. Rearing ponds at the facility are sanitized with chlorine at 20 parts per million before being stocked with fry. Equipment used at the rearing ponds is routinely disinfected with an iodine solution. Fish are monitored throughout the rearing phase by WDFW pathologists.

Mixed Harvest— The purpose of the fall Chinook hatchery program at the North Toutle Hatchery is to mitigate for losses resulting from hydroelectric development in the lower Columbia basin. Historically, exploitation rates of hatchery and wild fall Chinook likely were similar. Fall Chinook are an important target species in ocean and Columbia River commercial and recreational fisheries, as well as in Cowlitz River recreational fisheries. CWT data analysis of the fall Chinook 1989–1994 brood years from the Cowlitz Salmon and North Toutle hatcheries indicate a 33% and 41% exploitation rate, respectively, leaving 67% and 59% of the respective adult return for escapement. Exploitation of wild fish during the same period likely was similar. Hatchery and wild fall chinook harvest rates remain similar and are now constrained by ESA harvest limitations.

Mitigating for early run coho salmon lost as a result of hydroelectric development in the lower Columbia basin is the goal of the North Toutle Hatchery coho salmon program. The program provides fish for harvest while minimizing adverse effects on ESA-listed fish. All hatchery smolts are adipose fin-clipped to allow for selective harvest. Ocean and Columbia River sport and commercial fisheries and Cowlitz basin sport fisheries benefit from this program. Historically, naturally produced coho from the Columbia River were managed like hatchery fish and subjected to similar exploitation rates. Ocean and Columbia River combined harvest of Columbia River-produced coho ranged from 70% to over 90% during 1970–1983. To protect several wild coho stocks, ocean fisheries were limited beginning in the mid-1980s and Columbia River commercial fisheries were temporally adjusted in the early 1990s. With the advent of selective fisheries for marked hatchery fish, exploitation of wild coho has been reduced, while hatchery fish can be harvested at higher rates. Currently, Toutle wild coho benefit from ESA harvest restrictions placed on Oregon Coastal natural coho (federal listing) in ocean fisheries and Oregon Lower Columbia natural coho (state listing) in Columbia River fisheries.

At the Cowlitz Trout Hatchery and the North Toutle Hatchery, the summer steelhead hatchery programs mitigate for steelhead lost as a result of hydroelectric development in the basin and provide harvest opportunity. Summer steelhead are introduced to the basin; there is no intention of trying to develop a self-sustaining population of summer steelhead. Fisheries that benefit include tributary and lower Columbia River recreational fisheries. Selective fishing regulations and the differences in the timing of runs focus harvest on hatchery summer steelhead and minimize effects to wild steelhead.

Passage— At the North Toutle Hatchery, the adult collection facility is a temporary weir for collecting coho salmon and fall chinook. The weir is installed and removed annually and only effects fish passage during the time of adult coho and fall chinook collection.

Supplementation— The Cowlitz Trout Hatchery has an annual goal of restoring natural spawning late-run winter steelhead populations in the upper Cowlitz and Tilton River basins. Current annual release goals are 350,000 fingerlings and 37,500 smolts in the upper watershed. Juvenile downstream migrant passage is better at the hydro-facility then for chinook, and similar to coho.

Biological Risk Assessment

The evaluation of hatchery programs and implementation of hatchery reform in the Lower Columbia is occurring through several processes. These include: 1) the LCFRB recovery planning process; 2) Hatchery Genetic Management Plan (HGMP) preparation for ESA permitting; 3) FERC releated plans on the Cowlitz River and Lewis River; and 4) the federally mandated Artificial Production Review and Evaluation (APRE) process. Through each of these processes, WDFW is applying a consistent framework to identify the hatchery program enhancements that will maximize fishing-related economic benefits and promote attainment of regional recovery goals. Developing hatcheries into an integrated, productive, stock recovery tool requires a policy framework for considering the acceptable risks of artificial propagation, and a scientific assessment of the benefits and risks of each proposed hatchery program. WDFW developed the Benefit-Risk Assessment Procedure (BRAP) to provide that framework. The BRAP evaluates hatchery programs in the ecological context of the watershed, with integrated assessment and decisions for hatcheries, harvest, and habitat. The risk assessment procedure consists of five basic steps, grouped into two blocks:

Policy Framework

- Assess population status of wild populations
- Develop risk tolerance profiles for all stock conditions
- Assign risk tolerance profiles to all stocks

Risk Assessment

- Conduct risk assessments for all hatchery programs
- Identify appropriate management actions to reduce risk

Following the identification of risks through the assessment process, a strategy is developed to describe a general approach for addressing those risks. Building upon those strategies, program-specific actions and an adaptive management plan are developed as the final steps in the WDFW framework for hatchery reform.

Table 6 identifies hazards levels associated with risks involved with hatchery programs in the Toutle Basin. Table 7 identifies preliminary strategies proposed to address risks identified in the BRAP for the same populations.

The BRAP risk assessments and strategies to reduce risk have been key in providing the biological context to develop the hatchery recovery measures for lower Columbia River sub-basins.

Table 6. Preliminary BRAP for hatchery programs affecting populations in the Toutle River Basin.

Symbol	Description
○	Risk of hazard consistent with current risk tolerance profile.
?	Magnitude of risk associated with hazard unknown.
●	Risk of hazard exceeds current risk tolerance profile.
▨	Hazard not relevant to population

	Hatchery Program		Risk Assessment of Hazards											
			Genetic			Ecological			Demographic		Facility			
Toutle Population	Name	Release (millions)	Effective Population Size	Domestication	Diversity	Predation	Competition	Disease	Survival Rate	Reproductive Success	Catastrophic Loss	Passage	Screening	Water Quality
Fall Chinook	NF Toutle Fall Chinook	2.500	○	○	○	○	?	○	○	?	○	●	●	○
	NF Toutle Coho Type S	0.800	▨	▨	▨	?	?	○	▨	▨	▨	●	●	○
	SF Toutle S. Steelhead	0.025	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	NF Toutle S. Steelhead	0.025	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
Spring Chinook	NF Toutle Fall Chinook	2.500	▨	▨	▨	?	?	○	▨	▨	▨	●	●	○
	NF Toutle Coho Type S	0.800	▨	▨	▨	?	?	○	▨	▨	▨	●	●	○
	SF Toutle S. Steelhead	0.025	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	NF Toutle S. Steelhead	0.025	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
Winter Steelhead South Fork	NF Toutle Fall Chinook	2.500	▨	▨	▨	?	?	○	▨	▨	▨	●	●	○
	NF Toutle Coho Type S	0.800	▨	▨	▨	?	?	○	▨	▨	▨	●	●	○
	SF Toutle S. Steelhead	0.025	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	NF Toutle S. Steelhead	0.025	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
Winter Steelhead North Fork	NF Toutle Fall Chinook	2.500	▨	▨	▨	?	?	○	▨	▨	▨	●	●	○
	NF Toutle Coho Type S	0.800	▨	▨	▨	?	?	○	▨	▨	▨	●	●	○
	SF Toutle S. Steelhead	0.025	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○
	NF Toutle S. Steelhead	0.025	▨	▨	▨	?	?	○	▨	▨	▨	○	○	○

Table 7. Preliminary strategies proposed to address risks identified in the BRAP for Toutle River Basin populations.

Toutle Population	Hatchery Program		Risk Assessment of Hazards															
			Address Genetic Risks					Address Ecological Risks				Address Demographic Risks		Address Facility Risks			
	Name	Release (millions)	Mating Procedure	Integrated Program	Segregated Program	Research/ Monitoring	Broodstock Source	Number Released	Release Procedure	Disease Containment	Research/ Monitoring	Culture Procedure	Research/ Monitoring	Reliability	Improve Passage	Improve Screening	Pollution Abateme
Fall Chinook	N. Fork Toutle Fall Chinook	2.500											●		●	●	
	NF Toutle Coho Type S	0.800						●	●		●				●	●	
	SF Toutle S. Steelhead	0.025						●	●		●				—	—	
	NF Toutle S. Steelhead	0.025						●	●		●						
Spring Chinook	N. Fork Toutle Fall Chinook	2.500						●	●		●				●	●	
	NF Toutle Coho Type S	0.800						●	●		●				●	●	
	SF Toutle S. Steelhead	0.025						●	●		●						
	NF Toutle S. Steelhead	0.025						●	●		●						

Impact Assessment

The potential significance of negative hatchery impacts within the subbasin on natural populations was estimated with a simple index based on: 1) intra-specific effects resulting from depression in wild population productivity that can result from interbreeding with less fit hatchery fish and 2) inter-specific effects resulting from predation of juvenile salmonids of other species. The index reflects only a portion of net hatchery effects but can provide some sense of the magnitude of key hatchery risks relative to other limiting factors. Fitness effects are among the most significant intra-specific hatchery risks and can also be realistically quantified based on hatchery fraction in the natural spawning population and assumed fitness of the hatchery fish relative to the native wild population. Predation is among the most significant inter-specific effects and can be estimated from hatchery release numbers by species. This index assumed that equilibrium conditions have been reached for the hatchery fraction in the wild and for relative fitness of hatchery and wild fish. This simplifying assumption was necessary because more detailed information is lacking on how far the current situation is from equilibrium. The index does not consider the numerical benefits of hatchery spawners to natural population numbers, ecological interactions between hatchery and wild fish other than predation, or out-of-basin interactions, all of which are difficult to quantify. Appendix E contains a detailed description of the method and rationale behind this index.

The indexed potential for negative impacts of hatchery spawners on wild population fitness in the Toutle River subbasin is quite low (<1%) for winter steelhead where the majority of the run is comprised of natural spawners and hatchery and wild fish are segregated by differences in spawn timing (competition effects are not assessed). Fitness impact potential is substantially greater for fall Chinook (27%) and for coho in the North Toutle (26%). However, the high incidence of fall Chinook and coho hatchery spawners suggests that the fitness of natural and hatchery fish is now probably quite similar and natural populations might decline substantially without continued hatchery subsidy under current habitat conditions. Interspecific impacts from predation appear to be 1% or less for all species, except for chum, which are assumed to interact with releases from the Cowlitz Hatchery in the lower Cowlitz River.

Table 8. Presumed reductions in wild population fitness as a result of natural hatchery spawners and survival as a result of interactions with other hatchery species for Toutle River salmon and steelhead populations.

Population	Annual releases[a]	Hatchery fraction[b]	Fitness category[c]	Assumed fitness[d]	Fitness impact[e]	Interacting releases[f]	Interspecies impact[g]
Fall Chinook	2,500,000	0.90	2	0.7	0.27	850,000	0.04
Spring Chinook	0	0.90	3	0.5	0.00	--	--
Chum	0	0	-	-	0	50,000	0.002
Coho							
South Fork	0[i]	0.87	2	0.7	0.00	25,000	0
North Fork	800,000[j]	0.86	2	0.7	0.26	825,000	0.01
Winter steelhead							
South Fork	0[k]	0.02	2	0.7	0.006	0	0
North Fork	0[l]	0	2	0.7	0	0	0

[a] Annual release goals.

[b] Proportion of natural spawners that are first generation hatchery fish.

[c] Broodstock category: 1 = derived from native local stock, 2 = domesticated stock of native local origin, 3 = originates from same ESU but substantial divergence may have occurred, 4 = out-of-ESU origin or origin uncertain

[d] Productivity of naturally-spawning hatchery fish relative to native wild fish prior to significant hatchery influence. Because population-specific fitness estimates are not available for most lower Columbia River populations, we applied hypothetical rates comparable to those reported in the literature and the nature of local hatchery program practices.

[e] Index based on hatchery fraction and assumed fitness.

[f] Number of other hatchery releases with a potential to prey on the species of interest. Includes steelhead and coho for fall chinook and coho. .

[g] Predation impact based on interacting releases and assumed species-specific predation rates.

[h] There are no records of hatchery chum releases in the basin.

[i] Hatchery coho salmon are no longer released in the basin; hatchery fish in these basins appear to be strays from other programs.

[j] Comprised of early coho (type S) released in the NF Toutle and Green Rivers from the NF Toutle Hatchery.

[k] 25,000 summer steelhead are also released in each of the North and South Toutle.

[l] 25,000 summer steelhead are also released in each of the North and South Toutle.

3.6.2 *Harvest*

Fishing generally affects salmon populations through directed and incidental harvest, catch and release mortality, and size, age, and run timing alterations because of uneven fishing on different run components. From a population biology perspective, this results in fewer spawners and can alter age, size, run timing, fecundity, and genetic characteristics. Fewer spawners result in fewer eggs for future generations and diminish marine-derived nutrients delivered via dying adults, now known to be significant to the growth and survival of juvenile salmon in aquatic ecosystems. The degree to which harvest-related limiting factors influence productivity varies by species and location.

Most harvest of wild Columbia River salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. Fish are caught in the Canada/Alaska ocean, U.S. West Coast ocean, lower Columbia River commercial and recreational, tributary recreational, and in-river treaty Indian (including commercial, ceremonial, and subsistence) fisheries. Total exploitation rates have decreased for lower Columbia salmon and steelhead, especially since the 1970s as increasingly stringent protection measures were adopted for declining natural populations.

Current fishing impact rates on lower Columbia River naturally-spawning salmon populations ranges from 2.5% for chum salmon to 45% for tule fall Chinook (Table 9). These rates include estimates of direct harvest mortality as well as estimates of incidental mortality in catch and release fisheries. Fishery impact rates for hatchery produced spring Chinook, coho, and steelhead are higher than for naturally-spawning fish of the same species because of selective fishing regulations. These rates generally reflect recent year (2001-2003) fishery regulations and quotas controlled by weak stock impact limits and annual abundance of healthy targeted fish. Actual harvest rates will vary for each year dependent on annual stock status of multiple west coast salmon populations, however, these rates generally reflect expected impacts of harvest on lower Columbia naturally-spawning and hatchery salmon and steelhead under current harvest management plans.

Table 9. Approximate annual exploitation rates (% harvested) for naturally-spawning lower Columbia salmon and steelhead under current management controls (represents 2001-2003 fishing period).

	AK./Can. Ocean	West Coast Ocean	Col. R. Comm.	Col. R. Sport	Trib. Sport	**Wild Total**	Hatchery Total	Historic Highs
Spring Chinook	13	5	1	1	2	**22**	53	65
Fall Chinook (Tule)	15	15	5	5	5	**45**	45	80
Fall Chinook (Bright)	19	3	6	2	10	**40**	Na	65
Chum	0	0	1.5	0	1	**2.5**	2.5	60
Coho	<1	9	6	2	1	**18**	51	85
Steelhead	0	<1	3	0.5	5	**8.5**	70	75

Columbia River fall Chinook are subject to freshwater and ocean fisheries from Alaska to their rivers of origin in fisheries targeting abundant Chinook stocks originating from Alaska, Canada, Washington, Oregon, and California. Columbia tule fall Chinook harvest is constrained by a Recovery Exploitation Rate (RER) developed by NOAA Fisheries for management of Coweeman naturally-spawning fall Chinook. Some In-basin sport fisheries are closed to the retention of Chinook to protect natural spawning populations. Harvest of lower Columbia bright fall Chinook is managed to achieve an escapement goal of 5,700 natural spawners in the North Fork Lewis.

Rates are very low for chum salmon, which are not encountered by ocean fisheries and return to freshwater in late fall when significant Columbia River commercial fisheries no longer occur. Chum are no longer targeted in Columbia commercial seasons and retention of chum is prohibited in Columbia River and Toutle River sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead.

Harvest of Toutle coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River as well as recreational fisheries in the Toutle basin. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish.

Steelhead, like chum, are not encountered by ocean fisheries and non-Indian commercial steelhead fisheries are prohibited in the Columbia River. Incidental mortality of steelhead occurs in freshwater commercial fisheries directed at Chinook and coho and freshwater sport fisheries directed at hatchery steelhead and salmon. All recreational fisheries are managed to selectively harvest fin-marked hatchery steelhead and commercial fisheries cannot retain hatchery or wild steelhead. Toutle basin sport fisheries are open to selective harvest of hatchery summer steelhead and closed during the winter when wild winter steelhead return.

Access to harvestable surpluses of strong stocks in the Columbia River and ocean is regulated by impact limits on weak populations mixed with the strong. Weak stock management of Columbia River fisheries became increasingly prevalent in the 1960s and 1970s in response to continuing declines of upriver runs affected by mainstem dam construction. In the 1980s coordinated ocean and freshwater weak stock management commenced. More fishery restrictions followed ESA listings in the 1990s. Each fishery is controlled by a series of regulating factors. Many of the regulating factors that affect harvest impacts on Columbia River stocks are associated with treaties, laws, policies, or guidelines established for the management of other stocks or combined stocks, but indirectly control impacts of Columbia River fish as well. Listed fish generally comprise a small percentage of the total fish caught by any fishery. Every listed fish may correspond to tens, hundreds, or thousands of other stocks in the total catch. As a result of weak stock constraints, surpluses of hatchery and strong naturally-spawning runs often go unharvested. Small reductions in fishing rates on listed populations can translate to large reductions in catch of other stocks and recreational trips to communities which provide access to fishing, with significant economic consequences.

Selective fisheries for adipose fin-clipped hatchery spring Chinook (since 2001), coho (since 1999), and steelhead (since 1984) have substantially reduced fishing mortality rates for naturally-spawning populations and allowed concentration of fisheries on abundant hatchery fish. Selective fisheries occur in the Columbia River and tributaries, for spring Chinook and steelhead, and in the ocean, Columbia River, and tributaries for coho. Columbia River hatchery fall Chinook are not marked for selective fisheries, but likely will be in the future because of recent legislation enacted by Congress.

3.6.3 *Mainstem and Estuary Habitat*

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. Juvenile and adult salmon may be found in the mainstem and estuary at all times of the year, as different species, life history strategies and size classes continually rear or move through these waters. A variety of human activities in the mainstem and estuary have decreased both the quantity and quality of habitat used by juvenile salmonids. These include floodplain development; loss of side channel habitat, wetlands and marshes; and alteration of flows due to upstream hydro operations and irrigation withdrawals.

Effects on salmonids of habitat changes in the mainstem and estuary are complex and poorly understood. Effects are similar for Toutle populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook which rear for extended periods in the mainstem and estuary than for steelhead and coho which move through more quickly. Estimates of the impacts of human-caused changes in mainstem and estuary habitat conditions are available based on changes in river flow, temperature, and predation as represented by EDT analyses for the NPCC Multispecies Framework Approach (Marcot et al. 2002). These estimates generally translate into a 10-60% reduction in salmonid productivity depending on species (Appendix E). Estuary effects are described more fully in the estuary subbasin volume of this plan (Volume II-A).

3.6.4 *Hydropower Construction and Operation*

There are no hydro-electric dams in the Toutle River Basin. However, Toutle species are affected by changes in Columbia River mainstem and estuary related to Columbia basin hydropower development and operation. The mainstem Columbia River and estuary provide important habitats for anadromous species during juvenile and adult migrations between spawning and rearing streams and the ocean where they grow and mature. These habitats are particularly important for fall Chinook and chum which rear extensively in the Columbia mainstem and estuary. Aquatic habitats have been fundamentally altered throughout the Columbia River basin by the construction and operation of a complex of tributary and mainstem dams and reservoirs for power generation, navigation, and flood control.

The hydropower infrastructure and flow regulation affects adult migration, juvenile migration, mainstem spawning success, estuarine rearing, water temperature, water clarity, gas supersaturation, and predation. Dams block or impede passage of anadromous juveniles and adults. Columbia River spring flows are greatly reduced from historical levels as water is stored for power generation and irrigation, while summer and winter flows have increased. These flow changes affect juvenile and adult migration, and have radically altered habitat forming processes. Flow regulation and reservoir construction have increased average water temperature in the Columbia River mainstem and summer temperatures regularly exceed optimums for salmon. Supersaturation of water with atmospheric gases, primarily nitrogen, when water is spilled over high dams causes gas bubble disease. Predation by fish, bird, and marine mammals has been exacerbated by habitat changes. The net effect of these direct and indirect effects is difficult to quantify but is expected to be less significant for populations originating from lower Columbia River subbasins than for upriver salmonid populations. Additional information on hydropower effects can be found in the Regional Recovery and Subbasin Plan Volume I.

3.6.5 *Ecological Interactions*

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Salmon and steelhead are affected throughout their lifecycle by ecological interactions with non native species, food web components, and predators. Each of these factors can be exacerbated by human activities either by direct actions or indirect effects of habitat alternation. Effects of non-native species on salmon, effects of salmon on system productivity, and effects of native predators on salmon are difficult to quantify. Strong evidence exists in the scientific literature on the potential for significant interactions but effects are often context- or case-specific.

Predation is one interaction where effects can be estimated although interpretation can be complicated. In the lower Columbia River, northern pikeminnow, Caspian tern, and marine mammal predation on salmon has been estimated at approximately 5%, 10-30%, and 3-12%, respectively of total salmon numbers (see Appendix E for additional details). Predation has always been a source of salmon mortality but predation rates by some species have been exacerbated by human activities.

3.6.6 *Ocean Conditions*

Salmonid numbers and survival rates in the ocean vary with ocean conditions and low productivity periods increase extinction risks of populations stressed by human impacts. The ocean is subject to annual and longer-term climate cycles just as the land is subject to periodic droughts and floods. The El Niño weather pattern produces warm ocean temperatures and warm, dry conditions throughout the Pacific Northwest. The La Niña weather pattern is typified by cool ocean temperatures and cool/wet weather patterns on land. Recent history is dominated by a high frequency of warm dry years, along with some of the largest El Niños on record—particularly in 1982-83 and 1997-98. In contrast, the 1960s and early 1970s were dominated by a cool, wet regime. Many climatologists suspect that the conditions observed since 1998 may herald a return to the cool wet regime that prevailed during the 1960s and early 1970s.

Abrupt declines in salmon populations throughout the Pacific Northwest coincided with a regime shift to predominantly warm dry conditions from 1975 to 1998 (Beamish and Bouillon 1993, Hare et al 1999, McKinnell et al. 2001, Pyper et al. 2001). Warm dry regimes result in generally lower survival rates and abundance, and they also increase variability in survival and wide swings in salmon abundance. Some of the largest Columbia River fish runs in recorded history occurred during 1985–1987 and 2001–2002 after strong El Niño conditions in 1982–83 and 1997–98 were followed by several years of cool wet conditions.

The reduced productivity that accompanied an extended series of warm dry conditions after 1975 has, together with numerous anthropogenic impacts, brought many weak Pacific Northwest salmon stocks to the brink of extinction and precipitated widespread ESA listings. Salmon numbers naturally ebb and flow as ocean conditions vary. Healthy salmon populations are productive enough to withstand these natural fluctuations. Weak salmon populations may disappear or lose the genetic diversity needed to withstand the next cycle of low ocean productivity (Lawson 1993).

Recent improvements in ocean survival may portend a regime shift to generally more favorable conditions for salmon. The large spike in recent runs and a cool, wet climate would provide a respite for many salmon populations driven to critical low levels by recent conditions. The National Research Council (1996) concluded: *"Any favorable changes in ocean conditions—which could occur and could increase the productivity of some salmon populations for a time—should be regarded as opportunities for improving management techniques. They should not be regarded as reasons to abandon or reduce rehabilitation efforts, because conditions will change again"*. Additional details on the nature and effects of variable ocean conditions on salmonids can be found in the Regional Recovery and Subbasin Plan Volume I.

3.7 Summary of Human Impacts on Salmon and Steelhead

Stream habitat, estuary/mainstem habitat, harvest, hatchery and ecological interactions have all contributed to reductions in productivity, numbers, and population viability. Pie charts in Figure 18 describe the relative magnitude of potentially-manageable human impacts in each category of limiting factor for Toutle Basin salmon and steelhead. Impact values were developed for a base period corresponding to species listing dates. This depiction is useful for identifying which factors are most significant for each species and where improvements might be expected to provide substantial benefits. Larger pie slices indicate greater significance and scope for improvement in an impact for a given species. These numbers also serve as a working hypothesis for factors limiting salmonid numbers and viability.

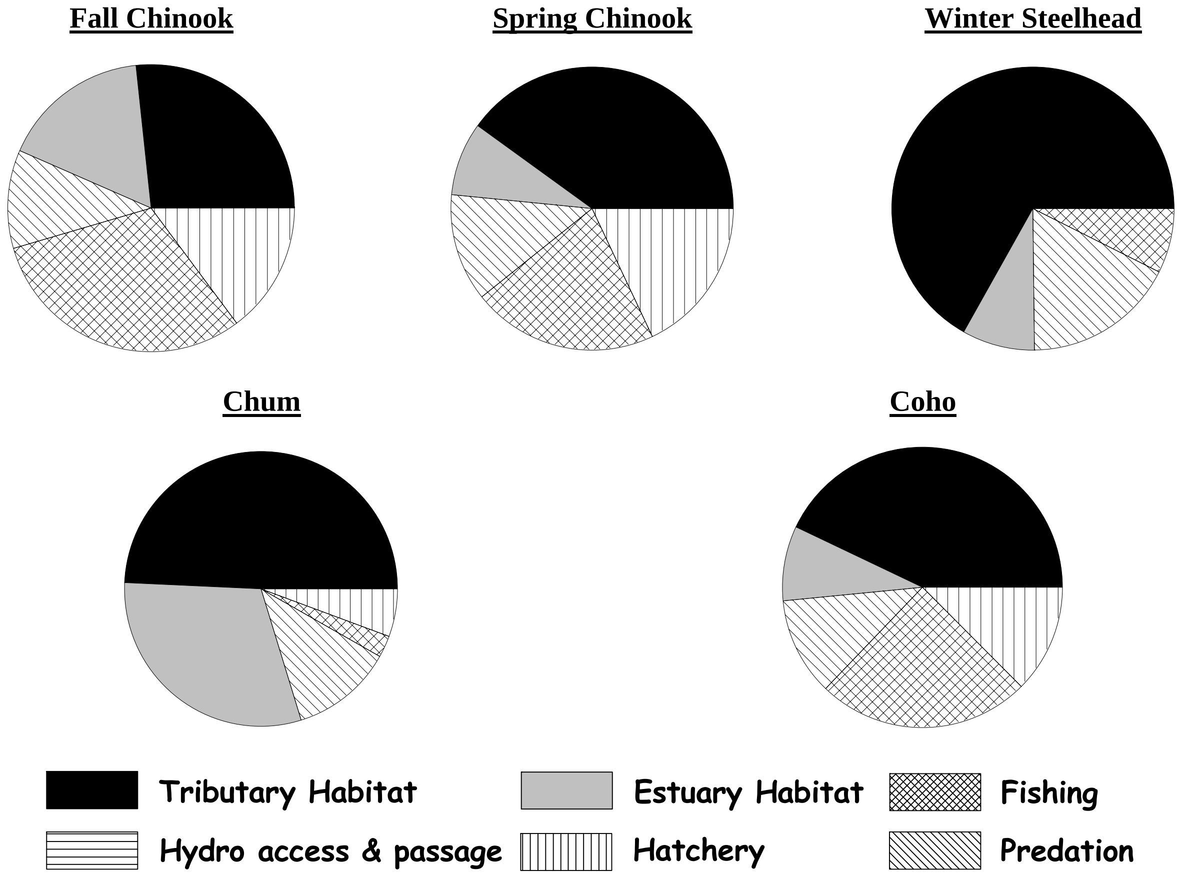


Figure 18. Relative contribution of potentially manageable impacts on Toutle River salmonid populations.

This assessment indicates that current salmonid status is the result of large impacts distributed among several factors. No single factor accounts for a majority of effects on all species. Thus, substantial improvements in salmonid numbers and viability will require significant improvements in several factors. Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species except for fall Chinook for which harvest effects dominate. Fishing impacts are of high importance for fall and spring Chinook and coho, of moderate importance for winter steelhead and of low importance for chum. Loss of estuary habitat quality and quantity is also relatively important for fall Chinook and chum and less important for spring Chinook, coho and winter steelhead. Hatchery impacts are moderate for fall

Chinook, spring Chinook, and coho; relatively low for chum and virtually nil for winter steelhead. Predation impacts are moderate for all species. Hydrosystem access and passage impacts appear to be relatively minor for all species.

Impacts were defined as the proportional reduction in average numbers or productivity associated with each effect. Tributary and estuary habitat impacts are the differences between the pre-development historical baseline and current conditions. Hydro impacts identify the percentage of historical habitat blocked by impassable dams and the mortality associated with juvenile and adult passage of other dams. Fishing impacts are the direct and indirect mortality in ocean and freshwater fisheries. Hatchery impacts include the equilibrium effects of reduced natural population productivity caused by natural spawning of less-fit hatchery fish and also effects of inter-specific predation by larger hatchery smolts on smaller wild juveniles. Hatchery impacts do not include other potentially negative indirect effects or potentially beneficial effects of augmentation of natural production. Predation includes mortality from northern pikeminnow, Caspian terns, and marine mammals in the Columbia River mainstem and estuary. Predation is not a direct human impact but was included because of widespread interest in it’s relative significance. Methods and data for these analyses are detailed in Appendix E.

Potentially-manageable human impacts were estimated for each factor based on the best available scientific information. Proportions are standardized to a total of 1.0 for plotting purposes. The index is intended to illustrate order-of-magnitude rather than fine-scale differences. Only the subset of factors we can potentially manage were included in this index – natural mortality factors beyond our control (e.g. naturally-occuring ocean mortality) are excluded. Not every factor of interest is included in this index – only readily-quantifiable impacts are included.

4.0 Key Programs and Projects

This section provides brief summaries of current federal, state, local, and non-governmental programs and projects pertinent to recovery, management, and mitigation measures and actions in this basin. These decriptions provide a context for descriptions of specific actions and responsibilities in the management plan portion of this subbasin plan. More detailed descriptions of these programs and projects can be found in the Comprehensive Program Directory (Appendix C).

4.1 Federal Programs

4.1.1 *NOAA Fisheries*

NOAA Fisheries is responsible for conserving, protecting and managing pacific salmon, ground fish, halibut, marine mammals and habitats under the Endangered Species Act, the Marine Mammal Protection Act, the Magnuson-Stevens Act, and enforcement authorities. NOAA administers the ESA under Section 4 (listing requirements), Section 7 (federal actions), and Section 10 (non-federal actions).

4.1.2 *US Army Corps of Engineers*

The U.S. Army Corps of Engineers (USACE) is the Federal government’s largest water resources development and management agency. USACE programs applicable to Lower Columbia Fish & Wildlife include: 1) Section 1135 – provides for the modification of the structure or operation of a past USACE project, 2) Section 206 – authorizes the implementation of aquatic ecosystem restoration and protection projects, 3) Hydroelectric Program – applies to the construction and operation of power facilities and their environmental impact, 4) Regulatory Program – administration of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act.

4.1.3 *Environmental Protection Agency*

The Environmental Protection Agency (EPA) is responsible for the implementation of the Clean Water Act (CWA). The broad goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation’s waters so that they can support the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water. The CWA requires that water quality standards (WQS) be set for surface waters. WQS are aimed at translating the broad goals of the CWA into waterbody-specific objectives and apply only to the surface waters (rivers, lakes, estuaries, coastal waters, and wetlands) of the United States.

4.1.4 *United States Forest Service*

The Unites States Forest Service (USFS) manages federal forest lands within the Gifford Pinchot National Forest (GPNF) and the Mount Saint Helens National Volcanic Monument. The GPNF operates under the Gifford Pinchot Forest Plan (GPFP). Management prescriptions within the GPFP have been guided by the 1994 Northwest Forest Plan, which calls for management of forests according to a suite of management designations including Reserves (e.g. late successional forests, riparian forests), Adaptively-Managed Areas, and Matrix Lands. Most timber harvest occurs in Matrix Lands. The GPNF implements a wide range of ecosystem restoration activities. Lands within the Mount St. Helens National Volcanic Monument are managed for protection and passive restoration of ecosystem processes.

4.1.5 *Natural Resources Conservation Service*

Formerly the Soil Conservation Service, the USDA Natural Resources Conservation Service (NRCS) works with landowners to conserve natural resources on private lands. The NRCS accomplishes this through various programs including, but not limited to, the Conservation Technical Assistance Program, Soil Survey Program, Conservation Reserve Enhancement Program, and the Wetlands Reserve Program. The NRCS works closely with local Conservation Districts; providing technical assistance and support.

4.1.6 *Northwest Power and Conservation Council*

The Northwest Power and Conservation Council, an interstate compact of Idaho, Montana, Oregon, and Washington, has specific responsibility in the Northwest Power Act of 1980 to mitigate the effects of the hydropower system on fish and wildlife of the Columbia River Basin. The Council does this through its Columbia River Basin Fish and Wildlife Program, which is funded by the Bonneville Power Administration. Beginning in Fiscal Year 2006, funding is guided by locally developed subbasin plans that are expected to be formally adopted in the Council’s Fish and Wildlife Program in December 2004.

4.2 State Programs

4.2.1 *Washington Department of Natural Resources*

The Washington Department of Natural Resources governs forest practices on non-federal lands and is steward to state owned aquatic lands. Management of DNR public forest lands is governed by tenets of their proposed Habitat Conservation Plan (HCP). Management of private industrial forestlands is subject to Forest Practices regulations that include both protective and restorative measures.

4.2.2 *Washington Department of Fish & Wildlife*

WDFW’s Habitat Division supports a variety of programs that address salmonids and other wildlife and resident fish species. These programs are organized around habitat conditions (Science Division, Priority Habitats and Species, and the Salmon and Steelhead Habitat Inventory and Assessment Program); habitat restoration (Landowner Incentive Program, Lead Entity Program, and the Conservation and Reinvestment Act Program, as well as technical assistance in the form of publications and technical resources); and habitat protection (Landowner Assistance, GMA, SEPA planning, Hydraulic Project Approval, and Joint Aquatic Resource Permit Applications).

4.2.3 *Washington Department of Ecology*

The Department of Ecology (DOE) oversees: the Water Resources program to manage water resources to meet current and future needs of the natural environment and Washington’s communities; the Water Quality program to restore and protect Washington’s water supplies by preventing and reducing pollution; and Shoreline and the Environmental Assistance program for implementing the Shorelines Management Act, the State Environmental Protection Act, the Watershed Planning Act, and 401 Certification of ACOE Permits.

4.2.4 *Washington Department of Transportation*

The Washington State Department of Transportation (WSDOT) must ensure compliance with environmental laws and statutes when designing and executing transportation projects. Programs that consider and mitigate for impacts to salmonid habitat include: the Fish Passage

Barrier Removal program; the Regional Road Maintenance ESA Section 4d Program, the Integrated Vegetation Management & Roadside Development Program; Environmental Mitigation Program; the Stormwater Retrofit Program; and the Chronic Environmental Deficiency Program.

4.2.5 *Interagency Committee for Outdoor Recreation*

Created through the enactment of the Salmon Recovery Act (Washington State Legislature, 1999), the Salmon Recovery Funding Board provides grant funds to protect or restore salmon habitat and assist related activities with local watershed groups known as lead entities. SRFB has helped finance over 500 salmon recovery projects statewide. The Aquatic Lands Enhancement Account (ALEA) was established in 1984 and is used to provide grant support for the purchase, improvement, or protection of aquatic lands for public purposes, and for providing and improving access to such lands. The Washington Wildlife and Recreation Program (WWRP), established in 1990 and administered by the Interagency Committee for Outdoor Recreation, provides funding assistance for a broad range of land protection, park development, preservation/conservation, and outdoor recreation facilities.

4.2.6 *Lower Columbia Fish Recovery Board*

The Lower Columbia Fish Recovery Board encompasses five counties in the Lower Columbia River Region. The 15-member board has four main programs, including habitat protection and restoration activities, watershed planning for water quantity, quality, habitat, and instream flows, facilitating the development of an integrated recovery plan for the Washington portion of the lower Columbia Evolutionarily Significant Units, and conducting public outreach activities.

4.3 Local Government Programs

4.3.1 *Cowlitz County*

Cowlitz County updated its Comprehensive Plan to the minimum requirements of the Growth Management Act (GMA) by adding a Critical Areas Ordinance (CAO) in 1996, but it is not fully planning under the GMA. Cowlitz County manages natural resources primarily through its CAO.

4.3.2 *Cowlitz / Wahkiakum Conservation District*

The Cowlitz/Wahkiakum CD provides technical assistance, cost-share assistance, project and water quality monitoring, community involvement and education, and support of local stakeholder groups within the two county service area. The CD is involved in a variety of projects, including fish passage, landowner assistance an environmental incentive program an education program, and water quality monitoring.

4.4 Non-governmental Programs

4.4.1 *Columbia Land Trust*

The Columbia Land Trust is a private, non-profit organization founded in 1990 to work exclusively with willing landowners to find ways to conserve the scenic and natural values of the land and water. Landowners donate the development rights or full ownership of their land to the Land Trust. CLT manages the land under a stewardship plan and, if necessary, will legally defend its conservation values.

4.4.2 *Lower Columbia Fish Enhancement Group*

The Washington State Legislature created the Regional Fisheries Enhancement Group Program in 1990 to involve local communities, citizen volunteers, and landowners in the state's salmon recovery efforts. RFEGs help lead their communities in successful restoration, education and monitoring projects. Every group is a separate, nonprofit organization led by their own board of directors and operational funding from a portion of commercial and recreational fishing license fees administered by the WDFW, and other sources. The mission of the Lower Columbia RFEG (LCFEG) is to restore salmon runs in the lower Columbia River region through habitat restoration, education and outreach, and developing regional and local partnerships.

4.5 NPCC Fish & Wildlife Program Projects

There are no NPCC Fish & Wildlife Program Projects in the Toutle River Basin.

4.6 Washington Salmon Recovery Funding Board Projects

Type	Project Name	Subbasin
Acquisition	So. Fork Toutle	Toutle

5.0 Management Plan

5.1 Vision

> ***Washington lower Columbia salmon, steelhead, and bull trout are recovered to healthy, harvestable levels that will sustain productive sport, commercial, and tribal fisheries through the restoration and protection of the ecosystems upon which they depend and the implementation of supportive hatchery and harvest practices.***
>
> ***The health of other native fish and wildlife species in the lower Columbia will be enhanced and sustained through the protection of the ecosystems upon which they depend, the control of non-native species, and the restoration of balanced predator/prey relationships.***

The Toutle Subbasin will play a key role in the regional recovery of salmon and steelhead. Natural populations of winter steelhead and coho will be restored to high levels of viability by significant reductions in human impacts throughout the lifecycle. Salmonid recovery efforts will provide broad ecosystem benefits to a variety of subbasin fish and wildlife species. Recovery will be accomplished through a combination of improvements in subbasin, Columbia River mainstem, and estuary habitat conditions as well as careful management of hatcheries, fisheries, and ecological interations among species.

Habitat protection or restoration will involve a wide range of Federal, State, Local, and non-governmental programs and projects. Success will depend on effective programs as well as a dedicated commitment to salmon recovery across a broad section of society.

Some hatchery programs will be realigned to focus on protection, conservation, and recovery of native fish. The need for hatchery measures will decrease as productive natural habitats are restored. Where consistent with recovery, other hatchery programs will continue to provide fish for fishery benefits for mitigation purposes in the interim until habitat conditions are restored to levels adequate to sustain healthy, harvestable natural populations.

Directed fishing on sensitive wild populations will be eliminated and incidental impacts of mixed stock fisheries in the Columbia River and ocean will be regulated and limited consistent with wild fish recovery needs. Until recovery is achieved, fishery opportunities will be focused on hatchery fish and harvestabable surpluses of healthy wild stocks.

Columbia basin hydropower effects on Toutle subbasin salmonids will be addressed by mainstem Columbia and estuary habitat restoration measures. Hatchery facilities in the Toutle River will also be called upon to produce fish to help mitigate for hydropower impacts on upriver stocks where compatible with wild fish recovery.

This plan uses a planning period or horizon of 25 years. The goal is to achieve recovery of the listed salmon species and the biological objectives for other fish and wildlife species of interest within this time period. It is recognized, however, that sufficient restoration of habitat conditions and watershed processes for all species of interest will likely take 75 years or more.

5.2 Biological Objectives

Biological objectives for Toutle subbasin salmonid populations are based on recovery criteria developed by scientists on the Willamette/Lower Columbia Technical Recovery Team convened by NOAA Fisheries. Criteria involve a hierarchy of ESU, Strata (i.e. ecosystem areas within the ESU – Coast, Cascade, and Gorge), and Population standards. A recovery scenario describing population-scale biological objectives for all species in all three strata in the lower Columbia ESUs was developed through a collaborative process with stakeholders based on biological significance, expected progress as a result of existing programs, the absence of apparent impediments, and the existence of other management opportunities. Under the preferred alternative, individual populations will variously contribute to recovery according to habitat quality and the population's perceived capacity to rebuild. Criteria, objectives, and the regional recovery scenario are described in greater detail in the Regional Recovery and Subbasin Plan Volume I.

Focal populations in the Toutle subbasin are targeted to improve to a level that contributes to recovery of the species. The scenario differentiates the role of populations by designating primary, contributing, and stabilizing categories. Primary populations are those that would be restored to high or better probabilities of persistence. Contributing populations are those where low to medium improvements will be needed to achieve stratum-wide average of moderate persistence probability. Stabilizing populations are those maintained at current levels.

Recovery goals call for restoring coho and winter steelhead to a high level of viability in the NF Toutle River and coho to high and winter steelhead to greater then a high level of viability in the SF Toutle River spring Chinook to a medium level of viability; and maintaining fall Chinook at a low level of viability. Chum, as part of the lower Cowlitz population, are targeted for a medium level of viability. The high target level will provide for a 95% or better probability of coho and winter steelhead populations survival over 100 years. Cutthroat will benefit from improvements in stream habitat conditions for anadromous species. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and Toutle subbasin although specific spawning and rearing habitat requirements are not well known. Bull trout do not occur in the subbasin.

Table 10. Current viability status of North Fork Toutle populations and the biological objective status that is necessary to meet the recovery criteria for the Cascade strata and the lower Columbia ESU.

	ESA	Hatchery	Current		Objective	
Species	**Status**	**Component**	**Viability**	**Numbers**	**Viability**	**Numbers**
Fall Chinook	Threatened	Yes	Low	300-5,000	Low[S]	1,000
Winter steelhead	Threatened	No	Low	100-300	High[P]	700
Coho	Candidate	Yes	Low	unknown	High[P]	600
Chum(a)	Threatened	No	Very Low	<150	Medium[C]	150-1,100

(a) Includes chum from the entire lower Cowlitz subbasin
P = primary population in recovery scenario
C = contributing population in recovery scenario
S = stabilizing population in recovery scenario

Table 11. Current viability status of South Fork Toutle populations and the biological objective status that is necessary to meet the recovery criteria for the Cascade strata and the lower Columbia ESU.

	ESA	Hatchery	Current		Objective	
Species	Status	Component	Viability	Numbers	Viability	Numbers
Spring Chinook	Threatened	No	Very Low	<200	Med^{C}	150-1,400
Winter Steelhead	Threatened	Yes	Med	200-2,500	High+^{P}	1,400-1,900
Coho	Candidate	No	Low	unknown	High^{P}	600

P = primary population in recovery scenario
C = contributing population in recovery scenario
S = stabilizing population in recovery scenario

5.3 Integrated Strategy

An Integrated Regional Strategy for recovery emphasizes that 1) it is feasible to recover Washington lower Columbia natural salmon and steelhead to healthy and harvestable levels; 2) substantial improvements in salmon and steelhead numbers, productivity, distribution, and diversity will be required; 3) recovery cannot be achieved based solely on improvements in any one factor; 4) existing programs are insufficient to reach recovery goals, 5) all manageable effects on fish and habitat conditions must contribute to recovery, 6) actions needed for salmon recovery will have broader ecosystem benefits for all fish and wildlife species of interest, and 7) strategies and measures likely to contribute to recovery can be identified but estimates of the incremental improvements resulting from each specific action are highly uncertain. The strategy is described in greater detail in the Regional Recovery and Subbasin Plan Volume I.

The Integrated Strategy recognizes the importance of implementing measures and actions that address each limiting factor and risk category, prescribing improvements in each factor/threat category in proportion to its magnitude of contribution to salmon declines, identifying an appropriate balance of strategies and measures that address regional, upstream, and downstream threats, and focusing near term actions on species at-risk of extinction while also ensuring a long term balance with other species and the ecosystem.

Population productivity improvement increments identify proportional improvements in productivity needed to recover populations from current status to medium, high, and very high levels of population viability consistent with the role of the population in the recovery scenario. Productivity is defined as the inherent population replacement rate and is typically expressed by models as a median rate of population increase (PCC model) or a recruit per spawner rate (EDT model). Corresponding improvements in spawner numbers, juvenile outmigrants, population spatial structure, genetic and life history diversity, and habitat are implicit in productivity improvements.

Improvement targets were developed for each impact factor based on desired population productivity improvements and estimates of potentially manageable impacts (see Section 3.7). Impacts are estimates of the proportional reduction in population productivity associated with human-caused and other potentially manageable impacts from stream habitats, estuary/mainstem habitats, hydropower, harvest, hatcheries, and selected predators. Reduction targets were driven by the regional strategy of equitably allocating recovery responsibilities among the six manageable impact factors. Given the ultimate uncertainty in the effects of recovery actions and the need to implement an adaptive recovery program, this approximation should be adequate for developing order-of-magnitude estimates to which recovery actions can be scaled consistent with the current best available science and data. Objectives and targets will need to be confirmed or refined during plan implementation based on new information and refinements in methodology.

The following table identifies population and factor-specific improvements consistent with the biological objectives for this subbasin. Per factor increments are less than the population net because factor affects are compounded at different life stages and density dependence is largely limited to freshwater tributary habitat. For example, productivity of SF Toutle River winter steelhead must increase by 80% to reach population viability goals. This requires impact reductions equivalent to a 14% improvement in productivity or survival for each of six factor categories. Thus, tributary habitat impacts on fall Chinook must decrease from 82% to 79% impact in order to achieve the required 14% increase in tributary habitat productivity potential from the current 18% of the historical potential to 21% of the historical potential.

Table 12. Productivity improvements consistent with biological objectives for the Toutle subbasin.

	Net	Per	Baseline impacts					
Species	**increase**	**factor**	**Trib.**	**Estuary**	**Hydro.**	**Pred.**	**Harvest**	**Hatch.**
Fall Chinook	0%	0%	0.56	0.36	0.00	0.23	0.65	0.31
Spring Chinook	--	--	1.00	0.20	0.00	0.31	0.53	0.45
Chum 1/	40%	2%	0.96	0.59	0.00	0.23	0.05	0.11
Coho	na	na	na	na	na	na	na	na
Winter Steelhead								
South Fork	80%	14%	0.82	0.11	0.00	0.24	0.10	0.01
North Fork	10%	1%	0.90	0.11	0.00	0.24	0.10	0.00

1/ data is from lower Cowlitz River

5.4 Tributary Habitat

Habitat assessment results were synthesized in order to develop specific prioritized measures and actions that are believed to offer the greatest opportunity for species recovery in the subbasin. As a first step toward measure and action development, habitat assessment results were integrated to develop a multi-species view of 1) priority areas, 2) factors limiting recovery, and 3) contributing land-use threats. For the purpose of this assessment, limiting factors are defined as the biological and physical conditions serving to suppress salmonid population performance, whereas threats are the land-use activities contributing to those factors. Limiting Factors refer to local (reach-scale) conditions believed to be directly impacting fish. Threats, on the other hand, may be local or non-local. Non-local threats may impact instream limiting factors in a number of ways, including: 1) through their effects on habitat-forming processes – such as the case of forest road impacts on reach-scale fine sediment loads, 2) due to an impact in a contributing stream reach – such as riparian degradation reducing wood recruitment to a downstream reach, or 3) by blocking fish passage to an upstream reach.

Priority areas and limiting factors were determined through the technical assessment, including primarily EDT analysis and the Integrated Watershed Assessment (IWA). As described later in this section, priority areas are also determined by the relative importance of subbasin focal fish populations to regional recovery objectives. This information allows for scaling of subbasin recovery effort in order to best accomplish recovery at the regional scale. Land-use threats were determined from a variety of sources including Washington Conservation Commission Limiting Factors Analyses, the IWA, the State 303(d) list, air photo analysis, the Barrier Assessment, personal knowledge of investigators, or known cause-effect relationships between stream conditions and land-uses.

Priority areas, limiting factors and threats were used to develop a prioritized suite of habitat measures. Measures are based solely on biological and physical conditions. For each measure, the key programs that address the measure are identified and the sufficiency of existing programs to satisfy the measure is discussed. The measures, in conjunction with the program sufficiency considerations, were then used to identify specific actions necessary to fill gaps in measure implementation. Actions differ from measures in that they address program deficiencies as well as biophysical habitat conditions. The process for developing measures and actions is illustrated in Figure 19 and each component is presented in detail in the sections that follow.

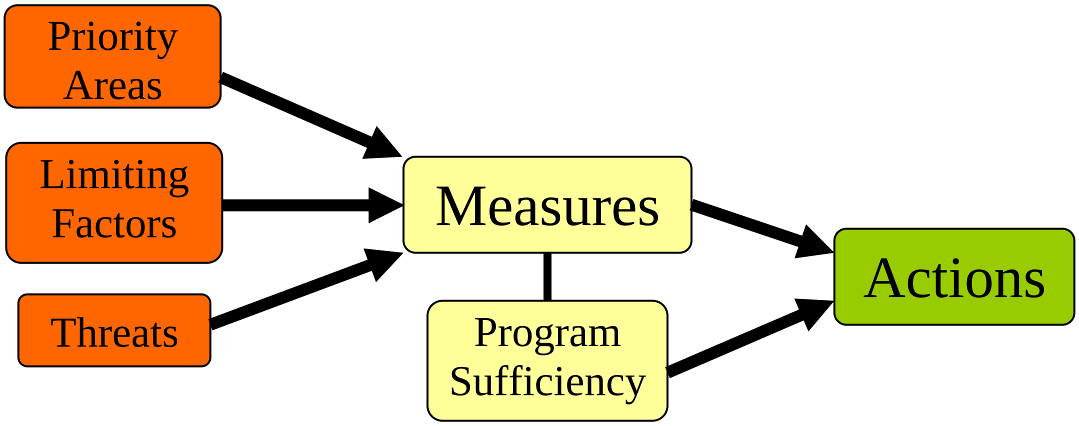


Figure 19. Flow chart illustrating the development of subbasin measures and actions.

5.4.1 *Priority Areas, Limiting Factors and Threats*

Priority habitat areas and factors in the subbasin are discussed below in two sections. The first section contains a generalized (coarse-scale) summary of conditions throughout the basin. The second section is a more detailed summary that presents specific reach and subwatershed priorities.

Summary

Decades of natural processes and human activity in the Toutle River Basin have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Moreover, with the exception of fall Chinook, stream habitat conditions within the Toutle Basin have a high impact on the health and viability of salmon and steelhead relative to other limiting factors. The following bullets provide a brief overview of each of the priority areas in the basin. These descriptions are a summary of the reach-scale priorities that are presented in the next section. These descriptions summarize the species most affected, the primary limiting factors, the contributing land-use threats, and the general type of measures that will be necessary for recovery. A tabular summary of the key limiting factors and land-use threats can be found in Table 13.

- **Lower Toutle Mainstem** *(reaches Toutle 1-5)* – Potentially productive habitats for fall Chinook, chum, and coho exist in the lower few miles of the lower mainstem Toutle. These reaches were heavily impacted by mud and debris flows during the 1980 Mount St. Helens eruption. Further degradation to channel, riparian, and floodplain conditions was caused by channel dredging and floodplain spoils placement in an effort to increase flow conveyance following the eruption. Effective recovery measures will entail reducing channel confinement and restoring riparian areas.
- **Lower North Fork and South Fork Toutle** *(reaches NF Toutle 1-2; SF Toutle 1-3)* – The lower SF Toutle up to approximately Brownell Creek and the NF Toutle just upstream of the SF confluence (reach NF Toutle 1-2) have good current and potential habitat for coho and fall Chinook. These reaches also support winter steelhead, but to a lesser degree. The SF was heavily impacted by the 1980 eruption, but less so than the NF. These reaches have recovered significantly over the past 24 years. The recovery emphasis in these reaches is for restoration as well as preservation actions. Floodplain and riparian restoration will need to be combined with recovery of functioning watershed process conditions.
- **Upper South Fork Toutle** *(reaches SF Toutle 4-20)* – The upper SF Toutle provides important habitat for winter steelhead and fall Chinook. These reaches have experienced rapid recovery since the 1980 eruption and subsequent heavy timber harvests. They have strong preservation value in addition to restoration value.
- **North Fork Toutle** *(reaches NF Toutle 6-13)* – The NF Toutle historically provided productive habitat for winter steelhead, spring Chinook, and coho. Fall Chinook may also have utilized these reaches to some degree. The reaches with the most potential are located just downstream of the Green River confluence and further upstream on the NF between Hoffstadt Creek and Castle Creek (reach NF Toutle 13). Volitional passage is currently blocked just upstream of the Green River confluence by the SRS, created to retain eruption-related sediments following the 1980 eruption. NF Toutle reaches were

severely impacted by mud and debris flows during the 1980 eruption, followed by intensive road building and timber harvests. The recovery emphasis is for restoration of watershed processes throughout the NF basin including addressing the dense road network and heavy harvests. Emphasis should also be placed on addressing the continued supply of sediment from the SRS, which has become a persistent limiting factor for fish in downstream reaches.

- **Green River** *(reaches Green River 1-9)* – Green River reaches contain important current and potential production for winter steelhead, fall Chinook, and coho, especially between Cascade Creek and Elk Creek. These reaches were spared the severe impacts from the 1980 eruption that most of the Toutle system experienced. These reaches are most impacted by forestry practices. The recovery emphasis here is for restoration as well as preservation of watershed process conditions.

Table 13. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem (LM), lower NF & SF (NS), upper SF (SF), upper NF (NF), and the Green River (GR) portions of the Toutle Basin. Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors					
	LM	**NS**	**SF**	**NF**	**GR**
Habitat connectivity					
Blockages to off-channel habitats	✓	✓			
Blockages to channel habitats				✓	
Habitat diversity					
Lack of stable instream woody debris	✓	✓	✓	✓	✓
Altered habitat unit composition	✓	✓	✓	✓	✓
Loss of off-channel/side-channel habitat	✓	✓			
Channel stability					
Bed and bank erosion	✓	✓	✓	✓	
Channel down-cutting (incision)	✓	✓	✓	✓	
Mass wasting	✓	✓	✓	✓	
Riparian function					
Reduced stream canopy cover	✓	✓		✓	
Reduced bank/soil stability	✓	✓	✓	✓	✓
Exotic and/or noxious species					
Reduced wood recruitment	✓	✓	✓	✓	✓
Floodplain function					
Altered nutrient exchange processes	✓				
Reduced flood flow dampening	✓				
Restricted channel migration	✓				
Disrupted hyporheic processes	✓				
Stream flow					
Altered magnitude, duration, rate of chg	✓	✓	✓	✓	✓
Water quality					
Altered stream temperature regime	✓	✓		✓	
Excessive turbidity	✓	✓		✓	
Substrate and sediment					
Lack of adequate spawning substrate	✓	✓	✓	✓	
Excessive fine sediment	✓	✓	✓	✓	✓
Embedded substrates	✓	✓	✓	✓	

Threats					
	LM	**NS**	**SF**	**NF**	**GR**
Agriculture/ grazing					
Clearing of vegetation		✓			
Floodplain filling		✓			
Forest practices					
Timber harvest –sediment supply impacts	✓	✓	✓	✓	✓
Timber harvests – impacts to runoff	✓	✓	✓	✓	✓
Riparian harvests (historical)		✓	✓	✓	✓
Forest roads – sediment supply impacts	✓	✓	✓	✓	✓
Forest roads – impacts to runoff	✓	✓	✓	✓	✓
Forest roads – riparian/floodplain impact		✓	✓	✓	✓
Channel manipulations					
Bank hardening	✓	✓			
Channel straightening	✓	✓			
Artificial confinement	✓	✓			
Clearing and snagging	✓	✓		✓	
Dredge and fill activities	✓	✓		✓	
Passage obstruction (SRS)				✓	

Specific Reach and Subwatershed Priorities

Specific reaches and subwatersheds have been prioritized based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Reaches have been placed into Tiers (1-4), with Tier 1 reaches representing the areas where recovery measures would yield the greatest benefits towards accomplishing the biological objectives. The reach tiering factors in each fish population's importance relative to regional recovery objectives, as well as the relative importance of reaches within the populations themselves. Reach tiers are most useful for identifying habitat recovery measures in channels, floodplains, and riparian areas. Reach-scale priorities were initially identified within individual populations (species) through the EDT Restoration and Preservation Analysis. This resulted in reaches grouped into categories of high, medium, and low priority for each population (see Stream Habitat Limitations section). Within a subbasin, reach rankings for all of the modeled populations were combined, using population designations as a weighting factor. Population designations for this subbasin are described in the Biological Objectives section. The population designations are 'primary', 'contributing', and 'stabilizing'; reflecting the level of emphasis that needs to be placed on population recovery in order to meet ESA recovery criteria.

Spatial priorities were also identified at the subwatershed scale. Subwatershed-scale priorities were directly determined by reach-scale priorities, such that a Group A subwatershed contains one or more Tier 1 reaches. Scaling up from reaches to the subwatershed level was done in recognition that actions to protect and restore critical reaches might need to occur in adjacent and/or upstream upland areas. For example, high sediment loads in a Tier 1 reach may originate in an upstream contributing subwatershed where sediment supply conditions are impaired because of current land use practices. Subwatershed-scale priorities can be used in conjunction with the IWA to identify watershed process restoration and preservation opportunities. The specific rules for designating reach tiers and subwatershed groups are presented in Table 14. Reach tier designations for this basin are included in

Table 15. Reach tiers and subwatershed groups are displayed on a map in Figure 20. A summary of reach- and- subwatershed-scale limiting factors is included in Table 16.

Table 14. Rules for designating reach tier and subwatershed group priorities. See Biological Objectives section for information on population designations.

Designation	Rule
Reaches	
Tier 1:	All high priority reaches (based on EDT) for one or more primary populations.
Tier 2:	All reaches not included in Tier 1 and which are medium priority reaches for one or more primary species and/or all high priority reaches for one or more contributing populations.
Tier 3:	All reaches not included in Tiers 1 and 2 and which are medium priority reaches for contributing populations and/or high priority reaches for stabilizing populations.
Tier 4:	Reaches not included in Tiers 1, 2, and 3 and which are medium priority reaches for stabilizing populations and/or low priority reaches for all populations.
Subwatersheds	
Group A:	Includes one or more Tier 1 reaches.
Group B:	Includes one or more Tier 2 reaches, but no Tier 1 reaches.
Group C:	Includes one or more Tier 3 reaches, but no Tier 1 or 2 reaches.
Group D:	Includes only Tier 4 reaches.

Table 15. Reach Tiers in the Toutle River Basin

Tier 1	Tier 2	Tier 4	
Green River 1	Big Wolf Creek	Alder Creek_A	LB trib6 (not listed)
Green River 6	Brownell Creek 2	Alder Creek_B	LB trib7 (not listed)
NF Toutle 1	Green River 2	Bear Creek	LB trib8 (not listed)
NF Toutle 10	Green River 3	Bear Creek (NF Trib.)	LB trib9 (not listed)
NF Toutle 12	Green River 4	Beaver Creek	Lower Cowlitz-2
NF Toutle 13	Green River 5	Brownell Creek 1	NF Toutle 3
NF Toutle 2	Green River 7	Cascade Creek	NF Toutle 4
NF Toutle 6	Green River 8	Castle Creek	NF Toutle 5
NF Toutle 7	Green River 9	Coldwater Creek	RB trib1 (26.0237)
SF Toutle 1	Hemlock Cr 1	Deer Creek	RB trib10 (not listed)
SF Toutle 12	Lower Cowlitz-1	Devils Creek	RB trib2 (Loch Ck)
SF Toutle 13	Miners Creek	Disappointment Cr	RB trib3 (Flye Ck)
SF Toutle 14	NF Toutle 11	Eighteen Creek	RB trib4 (Clancy Ck))
SF Toutle 15	NF Toutle 8	Elk Cr trib	RB trib5 (not listed)
SF Toutle 16	NF Toutle 9	Elk Creek 1	RB trib6 (not listed)
SF Toutle 17	SF Toutle 10	Elk Creek 2	RB trib7 (26.0320)
SF Toutle 18	SF Toutle 11	Fish Trap	RB trib9 (not listed)
SF Toutle 19	SF Toutle 4	Harrington Creek	Rock Creek
SF Toutle 2	SF Toutle 6	Hemlock Cr 2	Shultz Cr trib
SF Toutle 20	SF Toutle 8	Hemlock Cr 3	Shultz Creek 2
SF Toutle 3	SF Toutle 9	Hoffstadt Cr 1	Silver Lake 1
SF Toutle 5	Shultz Creek 1	Hoffstadt Cr 2	Silver Lake 2
SF Toutle 7	Stankey Cr	Hollywood Gorge	SRS (sedi retention strucure)
Toutle 1	Thirteen Creek	Jim Creek	Studebaker Cr 1
Toutle 3	Toutle 2	Johnson Creek	Studebaker Cr 2
Toutle 4	Toutle 7	LB trib1 (26.0228)	Sucker Cr
Toutle 5	Toutle 8	LB trib10 (not listed)	Tradedollar Creek
Toutle 6	Wyant Cr 1	LB trib2 (26.0229)	Trouble Creek
Toutle 9		LB trib3 (26.0235)	Twenty Creek
		LB trib4 (not listed)	unnamed Lake trib
		LB trib5 (not listed)	Whitten Creek
			Wyant Cr 2

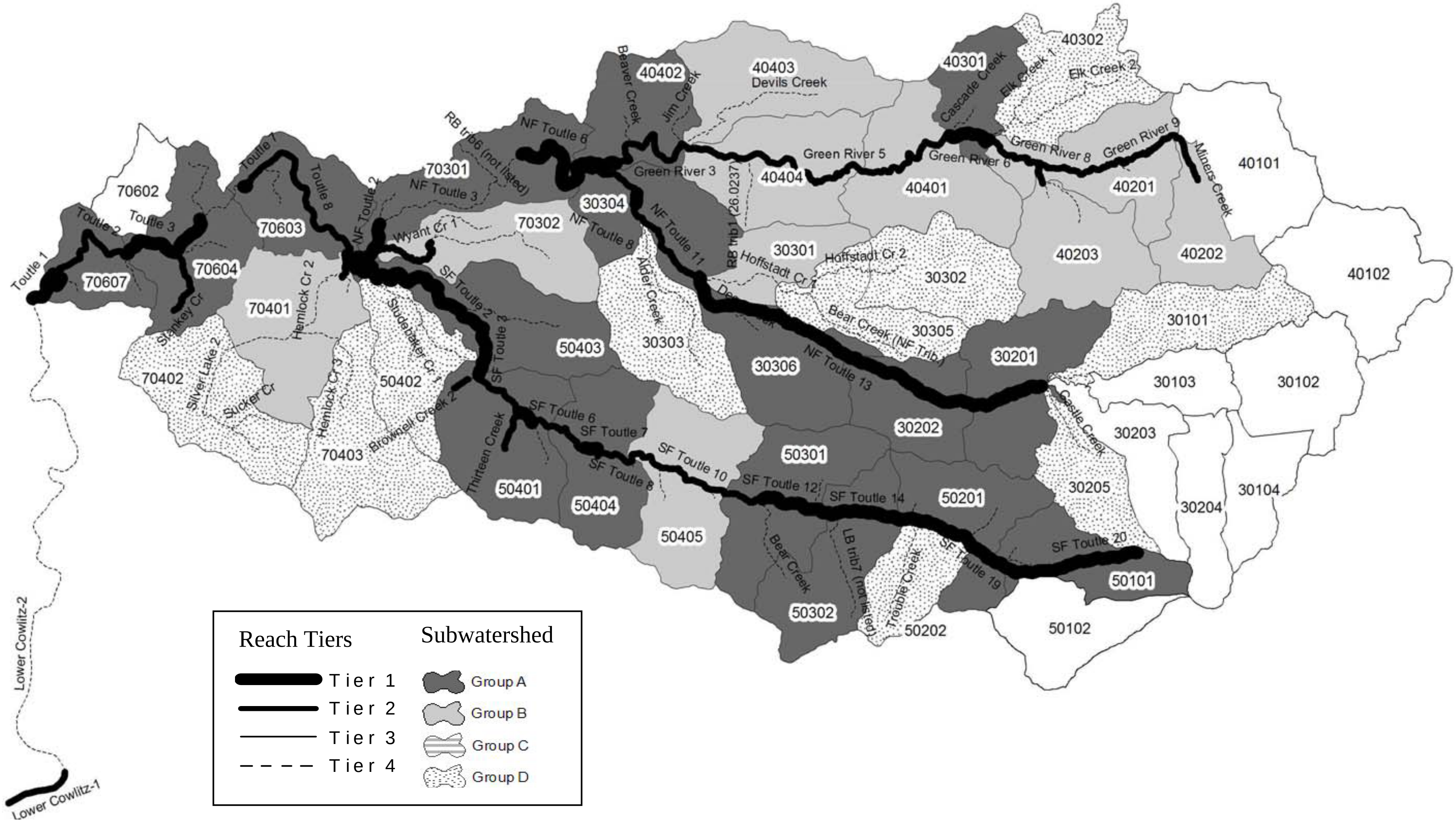


Figure 20. Reach tiers and subwatershed groups in the Toutle Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach scale are useful for identifying stream corridor recovery measures. Priorities at the subwatershed scale are useful for identifying watershed process recovery measures. Watershed process recovery measures for stream reaches will need to occur within the surrounding (local) subwatershed as well as in upstream contributing subwatersheds.

Table 16. Summary table of reach- and subwatershed-scale limiting factors in priority areas. The table is organized by subwatershed groups, beginning with the highest priority group. Species-specific reach priorities, critical life stages, high impact habitat factors, and recovery emphasis (P=preservation, R=restoration, PR=restoration and preservation) are included. Watershed process impairments: F=functional, M=moderately impaired, I=impaired. Species abbreviations: ChS=spring Chinook, ChF=fall Chinook, StS=summer steelhead, StW=winter steelhead.

								Watershed processes (local)			Watershed processes (watershed)	
Sub-watershed Group	Sub-watershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors by species	Preservation or restoration emphasis	Hydrology	Sediment	Riparian	Hydrology	Sediment
A	70607	LB trib1 (26.0228) LB trib2 (26.0229) Toutle 1 Toutle 2	StW	none				I	M	M	I	M
			Coho	Toutle 1	Summer rearing Winter rearing Juvenile migrant (age 1) Adult holding	habitat diversity sediment key habitat quantity	R					
			ChF	none								
			Chum	Toutle 1	Spawning Egg incubation Fry colonization Adult holding	none	R					
			ChS	none								
	70604	Hollywood Gorge LB trib3 (26.0235) Rock Creek Stankey Cr Toutle 3 Toutle 4 Toutle 5	StW	none				I	M	M	I	M
			Coho	Toutle 3 Toutle 4	Egg incubation Summer rearing Winter rearing Juvenile migrant (age 1)	channel stability habitat diversity temperature sediment	R					
			ChF	Toutle 4	Spawning Egg incubation Adult holding	channel stability temperature sediment	R					
			Chum	Toutle 3 Toutle 4 Toutle 5	Spawning Egg incubation Fry colonization Adult holding	channel stability habitat diversity sediment	R					
			ChS	none								
	70603	Hollywood Gorge LB trib4 (not listed) Toutle 6 Toutle 7 Toutle 8 Toutle 9	StW	none				I	M	M	I	M
			Coho	Toutle 6 Toutle 9	Summer rearing Winter rearing Juvenile migrant (age 1)	channel stability habitat diversity sediment	R					
			ChF	Toutle 9	Spawning Egg incubation Fry colonization	sediment	R					
			Chum	Toutle 6	Spawning Egg incubation Fry colonization Adult holding	habitat diversity sediment	R					
			ChS	none								
	70301	LB trib9 (not listed) NF Toutle 1 NF Toutle 2 NF Toutle 3 NF Toutle 4 NF Toutle 5 NF Toutle 6 RB trib5 (not listed) RB trib6 (not listed) RB trib7 (26.0320)	StW	none				I	M	M	I	M
			Coho	NF Toutle 1 NF Toutle 2 NF Toutle 6	Egg incubation Fry colonization Summer rearing Juvenile migrant (age 0) Winter rearing Juvenile migrant (age 1)	channel stability habitat diversity temperature sediment	R					
			ChF	none								
			ChS	none								
	50404	Big Wolf Creek LB trib5 (not listed) SF Toutle 6 SF Toutle 7 SF Toutle 8 Twenty Creek	StW	none				M	M	M	I	M
			Coho	SF Toutle 7	Egg incubation Summer rearing Winter rearing	habitat diversity	R					
			ChF	SF Toutle 7 SF Toutle 8	Spawning Egg incubation Fry colonization Summer rearing	sediment	P					
			ChS	none								
	50403	Johnson Creek SF Toutle 1 SF Toutle 2 SF Toutle 3	StW	none				I	I	M	I	M
			Coho	SF Toutle 1 SF Toutle 2 SF Toutle 3	Egg incubation Fry colonization Summer rearing Winter rearing	channel stability habitat diversity sediment	R					
			ChF	SF Toutle 1 SF Toutle 2 SF Toutle 3	Spawning Egg incubation Fry colonization	temperature sediment	PR					
	50401	Brownell Creek 1 Brownell Creek 2 Eighteen Creek SF Toutle 3 SF Toutle 4 SF Toutle 5 SF Toutle 6 Thirteen Creek	StW	none				I	M	M	I	M
			Coho	SF Toutle 3 SF Toutle 5	Egg incubation Summer rearing Winter rearing	channel stability habitat diversity sediment	R					
			ChF	SF Toutle 3 SF Toutle 4	Spawning Egg incubation Fry colonization Adult holding	sediment	PR					
	50302	Bear Creek LB trib7 (not listed) SF Toutle 13 SF Toutle 14 SF Toutle 15	StW	SF Toutle 13 SF Toutle 14 SF Toutle 15	Egg incubation Winter rearing Summer rearing	habitat diversity flow sediment key habitat quantity	PR	I	M	M	I	M
			Coho	none								
			ChF	SF Toutle 13	Egg incubation Fry colonization Adult holding		P					

Sub-watershed Group	Sub-watershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors by species	Preservation or restoration emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
A	50301	Bear Creek Harrington Creek SF Toutle 11 SF Toutle 12 SF Toutle 13	StW	SF Toutle 12 SF Toutle 13	Egg incubation Winter rearing Summer rearing	habitat diversity	PR	M	M	M	I	M
			Coho	none								
			ChF	SF Toutle 11 SF Toutle 12 SF Toutle 13	Egg incubation Fry colonization Summer rearing Adult holding	sediment	P					
	50201	RB trib2 (not listed) RB trib3 (not listed) RB trib4 (not listed) SF Toutle 16 SF Toutle 17 SF Toutle 18 SF Toutle 19	StW	SF Toutle 16 SF Toutle 17 SF Toutle 18 SF Toutle 19	Egg incubation Fry colonization Summer rearing Winter rearing	channel stability habitat diversity flow sediment	PR	I	M	M	I	M
			Coho	SF Toutle 17	Egg incubation Fry colonization Summer rearing Winter rearing	habitat diversity sediment	R					
			ChF	SF Toutle 16	Spawning Egg incubation Fry colonization Adult holding	sediment	PR					
	50101	Disappointment Cr SF Toutle 20	StW	SF Toutle 20	Egg incubation Fry colonization Summer rearing Winter rearing	flow sediment key habitat quantity	R	M	M	M	M	M
			Coho	none								
	40402	Beaver Creek Green River 1 Green River 2 Green River 3 Jim Creek	StW	none				I	M	M	I	M
			Coho	Green River 1	Egg incubation Summer rearing Winter rearing	habitat diversity sediment	R					
			ChF	Green River 3	Spawning Egg incubation Fry colonization	none	P					
			ChS	none								
	40301	Cascade Creek Green River 5 Green River 6	StW	Green River 6	Egg incubation Winter rearing Summer rearing	none	PR	I	M	M	I	M
			Coho	none								
			ChF	none								
	30306	Deer Creek NF Toutle 12 NF Toutle 13	StW	NF Toutle 12 NF Toutle 13	Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1) Juvenile migrant (age 2+)	temperature flow sediment key habitat quantity	R	I	M	M	M	M
			Coho	none								
			ChS	NF Toutle 12	Spawning Egg incubation Fry colonization Adult holding	channel stability habitat diversity temperature sediment	R					
	30304	NF Toutle 10 NF Toutle 11 NF Toutle 7 NF Toutle 8 NF Toutle 9 SRS (sedi retention)	StW	NF Toutle 7	Egg incubation Juvenile migrant (age 1) Summer rearing	temperature sediment	R	I	M	M	I	M
			Coho	NF Toutle 10	Egg incubation Fry colonization Summer rearing Juvenile migrant (age 0) Winter rearing Juvenile migrant (age 1)	habitat diversity sediment	R					
			ChF	none								
			ChS	NF Toutle 10 NF Toutle 11	Spawning Egg incubation Fry colonization Summer rearing Adult holding	channel stability habitat diversity temperature sediment	R					
	30202	NF Toutle 13	StW	NF Toutle 13	Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1) Juvenile migrant (age 2+) Adult holding	sediment key habitat quantity	R	I	M	M	M	F
			Coho	none								
			ChS	none								
	30201	NF Toutle 13	StW	NF Toutle 13	Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1) Juvenile migrant (age 2+) Adult holding	sediment key habitat quantity	R	I	F	M	M	F
			Coho	none								
			ChS	none								

Sub-watershed Group	Sub-watershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors by species	Preservation or restoration emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
B	70401	Hemlock Cr 1 Hemlock Cr 2 RB trib9 (not listed) Silver Lake 1 Silver Lake 2	StW	none				I	M	M	I	M
			Coho	none								
	70302	LB trib10 (not listed) Wyant Cr 1 Wyant Cr 2	StW	none				I	M	M	I	M
			Coho	none								
	50405	LB trib6 (not listed) SF Toutle 10 SF Toutle 11 SF Toutle 9 Whitten Creek	StW	none				M	M	M	I	M
			Coho	none								
			ChF	SF Toutle 11 SF Toutle 9	Spawning Egg incubation Fry colonization Summer rearing	sediment	P					
	40404	Green River 5 RB trib1 (26.0237)	StW	none				M	M	M	I	M
			Coho	none								
			ChF	none								
	40403	Devils Creek Green River 4	StW	none				M	M	M	M	M
			Coho	none								
			ChF	Green River 4	Spawning Egg incubation Fry colonization	channel stability habitat diversity temperature sediment	P					
	40401	Green River 5	StW	none				I	M	M	I	M
			Coho	none								
			ChF	none								
	40203	Shultz Cr trib Shultz Creek 1 Shultz Creek 2	StW	none				I	I	M	I	I
			Coho	none								
	40202	Miners Creek	StW	none				I	M	M	I	M
			Coho	none								
	40201	Green River 7 Green River 8 Green River 9 Tradedollar Creek	StW	none				I	M	M	I	M
			Coho	none								
			ChF	none								
	30301	Hoffstadt Cr 1 NF Toutle 11	StW Coho ChF	none none none				I	M	M	I	M
D	70403	Hemlock Cr 3 Silver Lake 1	StW	none				I	M	M	I	M
			Coho	none								
	70402	Silver Lake 2 Sucker Cr	StW	none				I	M	M	I	M
			Coho	none								
	50402	RB trib10 (not listed) Studebaker Cr 1 Studebaker Cr 2	StW	none				I	M	M	I	M
			Coho	none								
	50202	LB trib8 (not listed) Trouble Creek	StW	none				I	I	M	I	I
			Coho	none								
	40302	Elk Cr trib Elk Creek 1 Elk Creek 2	StW	none				I	I	M	I	I
			Coho	none								
	30305	Bear Creek (NF Trib.) Hoffstadt Cr 1 Hoffstadt Cr 2	StW	none				I	M	M	I	M
			Coho	none								
	30303	Alder Creek_A Alder Creek_B	StW	none				M	M	M	M	M
			Coho	none								
	30302	Hoffstadt Cr 2	StW	none				I	M	M	I	M
			Coho	none								
	30205	Castle Creek	StW	none				M	M	M	M	M
			Coho	none								
	30101	Coldwater Creek	StW Coho	none none				M	M	M	M	M

5.4.2 *Habitat Measures*

Measures are means to achieve the regional strategies that are applicable to the Toutle subbasin and necessary to accomplish the biological objectives for focal fish species.. Measures are based on the technical assessments for this subbasin (Section 3.0) as well as on the synthesis of priority areas, limiting factors, and threats presented earlier in this section. The measures applicable to the Toutle Basin are presented in priority order in Table 17. Each measure has a set of submeasures that define the measure in greater detail and add specificity to the particular circumstances occurring within the subbasin. The table for each measure and associated submeasures indicates the limiting factors that are addressed, the contributing threats that are addressed, the species that would be most affected, and a short discussion. Priority locations are given for some measures. Priority locations typically refer to either stream reaches or subwatersheds, depending on the measure. Addressing measures in the highest priority areas first will provide the greatest opportunity for effectively accomplishing the biological objectives.

Following the list of priority locations is a list of the programs that are the most relevant to the measure. Each program is qualitatively evaluated as to whether it is sufficient or needs expansion with respect to the measure. This exercise provides an indication of how effectively the measure is already covered by existing programs, policy, or projects; and therefore indicates where there is a gap in measure implementation. This information is summarized in a discussion of Program Sufficiency and Gaps.

The measures themselves are prioritized based on the results of the technical assessment and in consideration of principles of ecosystem restoration (e.g. NRC 1992, Roni et al. 2002). These principles include the hypothesis that the most efficient way to achieve ecosystem recovery in the face of uncertainty is to focus on the following prioritiies for approaches: 1) protect existing functional habitats and the processes that sustain them, 2) allow no further degradation of habitat or supporting processes, 3) re-connect isolated habitat, 4) restore watershed processes (ecosystem function), 5) restore habitat structure, and 6) create new habitat where it is not recoverable. These priorities have been adjusted for the specific circumstances occurring in the Toutle Basin. These priorities are adjusted depending on the results of the technical assessment and on the specific circumstances occurring in the basin. For example, re-connecting isolated habitat could be adjusted to a lower priority if there is little impact to the population created from passage barriers.

5.4.3 *Habitat Actions*

The prioritized measures and associated gaps are used to develop specific Actions for the subbasin. These are presented in Table 18. Actions are different than the measures in a number of ways: 1) actions have a greater degree of specificity than measures, 2) actions consider existing programs and are therefore not based strictly on biophysical conditions, 3) actions refer to the agency or entity that would be responsible for carrying out the action, and 4) actions are related to an expected outcome with respect to the biological objectives. Actions are not presented in priority order but instead represent the suite of activities that are all necessary for recovery of listed species. The priority for implementation of these actions must consider the priority of the measures they relate to, the “size” of the gap they are intended to fill, and feasibility considerations.

Table 17. Prioritized measures for the Toutle River Basin.

#1 – Protect stream corridor structure and function

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect floodplain function and channel migration processes B. Protect riparian function C. Protect access to habitats D. Protect instream flows through management of water withdrawals E. Protect channel structure and stability F. Protect water quality G. Protect the natural stream flow regime	Potentially addresses many limiting factors	Potentially addresses many threats related to limiting factors	All Species	The mainstem Toutle, lower NF Toutle, and lower SF Toutle were heavily dredged, rip rapped and confined shortly following the 1980 Mount St. Helens eruption, seriously compromising floodplain function (Wade 2000). The upper SF Toutle and upper NF Toutle (above the SRS) contain functioning floodplains and remain heavily aggraded with eruption sediments. The upper Green River (upstream of the hatchery) also contains functioning floodplains. Riparian areas were severely impacted by the eruption and subsequent timber harvests. Protecting floodplains, channel migration processes, and riparian areas from further degradation will be an important component of recovery.

Priority Locations

1st- Tier 1 or 2 reaches in mixed-use lands at risk of further degradation
Reaches: Toutle 1-9; SF Toutle 1-2; NF Toutle 1-2; Stankey Cr; Wyant Cr 1
2nd- Remaining Tier 1 and 2 reaches
3rd- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NOAA Fisheries	ESA Section 7 and Section 10	✓	
USFS	Northwest Forest Plan	✓	
US Army Corps of Engineers (USACE)	Dredge & fill permitting (Clean Water Act sect. 404); Navigable waterways protection (Rivers & Harbors Act Sect, 10)	✓	
WA Department of Natural Resources (WDNR)	State Lands HCP, Forest Practices Rules, Riparian Easement Program	✓	
WA Department of Fish and Wildlife (WDFW)	Hydraulics Projects Approval	✓	
Cowlitz County	Comprehensive Planning		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Landowner technical assistance, conservation programs		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Education, Enforcement, Control		✓

Non-Governmental Organizations (NGOs) (e.g. Columbia Land Trust) and public agencies	Land acquisition and easements	✓

Program Sufficiency and Gaps

Alterations to stream corridor structure that may impact aquatic habitats are regulated through the WDFW Hydraulics Project Approval (HPA) permitting program. Other regulatory protections are provided through USACE permitting, ESA consultations, HCPs, and County regulations. Riparian areas within private timberlands are protected through the Forest Practices Rules (FPR) administered by WDNR. The FPRs came out of an extensive review process and are believed to adequately protect riparian areas with respect to stream shading, bank stability, and LWD recruitment. The program is new and careful monitoring of the effect of the regulations is necessary. Land-use conversion is increasing in the lower basin and County ordinances must ensure that new development occurs in a manner that protects key habitats. Conversion of land-use from forest or agriculture to residential use has the potential to increase impairment of aquatic habitat, particularly when residential development is paired with flood control measures. County government can limit potentially harmful land-use conversions by thoughtfully directing growth through comprehensive planning and tax incentives, by providing consistent protection of critical areas across jurisdictions, and by preventing development in floodplains. In cases where existing programs are unable to protect critical habitats due to inherent limitations of regulatory mechanism, conservation easements and land acquisition may be necessary.

#2 – Protect hillslope processes

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Manage forest practices to minimize impacts to sediment supply processes, runoff regime, and water quality B. Manage growth and development to minimize impacts to sediment supply processes, runoff regime, and water quality	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Development – impacts to sediment supply, water quality, and runoff processes	All species	Hillslope runoff and sediment delivery processes have been degraded due to forest denudation related to the 1980 eruption of Mount St. Helens and subsequent intensive timber harvest and road building, particularly on private commercial timberlands. Limiting additional degradation will be necessary to prevent further habitat impairment.

Priority Locations

1st- Functional subwatersheds contributing to Tier 1 or 2 reaches (functional for sediment *or* flow according to the IWA – local rating)
Subwatersheds: 40101, 30201, 30204, 30104, 30102
2nd- All other functional subwatersheds plus Moderately Impaired subwatersheds contributing to Tier 1 or 2 reaches
Subwatersheds: All other subwatersheds except 50403, 50202, 40302 & 40203
3rd- All other Moderately Impaired subwatersheds plus Impaired subwatersheds contributing to Tier 1 or 2 reaches
Subwatersheds: 50403, 50202, 40302 & 40203

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, State Lands HCP	✓	
USFS	Northwest Forest Plan	✓	
Cowlitz County	Comprehensive Planning		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Landowner technical assistance, conservation programs		✓

Program Sufficiency and Gaps

Hillslope processes on private forest lands are protected through Forest Practices Rules administered by the WDNR. These rules, developed as part of the Forests & Fish Agreement, are believed to be adequate for protecting watershed sediment supply, runoff processes, and water quality on private forest lands. The program is new, however, and careful monitoring of the effect of the regulations is necessary particularly effects on subwatershed hydrology and sediment delivery Small private landowners may be unable to meet some of the requirements on a timeline commensurate with large industrial landowners. Financial assistance to small owners would enable greater and quicker compliance. On non-forest lands (rural residential and agricultural), County Comprehensive Planning is the primary nexus for protection of hillslope processes. Cowlitz County can control impacts through zoning that protects open-space, through stormwater management ordinances, and through tax incentives to prevent lands from becoming developed. These protections are pertinent in the lower mainstem Toutle basin that is the most susceptible to growth.

#3 – Address fish passage and sediment issues at the Sediment Retention Structure on the NF Toutle

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore access to isolated habitats blocked by culverts, dams, or other barriers B. Reduce persistent sediment contribution from the SRS	• Blockages to channel habitats • Excessive fine sediment • Excessive turbidity • Embedded substrates	• Dams, culverts, in-stream structures	All species	As many as 50 miles of habitat are blocked by the Sediment Retention Structure on the NF Toutle. Fish are currently transported around this structure. The structure is also a source of persistent sediment to the lower river.

Priority Locations

1st- Sediment Retention Structure on the NF Toutle

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
USACE	Sediment Retention Structure operations and maintenance		✓
WDFW	Habitat Program		✓

Program Sufficiency and Gaps

The Sediment Retention Structure (SRS) on the NF Toutle is operated by the USACE. There are concerns with the persistent contribution of fine sediment over the structure and into downstream habitats. The current management status of the structure is unknown. There are continued discussions regarding its operation and function.

#4 - Restore floodplain function and channel migration processes

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Set back, breach, or remove artificial confinement structures	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel incision • Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats	• Floodplain filling • Channel straightening • Artificial confinement	All species	Portions of the mainstem Toutle, lower NF Toutle, lower SF Toutle, and Green River all suffer from channel confinement and bank hardening in some areas. There is significant potential for restoration of floodplain function and channel migration processes that could improve flow conditions and create key habitat types. Selective breaching, setting back, or removing confining structures would help to restore floodplain and CMZ function as well as facilitate the creation of off-channel and side channel habitats. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.

Priority Locations

1st- Tier 1 reaches with hydro-modifications (obtained from EDT ratings)
Reaches: Toutle 1; NF Toutle 2 & 10; SF Toutle 2 & 3; Green River 6
2nd- Tier 2 reaches with hydro-modifications
Reaches: Toutle 2; NF Toutle 9 & 11; SF Toutle 6; Green River 7-9; Brownell Creek 2
3rd- Other reaches with hydro-modifications
Reaches: NF Toutle 3; Silver Lake 1; Sucker Cr; RB trib5

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDFW	Habitat Program		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓

Program Sufficiency and Gaps

There currently are no programs or policy in place that set forth strategies for restoring floodplain function and channel migration processes in the Toutle Basin. Without programmatic changes, projects are likely to occur only seldom as opportunities arise and only if financing is made available. The level of floodplain and CMZ impairment in the Toutle and the importance of these processes to listed fish species put an increased emphasis on restoration. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs and government entities to conduct restoration projects. Floodplain restoration projects are often expensive, large-scale efforts that require partnerships among many agencies, NGOs, and landowners. Building partnerships is a necessary first step toward floodplain and CMZ restoration.

#5- Restore degraded hillslope processes on forest, agricultural, and developed lands

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Upgrade or remove problem forest roads B. Reforest heavily cut areas not recovering naturally	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Rural residential and small scale agriculture – impacts to water quality and runoff processes	All species	Hillslope runoff and sediment delivery processes have been degraded due to the 1980 Mount St. Helens eruption and subsequent intensive timber harvest and road building. Rural residential development and small-scale agricultural operations contribute to degraded hillslope processes in the lower basin. Hillslope processes must be addressed for reach-level habitat recovery to be successful.

Priority Locations

1st- Moderately impaired or impaired subwatersheds contributing to Tier 1 reaches (mod. impaired or impaired for sediment *or* flow according to IWA – local rating)
Subwatersheds: All subwatersheds in the basin

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program		✓
USFS	Northwest Forest Plan, Mount St. Helens National Volcanic Monument	✓	
Cowlitz County	Stormwater Management		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Landowner technical assistance, conservation programs, habitat projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓

Program Sufficiency and Gaps

Forest management programs including the new Forest Practices Rules (private timber lands), the WDNR HCP (state timber lands), and the Northwest Forest Plan (federal lands) are expected to afford protections that will passively and actively restore degraded hillslope conditions. Timber harvest rules are expected to passively restore sediment and runoff processes. The road maintenance and abandonment requirements for private timber lands are expected to actively address road-related impairments within a 15 year time-frame. While these strategies are believed to be largely adequate to protect watershed processes, the degree of implementation and the effectiveness of the prescriptions will not be fully known for at least another 15 or 20 years. Of particular concern is the capacity of some forest land owners, especially small forest owners, to conduct the necessary road improvements (or removal) in the required timeframe. Additional financial and technical assistance would enable small forest landowners to conduct the necessary improvements in a timeline parallel to large industrial timber land owners. Ecological restoration of lands in rural residential development and small-scale agriculture occurs relatively infrequently and there are no programs that specifically require restoration in these areas. Restoring existing developed and farmed lands can involve retrofitting facilities with new materials, replacing existing systems, and adopting new management practices. Means of increasing restoration activity include increasing landowner participation through education and incentive programs, requiring Best Management Practices through permitting and ordinances, and increasing available funding for entities to conduct restoration projects.

#6 - Restore riparian conditions throughout the basin

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore the natural riparian plant community B. Exclude livestock from riparian areas C. Eradicate invasive plant species from riparian areas	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or invasive species • Bacteria	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to agriculture and residential development	All species	Riparian areas were severely degraded from mudflows from the 1980 Mount St. Helens eruption and subsequent timber harvest. Riparian impairment is a concern throughout the basin. There is a high potential benefit of riparian restoration due to the many limiting factors that are addressed. The increasing abundance of exotic and invasive species in riparian areas is a particular concern. Riparian restoration projects are relatively inexpensive and are often supported by landowners.

Priority Locations

1st- Tier 1 reaches
2nd- Tier 2 reaches
3rd- Tier 3 reaches
4th- Tier 4 reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program		✓
USFS	Northwest Forest Plan	✓	
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Landowner technical assistance, conservation programs, habitat projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Education, Enforcement, Control		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring riparian conditions; however, existing programs will afford protections that will allow for the *passive* restoration of riparian forests. These protections are believed to be adequate for riparian areas on forest lands that are subject to Forest Practices Rules, the State forest lands HCP, or the Northwest Forest Plan. Other lands receive variable levels of protection and passive restoration through the Cowlitz County Comprehensive Plan. Degraded riparian zones in rural residential, agricultural, or transportation corridor uses will not passively restore with existing regulatory protections and will require active measures. Riparian restoration in these areas may entail livestock exclusion, tree planting, road relocation, invasive species eradication, and adjusting current land-use in the riparian zone. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

#7 - Restore channel structure and stability

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting B. Structurally modify channel morphology to create suitable habitat C. Restore natural rates of erosion and mass wasting within river corridors	• Lack of stable instream woody debris • Altered habitat unit composition • Reduced bank/soil stability • Excessive fine sediment • Excessive turbidity • Embedded substrates	• None (symptom-focused restoration strategy)	All species	Channel structure and stability was severely compromised due to mudflows associated with the 1980 eruption. Channels remain highly aggraded and unstable. Much of the large wood was transported through the system or buried in sediments during or shortly after the eruption. As channels naturally become more stable, large wood installation projects may be appropriate. Care should be taken to acknowledge that structural enhancements may not succeed if channels are too unstable or if artificial confinement structures are inhibiting natural flow processes.

Priority Locations

1st- Tier 1 reaches
2nd- Tier 2 reaches
3rd- Tier 3 reaches
4th- Tier 4 reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NGOs, tribes, agencies, landowners	Habitat Projects		✓
WDFW	Habitat Program		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
USFS	Habitat Projects		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Landowner technical assistance, conservation programs, habitat projects		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring channel stability and structure. Passive restoration is expected to slowly occur as stream channels and riparian areas continue to naturally recover from the eruption and past timber harvests. Natural recovery will be made possible through regulatory protections afforded to riparian areas and hillslope processes. Active measures may be warranted in high priority reaches. Past structural enhancement projects have largely been opportunistic and have been completed due to the efforts of local NGOs, landowners, and government agencies; such projects are likely to continue in a piecemeal fashion as opportunities arise and only if financing is made available. The lack of LWD in stream channels, and the importance of wood for habitat of listed species, places an emphasis on LWD supplementation projects. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

#8 – Restore degraded water quality with emphasis on temperature impairments

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Increase riparian shading B. Decrease channel width-to-depth ratios	• Altered stream temperature regime	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to rural development and agriculture	• All species	There are a few stream segments on the draft 2002-2004 303(d) list for temperature impairment and one stream segment included as a concern for temperature impairment. Despite the few listed segments, elevated stream temperature is believed to be a concern throughout the basin due to high channel width-to-depths and lack of riparian cover. High suspended sediment levels are also a concern but are related primarily to high sediment loads and unstable channels due to the 1980 eruption.

Priority Locations

1st- Reaches with 303(d) listings
Reaches: Harrington Creek; Hoffstadt Cr 2; Shultz Creek 2
2nd- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Washington Department of Ecology	Water Quality Program		✓
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program		✓
USFS	Northwest Forest Plan	✓	
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Landowner technical assistance, conservation programs, habitat projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓

Program Sufficiency and Gaps

The WDOE Water Quality Program manages the State 303(d) list of impaired water bodies. There are a few listings for temperature in the Toutle Basin and one area of concern (Green River) (WDOE 2004). A Water Quality Clean-up Plan (TMDL) is required by the WDOE and it is anticipated that the TMDL will adequately set forth strategies to address the temperature impairment. It will be important that the strategies specified in the TMDL are implementable and adequately funded. The 303(d) listings are believed to address the primary water quality concerns; however, other impairments may exist that the current monitoring effort is unable to detect. Additional monitoring is needed to fully understand the degree of water quality impairment in the basin.

#9 – Provide for adequate instream flows during critical periods

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect instream flows through water rights closures and enforcement B. Restore instream flows through acquisition of existing water rights C. Restore instream flows through implementation of water conservation measures	• Stream flow – maintain or improve Summer low-flows	• Water withdrawals	All species	Instream flow management strategies for the Toutle Basin have been identified as part of Watershed Planning for WRIA 26 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies. This measure applies to instream flows associated with water withdrawals and diversions, generally a concern only during low flow periods. Hillslope processes also affect low flows but these issues are addressed in separate measures.

Priority Locations

Entire Basin

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WRIA 25/26 Watershed Planning Unit	Watershed Planning	✓	
Washington Department of Ecology	Water Resources Program		✓

Program Sufficiency and Gaps

The Water Resources Program of the WDOE, in cooperation with the WDFW and other entities, manages water rights and instream flow protections. A collaborative process for setting and managing instream flows was launched in 1998 with the Watershed Planning Act (HB 2514), which called for the establishment of local watershed planning groups who's objective was to recommend instream flow guidelines to WDOE through a collaborative process. The current status of this planning effort is to adopt a watershed plan by December 2004. Instream flow setting in the Toutle Basin will be conducted using the recommendations of the WRIA 25/26 Planning Unit, which is coordinated by the LCFRB. Draft products of the WRIA 25/26 watershed planning effort can be found on the LCFRB website: www.lcfrb.gen.wa.us. The recommendations of the planning unit have been developed in close coordination with recovery planning and the instream flow prescriptions developed by this group are anticipated to adequately protect instream flows necessary to support healthy fish populations. The measures specified above are consistent with the planning group's recommended strategies.

#10 – Restore access to habitat blocked by artificial barriers

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore access to isolated habitats blocked by culverts, dams, or other barriers	• Blockages to channel habitats • Blockages to off-channel habitats	• Dams, culverts, in-stream structures	All species	Culverts or other barriers block as much as 23 miles of anadromous habitat; the blocked habitat is believed to be marginal in most cases. Passage restoration projects should focus on cases where it can be demonstrated that there is good potential benefit and reasonable project costs. Passage issues at the SRS on the NF Toutle are addressed in a separate measure.

Priority Locations

1st- Several small tributaries with blockages

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, Family Forest Fish Passage, State Forest Lands HCP		✓
WDFW	Habitat Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Washington Department of Transportation / WDFW	Fish Passage Program		✓
Cowlitz County	Roads		✓

Program Sufficiency and Gaps

The Forest Practices Rules require forest landowners to restore fish passage at artificial barriers by 2016. Small forest landowners are given the option to enroll in the Family Forest Fish Program in order to receive financial assistance to fix blockages. The Washington State Department of Transportation, in a cooperative program with WDFW, manages a program to inventory and correct blockages associated with state highways. The Salmon Recovery Funding Board, through the Lower Columbia Fish Recovery Board, funds barrier removal projects. Past efforts have corrected major blockages and have identified others in need of repair. Additional funding is needed to correct remaining blockages. Further monitoring and assessment is needed to ensure that all potential blockages have been identified.

#11 – Create/restore off-channel and side-channel habitat

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore historical off-channel and side-channel habitats where they have been eliminated B. Create new channel or off-channel habitats (i.e. spawning channels)	• Loss of off-channel and/or side-channel habitat	• Floodplain filling • Channel straightening • Artificial confinement	chum coho	There was significant loss of off-channel and side-channel habitats due to mudflows associated with the 1980 eruption. Sediment loading and subsequent channel braiding may set the stage for the creation of quality side channel and off-channel habitats as stream channels slowly stabilize and fines are transported out of the system. Dredging and levee construction following the eruption will limit side-channel and off-channel creation in places. Creating habitats may be warranted in some areas, especially targeted for chum spawning; however, processes limiting habitat creation and maintenance (i.e. instability, confinement) must be addressed for them to be successful.

Priority Locations

1st- Lower mainstem Toutle, lower NF Toutle, lower SF Toutle
2nd- Other reaches that may have potential for off-channel and side-channel habitat restoration or creation

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDFW	Habitat Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for creating or restoring off-channel and side-channel habitat. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

Table 18. Habitat actions for the Toutle Basin.

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
Toutle 1. Address fish passage and sediment issues at the Sediment Retention Structure on the NF Toutle	Expansion of existing program or activity	WDFW, USACE	3	High: Sediment from the SRS affects downstream reaches. Volitional access is blocked to approx. 50 miles	High: Reduction of sedimentation of lower NF and mainstem Toutle. Volitional passage to ~50 miles of habitat	High
Toutle 2. Conduct floodplain restoration where feasible along the mainstem Toutle, SF Toutle, and NF Toutle, especially in areas affected by dredging and floodplain filling following the 1980 Mount St. Helens eruption. Survey landowners, build partnerships, and provide financial incentives	New program or activity	NRCS, C/WCD, NGOs, WDFW, LCFRB, USACE, LCFEG	4, 6, 7, 8 & 10	High: Lower mainstem and lower portion of lower mainstem tributaries	High: Restoration of floodplain function, habitat diversity, and habitat availability.	High
Toutle 3. Fully implement and enforce the Forest Practices Rules (FPRs) on private timber lands in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 5, 6, 8 & 10	High: Private commercial timber lands	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
Toutle 4. Continue to manage federal forest lands according to the Northwest Forest Plan	Activity is currently in place	USFS	1, 2, 5, 6, 8 & 10	Medium: National Forest and National Monument lands in the upper basin	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	High
Toutle 5. Review and adjust operations to ensure compliance with	Expansion of existing	Cowlitz County	1, 5, 6, & 8	Low: Applies to lands under public	Medium: Protection of water quality, greater streambank stability,	High

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[1] Relative amount of basin affected by action
[2] Expected response of action implementation
[3] Relative certainty that expected results will occur as a result of full implementation of action

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
the Endangered Species Act; examples include roads, parks, and weed management	program or activity			jurisdiction	reduction in road-related fine sediment delivery, restoration and preservation of fish access to habitats	
Toutle 6. Expand standards in County ordinances to afford adequate protections of ecologically important areas (i.e. stream channels, riparian zones, floodplains, CMZs, wetlands, unstable geology)	Expansion of existing program or activity	Cowlitz County	1 & 2	Medium: Private lands. Applies primarily to lands in the lower basin in open-space, rural residential, or forestland uses at risk of development	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
Toutle 7. Prevent floodplain impacts from new development through land use controls and Best Management Practices	New program or activity	Cowlitz County, WDOE	1	Medium: Private lands. Applies primarily to lands in the lower basin in open-space, rural residential, or forestland uses at risk of development	High: Protection of floodplain function, CMZ processes, and off-channel/side-channel habitat. Prevention of reduced habitat diversity and key habitat availability	High
Toutle 8. Manage future growth and development patterns to ensure the protection of watershed processes. This includes limiting the conversion of lands to developed uses through zoning regulations and tax incentives	Expansion of existing program or activity	Cowlitz County	1 & 2	Medium: Private lands. Applies primarily to lands in the lower basin in open-space, rural residential, or forestland uses at risk of development	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
Toutle 9. Implement the prescriptions of the WRIA 25/26 Watershed Planning Unit regarding instream flows	Activity is currently in place	WDOE, WDFW, WRIA 25/26 Planning Unit	9	High: Entire basin	Medium: Adequate instream flows to support life stages of salmonids and other aquatic biota.	Medium
Toutle 10. Increase the level of implementation of voluntary habitat enhancement projects in high priority reaches and subwatersheds. This includes building partnerships, providing incentives to landowners, and increasing funding	Expansion of existing program or activity	LCFRB, BPA (NPCC), NGOs, WDFW, NRCS, C/W CD, LCFEG	4, 5, 6, 7, 8, 10 & 11	High: Priority stream reaches and subwatersheds throughout the basin	Medium: Improved conditions related to water quality (temperature and bacteria), LWD quantities, bank stability, key habitat availability, habitat diversity, riparian function, floodplain function, sediment availability, & channel migration	Medium

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
					processes	
Toutle 11. Increase technical support and funding to small forest landowners faced with implementation of Forest Practices Rules to ensure full and timely compliance with regulations	Expansion of existing program or activity	WDNR	1, 2, 5, 6, 8 & 10	Low: Small private timberland owners	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
Toutle 12. Increase funding available to purchase easements or property in sensitive areas in order to protect watershed function where existing programs are inadequate	Expansion of existing program or activity	LCFRB, NGOs, WDFW, USFWS, BPA (NPCC)	1 & 2	Low: Private lands. Applies primarily to lands in the lower basin in open-space, rural residential, or forestland uses at risk of development	High: Protection of riparian function, floodplain function, water quality, wetland function, and runoff and sediment supply processes	High
Toutle 13. Increase technical assistance to landowners and increase landowner participation in conservation programs that protect and restore habitat and habitat-forming processes. Includes increasing the incentives (financial or otherwise) and increasing program marketing and outreach	Expansion of existing program or activity	NRCS, C/WCD, WDNR, WDFW, LCFEG, Cowlitz County	1, 2, 4, 5, 6, 7, 8, 9, 10 & 11	Medium: Private lands. Applies primarily to lands in the lower basin in open-space, rural residential, or forestland uses at risk of development	High: Increased landowner stewardship of habitat. Potential improvement in all factors	Medium
Toutle 14. Conduct forest practices on state lands in accordance with the Habitat Conservation Plan in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 5, 6, 8 & 10	Medium: State timber lands in the Toutle Basin (approximately 18% of the basin area)	Medium: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats. Response is medium because of location and quantity of state lands	Medium
Toutle 15. Assess the impact of fish passage barriers throughout the basin and restore access to potentially productive habitats (not including the	Expansion of existing program or activity	WDFW, WDNR, Cowlitz County, WSDOT,	10	Low: As many as 23 miles of stream are blocked by artificial barriers	Low: Increased spawning and rearing capacity due to access to blocked habitat. Habitat is marginal in most cases	High

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
SRS, which is covered in a separate action)		LCFEG				
Toutle 16. Create and/or restore lost side-channel/off-channel habitat for chum spawning and coho overwintering	New program or activity	LCFRB, BPA (NPCC), NGOs, WDFW, NRCS, C/W CD	11	Low: Lower mainstem Toutle	Medium: Increased habitat availability for spawning and rearing	Low
Toutle 17. Protect and restore native plant communities from the effects of invasive species	Expansion of existing program or activity	Weed Control Boards (local and state); NRCS, C/W CD, LCFEG	1 & 6	Medium: Greatest risk is in lower basin agriculture and residential use areas	Medium: restoration and protection of native plant communities necessary to support watershed and riparian function	Low
Toutle 18. Assess, upgrade, and replace on-site sewage systems that may be contributing to water quality impairment	Expansion of existing program or activity	Cowlitz County, C/W CD	8	Low: Private agricultural and rural residential lands in lower basin	Medium: Protection and restoration of water quality (bacteria)	Medium

5.5 Hatcheries

5.5.1 *Subbasin Hatchery Strategy*

The desired future state of fish production within the Toutle River Basin includes natural salmon and steelhead populations that are improving on a trajectory to recovery and hatchery programs that either enhance the natural fish recovery trajectory or are operated to not impede progress towards recovery. Hatchery recovery actions in each subbasin are tailored to the specific ecological and biological circumstances for each species in the subbasin. This may involve substantial changes in some hatchery programs from their historical focus on production for fishery mitigation. The recovery strategy includes a mixture of conservation programs and mitigation programs. Mitigation programs involve areas or practices selected for consistentency with natural population conservation and recovery objectives. A summary of the types of natural production enhancement strategies and fishery enhancement strategies to be implemented in the Toutle River Basin and South Fork Toutle are displayed by species in Table 19 and Table 20. More detailed descriptions and discussion of the regional hatchery strategy can be found in the Regional Recovery and Subbasin Plan Volume I.

Table 19. Summary of natural production and fishery enhancement strategies to be implemented in the Toutle River Basin.

		Fall Chinook	Spring Chinook	Coho	Chum	Winter Steelhead	Summer Steelhead
Natural Production Enhancement	**Supplementation**			✓			
	Hatch/Nat Conservation 1/						
	Isolation						
	Refuge						
Fishery Enhancement	**Hatchery Production**	✓		✓			✓

Table 20. Summary of natural production and fishery enhancement strategies to be implemented in the South Fork Toutle River.

		Species					
		Fall Chinook	**Spring Chinook**	**Coho**	**Chum**	**Winter Steelhead**	**Summer Steelhead**
Natural Production Enhancement	**Supplementation**			✓			
	Hatch/Nat Conservation 1/						
	Isolation						
	Refuge						
Fishery Enhancement	**Hatchery Production**						✓

1/ Hatchery and natural population management strategy coordinated to meet biological recovery objectives. Strategy may include integration and/or isolation strategy over time. Strategy will be unique to biological and ecological circumstances in each watershed.

Conservation-based hatchery programs include strategies and actions which are specifically intended to enhance or protect production of a particular wild fish population within the basin. A unique conservation strategy is developed for each species and watershed depending on the status of the natural population, the biological relationship between the hatchery and natural populations, ecological attributes of the watershed, and logistical opportunities to jointly manage the populations. Four types of hatchery conservation strategies may be employed:

Natural Refuge Watersheds: In this strategy, certain sub-basins are designated as wild-fish-only areas for a particular species. The refuge areas include watersheds where populations have persisted with minimum hatchery influence and areas that may have a history of hatchery production but would not be subjected to future hatchery influence as part of the recovery strategy. More refuge areas may be added over time as wild populations recover. These refugia provide an opportunity to monitor population trends independent of the confounding influence of hatchery fish and will be key indicators of natural population status within the ESU. This strategy would not be included in near-term actions for the Toutle Subbasin,

Hatchery Supplementation: This strategy utilizes hatchery production as a tool to assist in rebuilding depressed natural populations. Supplementation would occur in selected areas that are producing natural fish at levels significantly below current capacity or capacity is expected to increase as a result of immediate benefits of habitat or passage improvements. This is intended to be a temporary measure to jump start critically low populations and to bolster natural fish numbers above critical levels in selected areas until habitat is restored to levels where a population can be self sustaining. This strategy would include coho in the Toutle Subbasin and South Fork Toutle.

Hatchery/Natural Isolation: This strategy is focused on physically separating hatchery adult fish from naturally-produced adult fish to avoid or minimize spawning interactions to allow natural adaptive processes to restore native population diversity and productivity. The strategy may be implemented in the entire watershed or more often in a section of the watershed upstream of a barrier or trap where the hatchery fish can be removed. This strategy is currently aimed at hatchery steelhead in watersheds with trapping capabilities. The strategy may also become part of spring and fall Chinook as well as coho strategy in certain watersheds in the future as unique wild runs develop. This strategy would not be included in near-term actions for the Toutle Subbasin but could be considered in the future for coho. This definition refers only to programs where fish are physically sorted using a barrier or trap. Some fishery mitigation programs, particularly for steelhead, are managed to isolate hatchery and wild stocks based on run timing and release locations. There are no hatchery winter steelhead released in the Toutle basin.

Hatchery/Natural Merged Conservation Strategy: This strategy addresses the case where natural and hatchery fish have been homogenized over time such that they are principally all one stock that includes the native genetic material for the basin. Many spring Chinook, fall Chinook, and coho populations in the lower Columbia currently fall into this category. In many cases, the composite stock productivity is no longer sufficient to support a self-sustaining natural population especially in the face of habitat degradation. The hatchery program will be critical to maintaining any population until habitat can be improved and a strictly natural population can be re-established. This merged strategy is intended to transition these mixed populations to a self-supporting natural population that is not subsidized by hatchery production or subject to deleterious hatchery impacts. Elements include separate management of hatchery and natural subpopulations, regulation of hatchery fish in natural areas, incorporation of natural fish into hatchery broodstock, and annual abundance-driven distribution. Corresponding programs are expected to evolve over time dependent on changes in the populations and in the habitat productivity. This strategy is primarily aimed at Chinook salmon in areas where harvest production occurs. The strategy is not included for Toutle basin chinook, as the recovery goal for Toutle fall chinook is to stabilize at the current viability level, and there is no hatchery program for spring chinook harvest in the basin

Not every lower Columbia River hatchery program will be turned into a conservation program. The majority of funding for lower Columbia basin hatchery operations (including the North Fork Toutle Hatchery) is for producing salmon and steelhead for harvest to mitigate for lost harvest of natural production due to hydro development and habitat degradation. Programs for fishery enhancement will continue during the recovery period, but will be managed to minimize risks and ensure they do not compromise recovery objectives for natural populations. It is expected that the need to produce compensatory fish for harvest through artificial production will reduce in the future as natural populations recover and become harvestable. There are fishery enhancement programs for fall Chinook, coho, and summer steelhead in the Toutle Subbasin.

The North Fork Toutle Hatchery will be operated to include natural production enhancement strategies for coho in the Green River and North and South Fork Toutle River as well as support fishery enhancement of Toutle fall Chinook, Toutle early coho, and Skamania summer steelhead. This plan adds three new conservation programs at the Cowlitz River Hatchery facility (Table 21).

Table 21. A summary of conservation and harvest strategies to be implemented through Toutle River Hatchery programs.

		Stock
Natural Production Enhancement	Supplementation	North Toutle Coho √ Green River Coho √ S ForkToutle Coho √
	Hatch/Nat Conservation 1/	
	Isolation	
	Broodstock development	
Fishery Enhancement	In-basin releases (final rearing at Toutle)	Toutle Early Coho Toutle Fall Chinook Skamania Summer Steelhead
	Out of Basin Releases (final rearing at Toutle)	

1/ May include integrated and/or isolated strategy over time.
√ Denotes new program

5.5.2 *Hatchery Measures and Actions*

Hatchery strategies and measures are focused on evaluating and reducing biological risks consistent with the recovery strategies identified for each natural population. Artificial production programs within Toutle River facilities have been evaluated in detail through the WDFW Benefit-Risk Assessment Procedure (BRAP) relative to risks to natural populations. The BRAP results were utilized to inform the development of these program actions specific to the Toutle River Basin (Table 22 and Table 23). The Sub-Basin plan hatchery recovery actions were developed in coordination with WDFW and at the same time as the Hatchery and Genetic

Management Plans (HGMP) were developed by WDFW for each hatchery program. As a result, the hatchery actions represented in this document will provide direction for specific actions which will be detailed in the HGMPs submitted by WDFW for public review and for NOAA fisheries approval. It is expected that the HGMPs and these recovery actions will be complementary and provide a coordinated strategy for the Toutle River Basin hatchery programs. Further explanation of specific strategies and measures for hatcheries can be found in the Regional Recovery and Subbasin Plan Volume I.

Table 22. Hatchery program actions to be implemented in the Toutle River Basin.

Activity	Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Expected Outcome
• Continue to mass mark coho hatchery releases to provide the means to identify hatchery fish for selective fisheries and to distinguish between hatchery and wild fish in the Toutle basin • Establish a mass marking program for fall chinook to enable selective fishing options and distinguish wild and hatchery production.	*Adipose fin-clip mark hatchery released coho **Adipose fin-clip mark hatchery released fall chinook	North Toutle Hatchery coho and fall chinook.	Toutle coho, and fall chinook	Domestication, Diversity, Abundance	• In-breeding • Harvest	• Maintain lower harvest impacts for natural Toutle coho compared to hatchery production • Provide the opportunity to develop fishing regulations which accomplish a lower harvest impact for wild Toutle fall chinook compared to Toutle Hatchery fall chinook. • Enable visual identification of hatchery and wild returns to provide the means to account for and manage the natural and wild escapement consistent with biological objectives
• Utilize existing North Toutle early coho stock to supplement natural coho populations in North Toutle, Green, and SF Toutle tributaries. • Develop brood stock representative of Toutle spawn timing abundance curves. • Integrate hatchery and wild broodstock in the future after wild production is established	**North Toutle Hatchery facilities utilized to supplement natural coho	North Toutle Hatchery coho	Toutle Basin coho	Abundance, spatial distribution	• low numbers of natural spawners and distribution into the upper watershed habitat	• Habitat is seeded as it continues to recover from the 1980 eruption of Mt. St. Helens. • Self-sustaining populations are present in North Toute, Green, and SF Toutle tributaries • A future integrated hatchery and wild coho program addresses natural production management and provides harvest opportunity.
• Hatchery produced coho, and fall chinook will be scheduled for release during the time when the maximum numbers of fish are smolted and prepared to emigrate rapidly.	*Juvenile release strategies to minimize impacts to natural populations	North Toutle Hatchery coho, and fall chinook	Toutle Basin fall chinook, chum, and coho, and steelhead	Predation, Competition	• Hatchery smolt residence time in the North and mainstem Toutle.	• Minimal residence time of hatchery released juvenile resulting in reduced ecological interactions between hatchery and wild juvenile. Displacement of natural fall chinook from preferred habitat by larger hatchery fall chinook will be minimized.

Activity	Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Expected Outcome
• Juvenile rearing strategies will be implemented to provide a fish growth schedule which coincides with an optimum release time for hatchery production survival and to minimize time spent in the Toutle Basin.						• Minimal predation by coho smolts upon natural produced fall chinook, coho, steelhead, and chum. • Improved survival of wild juveniles, resulting in increased productivity and abundance
• Appropriate maintenance weir in the lower Green River to enable efficient accounting and sorting of fall chinook and passage of steelhead and coho. • Appropriate maintenance and engineerinf of the Sediment retention Dam trap to assure efficient collection and passage of natural produced salmon and steelhead. • Complies with NPDES permit monitoring requirements. Fish health monitored and treated as per co-mangers fish health policy • Maintain in-take screens at North Toutle Hatchery to assure they do not impact wild juvenile coho, chinook,	**Evaluate facility operations	All species	All species	Access, Habitat quality, genetic integrity	• Fish barriers, in-take screens • water quality, sorting efficiency	• Access to natural spawning habitats for natural returning fish • Hatchery fish disease controlled and water quality standards upheld to avoid impact to habitat quality in the Green and Toutle rivers downstream of the hatchery. • In-take screens at North Toutle hatchery function in a way that has negligible impacts in natural produced salmon and steelhead.

Activity	Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Expected Outcome
or steelhead						
• Research, monitoring , and evaluation of performance of the above actions in relation to expected outcomes • Performance standards developed for each actions with measurable criteria to determine success or failure • Adaptive Management applied to adjust or change actions as necessary	** Monitoring and evaluation, adaptive management	All species	All species	Hatchery production performance, Natural production performance	• All of above	• Clear standards for performance and adequate monitoring programs to evaluate actions. • Adaptive management strategy reacts to information and provides clear path for adjustment or change to meet performance standard

** Extension or improvement of existing actions-may require additional funding*
*** New action-will likely require additional funding*

Table 23.Regional hatchery actions from Volume I, Chapter 7 with potential implementation actions in the South Fork Toutle Subbasin

Activity	Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Expected Outcome
• Continue to mass mark Skamania Hatchery steelhead releases to provide the means to identify hatchery fish for selective fisheries and to distinguish between hatchery and wild fish returning to the SF Toutle.	*Adipose fin-clip mark hatchery released steelhead.	Skamania Hatchery summer steelhead released into the SF Toutle.	SF Toutle Winter steelhead	Domestication, Diversity, Abundance	• In-breeding • Harvest	• Continue selective fishery opportunity for hatchery produced summer steelhead in the SF Toutle • Enable visual identification of hatchery and wild returns to provide the means to account for and manage the natural and wild escapement consistent with biological objectives
• Hatchery produced steelhead will be scheduled for release during the time when the maximum numbers of fish are smolted and prepared to emigrate rapidly. • Juvenile rearing strategies will be implemented to provide a fish growth schedule which coincides with an optimum release time for hatchery production survival and to minimize time spent in the Toutle Basin.	*Juvenile release strategies to minimize impacts to natural populations	Skamania Hatchery summer steelhead released into the SF Toutle.	SF Toutle winter steelhead and coho.	Predation, Competition	• Hatchery smolt residence time in the SF Toutle and mainstem Toutle.	• Minimal residence time of hatchery released juvenile resulting in reduced ecological interactions between hatchery and wild juveniles. • Minimized predation by summer steelhead smolts upon natural produced winter steelhead and, coho. • Improved survival of wild juveniles, resulting in increased productivity and abundance of winter steelhead and coho
• Research, monitoring , and evaluation of performance of the above actions in relation to expected outcomes • Performance standards developed for each actions with measurable criteria to determine success or failure • Adaptive Management applied to adjust or change actions as necessary	** Monitoring and evaluation, adaptive management	All species	All species	Hatchery production performance, Natural production performance	• All of above	• Clear standards for performance and adequate monitoring programs to evaluate actions. • Adaptive management strategy reacts to information and provides clear path for adjustment or change to meet performance standard

- Extension or improvement of existing actions-may require additional funding
- ** New action-will likely require additional funding

5.6 Harvest

Fisheries are both an impact that reduces fish numbers and an objective of recovery. The long-term vision is to restore healthy, harvestable natural salmonid populations in many areas of the lower Columbia basin. The near-term strategy involves reducing fishery impacts on natural populations to ameliorate extinction risks until a combination of actions can restore natural population productivity to levels where increased fishing may resume. The regional strategy for interim reductions in fishery impacts involves: 1) elimination of directed fisheries on natural populations, 2) regulation of mixed stock fisheries for healthy hatchery and natural populations to limit and minimize indirect impacts on natural populations, 3) scaling of allowable indirect impacts for consistency with recovery, 4) annual abundance-based management to provide added protection in years of low abundance while allowing greater fishing opportunity consistent with recovery in years with much higher abundance, and 5) mass marking of hatchery fish for identification and selective fisheries.

Actions to address harvest impacts are generally focused at a regional level to cover fishery impacts accrued to lower Columbia salmon as they migrate along the Pacific Coast and through the mainstem Columbia River. Fisheries are no longer directed at weak natural populations but incidentally catch these fish while targeting healthy wild and hatchery stocks. Subbasin fisheries affecting natural populations have been largely eliminated. Fishery management has shifted from a focus on maximum sustainable harvest of the strong stocks to ensuring protection of the weak stocks. Weak stock protections often preclude access to large numbers of otherwise harvestable fish in strong stocks.

Fishery impact limits to protect ESA-listed weak populations are generally based on risk assessments that identify points where fisheries do not pose jeopardy to the continued persistence of a listed group of fish. In many cases, these assessments identify the point where additional fishery reductions provide little reduction in extinction risks. A population may continue to be at significant risk of extinction but those risks are no longer substantially affected by the specified fishing levels. Often, no level of fishery reduction will be adequate to meet naturally-spawning population escapement goals related to population viability. The elimination of harvest will not in itself lead to the recovery of a population. However, prudent and careful management of harvest can help close the gap in a coordinated effort to achieve recovery.

Fishery actions specific to the subbasins are addressed through the Washington State Fish and Wildlife sport fishing regulatory process. This public process includes an annual review focused on emergency type regulatory changes and a comprehensive review of sport fishing regulations which occurs every two years. This regulatory process includes development of fishing rules through the Washington Administrative Code (WAC) which are focused on protecting weak stock populations while providing appropriate access to harvestable populations. The actions consider the specific circumstances in each area of each subbasin and respond with rules that fit the relative risk to the weak populations in a given time and area of the subbasin. Regulatory and protective fishery actions pertaining to salmon and steelhead in the Toutle basin are presented in Table 22 for the mainstem and NF Toutle and Table 23 for the SF Toutle. Additional detail of tributary fishing rules can be found in the WDFW sport fishing regulation pamphlet.

Regional actions cover species from multiple watersheds which share the same migration routes and timing, resulting in similar fishery exposure. Regional strategies and measures for harvest are detailed in the the Regional Recovery and Subbasin Plan Volume I. A number of regional strategies for harvest involve implementation of actions within specific subbasins. In-basin fishery management is generally applicable to steelhead and salmon while regional management is more applicable to salmon. Regional harvest actions with significant application to the Toutle Subbasin and South Fork Toutle populations are summarized in Table 24.

Table 24. Summary of regulatory and protective fishery actions in the North ForkToutle basin

Species	General Fishing Actions	Explanation	Other Protective Fishing Actions	Explanation
Fall chinook	Open for fall chinook	Hatchery fish are produced for harvest. Hatchery fish are not mass marked	Closures in spawning areas, night closures, and gear restrictions in NF Toutle and Green.	Protects fall chinook while spawning and in heavy concentration areas
Spring chinook	Retain only adipose fin-clipped chinook	Selective fishery for hatchery chinook, unmarked wild spring chinook must be released	Open only downstream of North Toutle Hatchery in lower Green River	Spring chinook fishing only allowed where hatchery fish are concentrated.
chum	Closed to retention	Protects natural chum. Hatchery chum are not produced for harvest		
coho	Retain only adipose fin-clip marked coho	Selective fishery for hatchery coho, unmarked wild coho must be released	Upper NF Toutle, upper Green River, and tributaries closed to salmon fishing	Protects wild spawners in tributary creeks. Hatchery coho are released in the lower Green River.
Winter steelhead	Closed season	Steelhead fishing is closed in the winter months to protect wild fish. No hatchery winter steelhead are released in the Toutle basin	Summer Steelhead and trout fishing closed in the spring and minimum size restrictions in affect	Spring closure Protects adult wild steelhead during spawning and minimum size protects juvenile steelhead
Summer steelhead	Retain only adipose fin-clipped steelhead	Selective fishery for hatchery produced summer steelhead, unmarked wild steelhead must be released	Season open in late spring to late fall when hatchery summer steelhead are present and wild winter steelhead are not	Only wild winter steelhead are native to the Toutle basin. Season is structured to avoid wild fish encounters

Table 25. Summary of regulatory and protective fishing actions in the South Fork Toutle basin

Species	General Fishing Actions	Explanation	Other Protective Fishing Actions	Explanation
Fall chinook	Closed to retention	Protects wild fall chinook. No hatchery produced fall chinook in the SF Toutle	No fisheries for other salmon	Further protection of wild fall chinook spawners
chum	Closed to retention	Protects wild chum. Hatchery chum are not released in the SF Toutle	No fisheries for other salmon and steelhead season closed before December	Further protection of wild chum spawners
coho	Closed to retention	Protects wild coho. Hatchery coho are not released in the SF Toutle for harvest.	No fisheries for other salmon	Further protection of wild coho spawners
Summer steelhead	Retain only adipose fin-clip marked steelhead	Selective fishery for hatchery steelhead, unmarked wild steelhead must be released.	Steelhead and trout fishing closed in the spring and minimum size restrictions in affect	Spring closure Protects adult wild winter steelhead during spawning and minimum size protects juvenile steelhead
Winter steelhead	Closed season	Winter months are closed to fishing. No hatchery winter steelhead are released in the SF Toutle	Spring closures, minimum size and special selective gear rules in affect.	Further protection for wild winter adult and juvenile steelhead

Table 26. Regional harvest actions from Volume I, Chapter 7 with significant application to the Toutle River Subbasin populations.

Action	Description	Responsible Parties	Programs	Comments
**F.A12	Monitor chum handle rate in winter steelhead and late coho tributary sport fisheries.	WDFW	Columbia Compact	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
**F.A8	Develop a mass marking plan for hatchery tule Chinook for tributary harvest management and for naturally-spawning escapement monitoring.	WDFW, NOAA, USFWS, Col. Tribes	U.S. Congress, Washington Fish and Wildlife Commission	Provides the opportunity to implement selective tributary sport fishing regulations in the Toutle watershed. Recent legislation passed by Congress mandates marking of all Chinook, coho, and steelhead produced in federally funded hatcheries that are intended for harvest. Details for implementation are currently under development by WDFW, ODFW, treaty Indian tribes, and federal agencies.
*F.A13	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Includes monitoring of naturally-spawning steelhead encounter rates in fisheries and refinement of long-term catch and release handling mortality estimates. Would include assessment of the current monitoring programs and determine their adequacy in formulating naturally-spawning steelhead incidental mortality estimates.
*F.A14	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Regulatory agencies should continue to refine gear, handle and release methods, and seasonal options to minimize mortality of naturally-spawning steelhead in commercial and sport fisheries.
*F.A20	Maintain selective sport fisheries in Ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	WDFW, NOAA, ODFW, USFWS	PFMC, Columbia Compact, BPA Fish and Wildlife Program, WDFW Creel	Mass marking of lower Columbia River coho and steelhead has enabled successful ocean and freshwater selective fisheries to be implemented since 1998. Marking programs should be continued and fisheries monitored to provide improved estimates of naturally-spawning salmon and steelhead release mortality.

* Extension or improvement of existing action
** New action

5.7 Hydropower

No hydropower facilities exist in the Toutle subbasin, hence, no in-basin hydropower actions are identified. Toutle River anadromous fish populations will benefit from regional hydropower measures recovery measures and actions identified in regional plans to address habitat effects in the mainstem and estuary.

5.8 Mainstem and Estuary Habitat

Toutle River anadromous fish populations will also benefit from regional recovery strategies and measures identified to address habitat conditions and threats in the Columbia River mainstem and estuary. Regional recovery plan strategies involve: 1) avoiding large scale habitat changes where risks are known or uncertain, 2) mitigating small-scale local habitat impacts to ensure no net loss, 3) protecting functioning habitats while restoring impaired habitats to functional conditions, 4) striving to understand, protect, and restore habitat-forming processes, 5) moving habitat conditions in the direction of the historical template which is presumed to be more consistent with restoring viable populations, and 6) improving understanding of salmonid habitat use in the Columbia River mainstem and estuary and their response to habitat changes. A series of specific measures are detailed in the regional plan for each of these strategies.

5.9 Ecological Interactions

For the purposes of this plan, ecological interactions refer to the relationships of salmon anad steelhead with other elements of the ecosystem. Regional strategies and measures pertaining to exotic non-native species, effects of salmon on system productivity, and native predators of salmon are detailed and discussed at length in the Regional Recovery and Subbasin Plan Volume I and are not reprised at length in each subbasin plan. Strategies include 1) avoiding, eliminating introductions of new exotic species and managing effects of existing exotic species, 2) recognizing the significance of salmon to the productivity of other species and the salmon themselves, and 3) managing predation by selected species while also maintaining a viable balance of predator populations. A series of specific measures are detailed in the regional plan for each of these strategies. Implementation will occur at the regional and subbasin scale.

5.10 Monitoring, Research, & Evaluation

Biological status monitoring quantifies progress toward ESU recovery objectives and also establishes a baseline for evaluating causal relationships between limiting factors and a population response. Status monitoring involves routine and intensive efforts. Routine monitoring of biological data consists of adult spawning escapement estimates, whereas routine monitoring for habitat data consists of a suite of water quality and quantity measurements.

Intensive monitoring supplements routine monitoring for populations and basins requiring additional information. Intensive monitoring for biological data consists of life-cycle population assessments, juvenile and adult abundance estimates and adult run-reconstruction. Intensive monitoring for habitat data includes stream/riparian surveys, and continuous stream flow assessment. The need for additional water quality sampling may be identified. Rather than prescribing one monitoring strategy, three scenarios are proposed ranging in level of effort and cost from high to low (Level 1-3 respectively). Given the fact that routine monitoring is ongoing, only intensive monitoring varies between each level.

An in-depth discussion of the monitoring, research and evaluation (M, R & E) approach for the Lower Columbia Region is presented in the Regional Recovery and Management Plan. It includes site selection rationale, cost considerations and potential funding sources. The following tables summarize the biological and habitat monitoring efforts specific to the Toutle subbasin.

Table 27. Summary of the biological monitoring plan for the North Fork Toutle River populations.

NF Toutle: Lower Columbia Biological Monitoring Plan				
Monitoring Type	**Fall Chinook**	**Chum**	**Coho**	**Winter Steelhead**
Routine	AA	AA	AA	AA
Intensive				
Level 1			✓	✓
Level 2				
Level 3				

AA Annual adult abundance estimates
✓ Adult and juvenile intensive biological monitoring occurs periodically on a rotation schedule (every 9 years for 3-year duration)
× Adult and juvenile intensive biological monitoring occurs annually

Table 28. Summary of the biological monitoring plan for the South Fork Toutle River populations.

SF Toutle: Lower Columbia Biological Monitoring Plan					
Monitoring Type	**Fall Chinook**	**Chum**	**Coho**	**Winter Steelhead**	**Spring Chinook**
Routine	AA	AA	AA	AA	AA
Intensive					
Level 1			✓	✓	
Level 2			✓	✓	
Level 3					

AA Annual adult abundance estimates
✓ Adult and juvenile intensive biological monitoring occurs periodically on a rotation schedule (every 9 years for 3-year duration)
× Adult and juvenile intensive biological monitoring occurs annually

Table 29. Summary of the habitat monitoring plan for the Toutle River populations.

Toutle: Lower Columbia Habitat Monitoring Plan				
Monitoring Type	**Watershed**	**Existing stream / riparian habitat**	**Water quantity[3] (level of coverage)**	**Water quality [2] (level of coverage)**
Routine [1] (level of coverage)	Baseline complete	Poor	Stream Gage-Good IFA-Poor	WDOE-Poor USGS-Good Temperature-Poor
Intensive				
Level 1				
Level 2				
Level 3				

IFAComprehensive Instream Flow Assessment (i.e. Instream Flow Incremental Methodology)
[1] Routine surveys for habitat data do not imply ongoing monitoring
[2] Intensive monitoring for water quality to be determined
[3] Water quantity monitoring may include stream gauge installation, IFA or low flow surveys

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